SCDF

The Life Saving Force

. . . for a safer Singapore

CODE OF PRACTICE FOR FIRE PRECAUTIONS IN BUILDINGS 2023

SINGAPORE CIVIL DEFENCE FORCE

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1.0 General

2.0 Scope

3.0 Contents of the Manual

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CLAUSE 1.1 SCOPE

The Code of Practice for Fire Precautions in Buildings, hereinafter called "the/ this Code" or "Fire Code", serves to establish the minimum requirements for fire safety provisions in all buildings. It takes into account the function, design, management, operation, and maintenance of buildings to secure the life safety of occupants and property safety in the event of a fire.

1.1.1 Rapid Transit System (RTS)

RTS comprises underground, surface, and elevated facilities, including transit stations, trainways, train maintenance depots, on-line electrical substations, OCCs, relay buildings, ventilation buildings and RTS facility buildings.

a. Transit stations and trainways shall comply with the Code of Practice for Fire Precautions in Rapid Transit Systems (CPFPRTS).

b. Train maintenance depots, on-line electric substations, OCCs, relay buildings, ventilation buildings, and RTS facility buildings shall comply with the Fire Code, except as modified in the CPFPRTS.

c. New fire safety requirements implemented in the Fire Code on or after 1 Mar 2024 shall be complied with for the design of transit station and trainways, unless modified or stated otherwise in the CPFPRTS. The above new requirements shall exclude any amendments, revisions, or reinstatement of clauses from preceding versions of this Code.

1.1.2 Fire safety requirements for laboratories handling hazardous chemicals

Laboratories storing and using chemicals/ HazMat shall comply with *SS 641*. For the purpose of designing the ventilation system to limit the amount of flammable vapour/ gases inside the laboratory, fresh air shall be drawn directly from an external space or air well.

1.1.3 Fire safety requirements for road tunnels

Fire safety requirements for road tunnels shall be in compliance with Code of Practice for Fire Precautions in Road Tunnels.

1.1.4 Fire Safety Report (*Appendix 1*)

Note

1. Fire safety report is to document the provision of fire protection and life safety features in the building and/or plants/installations. This report serves as a useful reference to FSMs, building owners, RIs, the SCDF and QPs appointed to carry out any subsequent additions and alteration works. Where the nature of the additions and alteration works would require the updating of the fire safety report, the QP shall be responsible to submit revised and updated report to the building owner/s and the SCDF.

2. The fire safety instruction manual is a document prepared by the QP to remind the building owner on the management of fire safety provisions within the building. This includes maintenance regimes for such provisions, evacuation procedures, and other relevant documents to be kept and maintained by the building owner. Any subsequent additions and alteration works shall be updated in the fire safety instruction manual.

3. The fire safety manual, including any subsequent updates, shall be submitted by the QP to the SCDF for record when making building plan submission. A copy of which shall be handled officially to the building owner for information and safe keeping before occupation of the building.

4. Details of the fire safety report and fire safety instruction manual can be found at SCDF's website: http://www.scdf.gov.sg.

Fire Safety Report for building projects/ fire safety provisions specified by SCDF shall be submitted when making building plan submission.

1.1.5 Fire Safety Instruction Manual (*Appendix 2*)

Note

1. Fire safety report is to document the provision of fire protection and life safety features in the building and/or plants/installations. This report serves as a useful reference to FSMs, building owners, RIs, the SCDF and QPs appointed to carry out any subsequent additions and alteration works. Where the nature of the additions and alteration works would require the updating of the fire safety report, the QP shall be responsible to submit revised and updated report to the building owner/s and the SCDF.

2. The fire safety instruction manual is a document prepared by the QP to remind the building owner on the management of fire safety provisions within the building. This includes maintenance regimes for such provisions, evacuation procedures, and other relevant documents to be kept and maintained by the building owner. Any subsequent additions and alteration works shall be updated in the fire safety instruction manual.

3. The fire safety manual, including any subsequent updates, shall be submitted by the QP to the SCDF for record when making building plan submission. A copy of which shall be handled officially to the building owner for information and safe keeping before occupation of the building.

4. Details of the fire safety report and fire safety instruction manual can be found at SCDF's website: http://www.scdf.gov.sg.

a. Fire Safety Instruction Manual for building projects/ fire safety provisions specified by SCDF shall be submitted when making application for Temporary Fire Permit or Fire Safety Certificate.

b. The building owner shall maintain and keep the Fire Safety Instruction Manual at all times and present to the QP upon request. Where any Addition & Alteration works are carried out to the buildings, the building owner shall ensure that changes in the management of fire safety provisions are updated in the Fire Safety Instruction Manual by the QP. The updated Fire Safety Instruction Manual shall be submitted to SCDF for record.

1.1.6 Fire safety requirements for open plant processing structure

The design of open plant processing facilities in the oil, chemical and process industries shall comply with *SS 634*.

1.1.7 Fire safety requirements for pipeline service corridors

The design, construction and operation of pipeline service corridors shall comply with *SS 512*.

1.1.8 Fire safety requirement for storage of flammable liquids

The safe storage of flammable liquids shall comply with *SS 532*.

1.1.9 Fire safety requirement for storage of flammable particulate solids under Globally Harmonized System of Classification and Labelling of Chemicals (GHS) Class 4.1, 4.2 and 4.3

Facilities storing flammable particulate solids classified under Class 4.1 (Flammable solid), 4.2 (Substance liable to spontaneous combustion) and 4.3 (Substance dangerous when contact with water) of the GHS shall comply with *SS 667*.

CLAUSE 1.2 CODES AND STANDARDS

1.2.1 Reference

This Code makes reference to numerous local and international codes of practice and standards. Only the latest version of the codes of practice and standards shall be used for the purpose of this Code. A list of such codes of practice and standards is as shown in *Table 1.2A*.

1.2.2 Conflicting requirements

All codes of practice and standards which this Code referred to shall be read in conjunction with the relevant clauses in this Code. Where conflict exists between this Code and the referred codes of practice and/ or standards, the requirements stipulated in this Code shall take precedence.

1.2.3 Maintenance of fire protection systems

All fire protection systems when installed/ provided in a building, shall be maintained in accordance with applicable codes or standards specified in *Table 1.2A*. The QP shall document the maintenance details in the Fire Safety Instruction Manual and handover to the building owner for compliance at the completion of the building project.

For the purpose of this Code, “fire protection system” has the same meaning as in the Fire Safety Act 1993.

CLAUSE 1.3 ABBREVIATIONS

The abbreviations used in this Code are listed in *Table 1.3A*.

CLAUSE 1.4 DEFINITIONS

In this Code, unless the context otherwise requires, the following definitions will apply.

1.4.1 Accessible Floor Area (AFA)

“Accessible floor area” refers to the total floor area of all covered spaces within a building, including service ducts, lift shafts, toilets, staircases, areas occupied by fixed/ moveable furniture/ equipment/ facilities, and any open-to-sky habitable areas above or below the first storey of the building.

1.4.2 Air well

Explanation and Illustrations

(No illustration)

The minimum air well size specification in Table 1.4.2 is intended for exit staircase ventilation via an external space that is within an air well situation. To qualify as external space, the air well size shall comply with Table 1.4.2 and air well shall be devoid of any overhead obstruction such as trellis over the air well as it may have an adverse effect on smoke ventilation.

Readers should not confuse the ventilation requirements for smoke-stop lobby with that for exit staircase where the air well size differs. To qualify as external space under *Cl.2.2.13a.(3)*, the air well size shall have minimum width 6m and a superficial plan area of not less than 93m^2. However, in the case of exit staircase ventilation via an air well, the minimum clear width of the air well is 10m.

“Air well” refers to a space(s) enclosed substantially by building(s) and directly open to the sky. An air well can be considered as an external space if it meets the minimum clear width and length below:

TABLE 1.4.2 - AIR WELL SIZE

Max. Habitable Height of Building	Min. Clear Width and Length of Air Well
18m	10m
24m	11m
36m	12m
48m	13m
60m and above	14m

Rationale

The table stipulates the minimum size of an air well for effective smoke ventilation equivalent to an external space. These dimensions have been validated through fire engineering study.

1.4.3 Ambulatory care facility

'Ambulatory care facility” is a building, or part thereof, used for providing services on an out-patient basis for treatment for patients which would render them incapable of taking action for self-preservation or safety under emergency conditions without assistance from others, such as haemodialysis units or surgical treatment requiring general anaesthesia. Such facilities shall include the followings:

a. Renal dialysis day centres;

b. Aesthetic clinics;

c. Non-mental rehabilitation day centres; and

d. Endoscopy clinics.

1.4.4 Ancillary office

“Ancillary office” refers to any office which supports the activities of a building within Purpose Groups III, V, VI, VII and VIII and which is located within the same building or compartment as the purpose group it serves.

1.4.5 Ancillary usage

Explanation and Illustrations

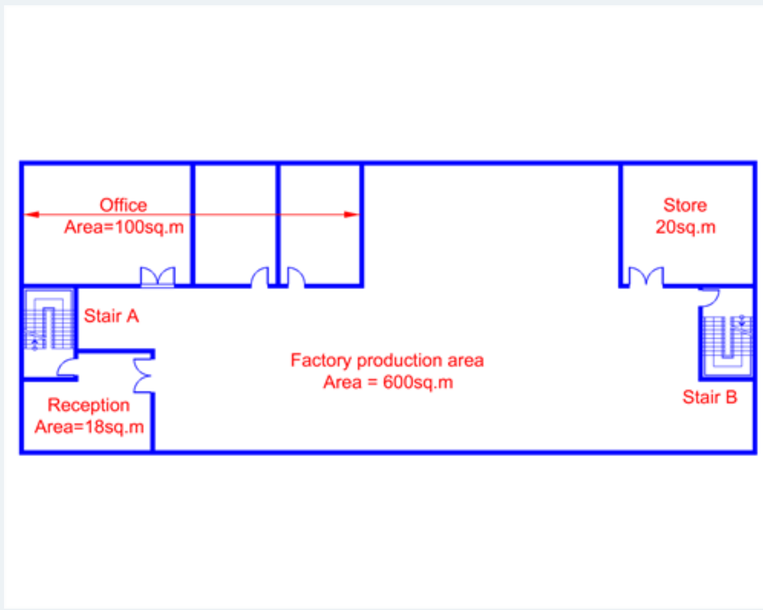


Figure 1.4.5

The office is “supporting” the activities at the factory production area. If the office is rented to other tenant & having activities that is not supporting the activities at the production area, it is not considered as ancillary office.

“Ancillary usage” refers to a room/ space that serves a supporting function, and which belongs to the same purpose group as the primary building. Such rooms include sick/ first aid rooms, reception lobbies/ areas, waiting areas, staff lounges/ staff recreation rooms, staff changing/ locker rooms, staff training rooms, meeting rooms, workshops, laboratories (no open-flame), store rooms, material/ product holding areas, packing distribution areas within factories/ warehouse buildings, etc.

1.4.6 Anteroom

“Anteroom” refers to the room leading into the BSL-3 or BSL-4 containment laboratory, used for showering and changing. It is also serves as a containment facility for controlling air flow and providing additional physical containment between the laboratory and adjoining spaces.

1.4.7 Approved

“Approved” refers to being approved by the SCDF.

1.4.8 Area of compartment/ room/ space

Explanation and Illustrations

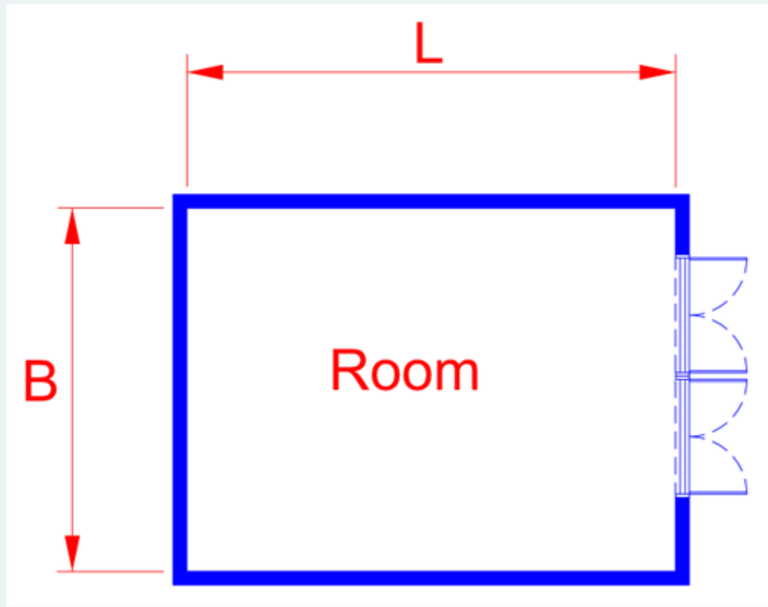
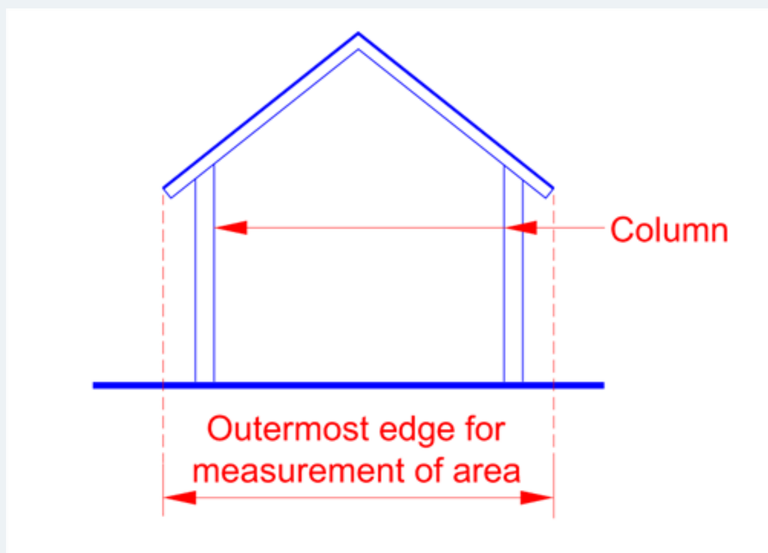


Figure. 1.4 8 – 1

Measurement of area of room



Section

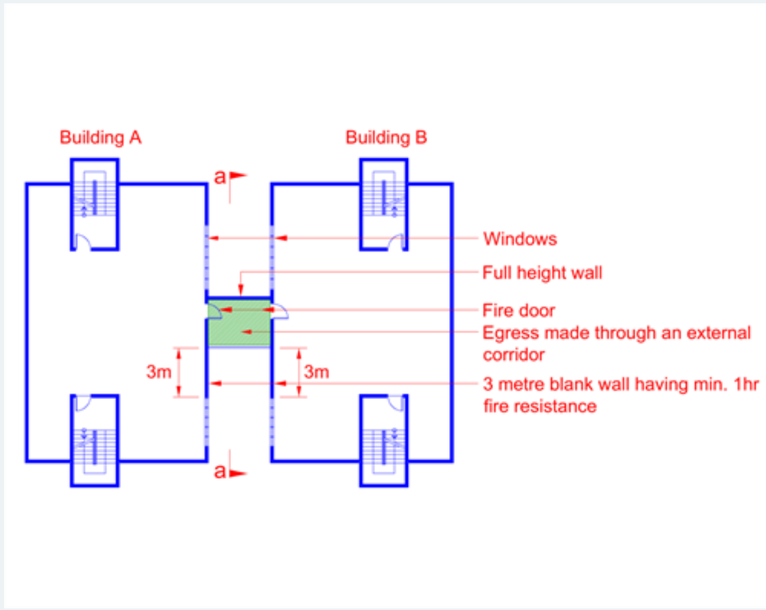
Figure. 1.4.8 – 2

Measurement of area for building without external wall

"Area of compartment/ room/ space" refers to the total area of any compartment/ room/ space bounded by the inner finished surfaces of the walls that form the compartment/ room/ space. Where there is no enclosing wall on any one side, the area of the compartment/ room/ space shall be measured by the outermost edge of the floor on that side.

1.4.9 Area of refuge

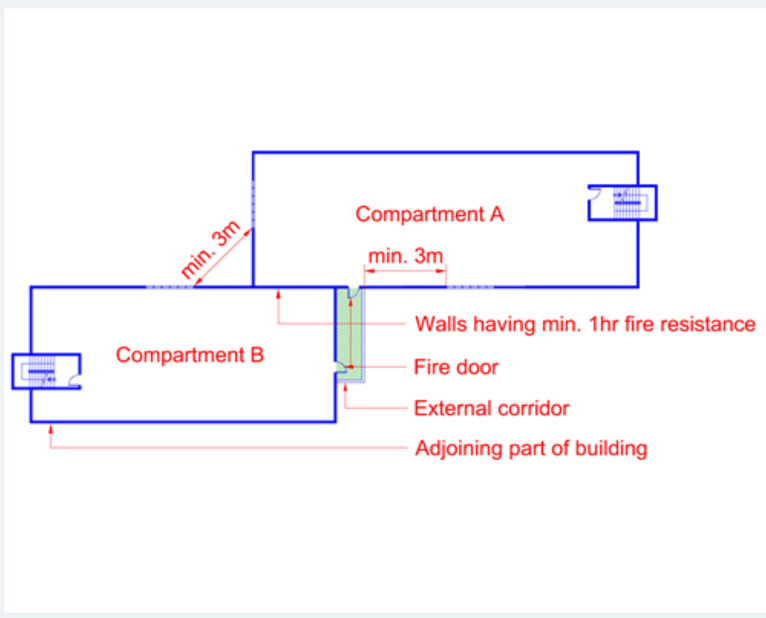
Explanation and Illustrations



Section a – a

Figure 1.4.9 – 1

For building A to qualify for reduction in the provision of exits, adjoining building B must act as an area of refuge.



Note : The area of refuge is a temporary holding area. Hence the staircases provided need not be designed to accommodate all the people that will occupy the area of refuge in case of emergency.

Figure 1.4.9 – 2

An area in an adjoining part of the same building may act as an area of refuge.

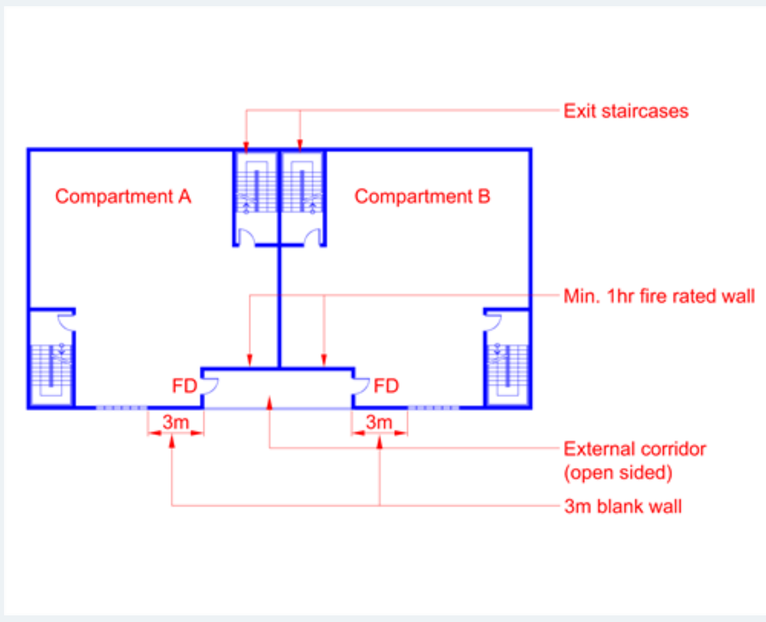


Figure 1.4.9 – 3 : Acceptable proposal

It is acceptable for compartment B to act as an area of refuge for compartment A or vice versa as the access is through an open sided corridor.

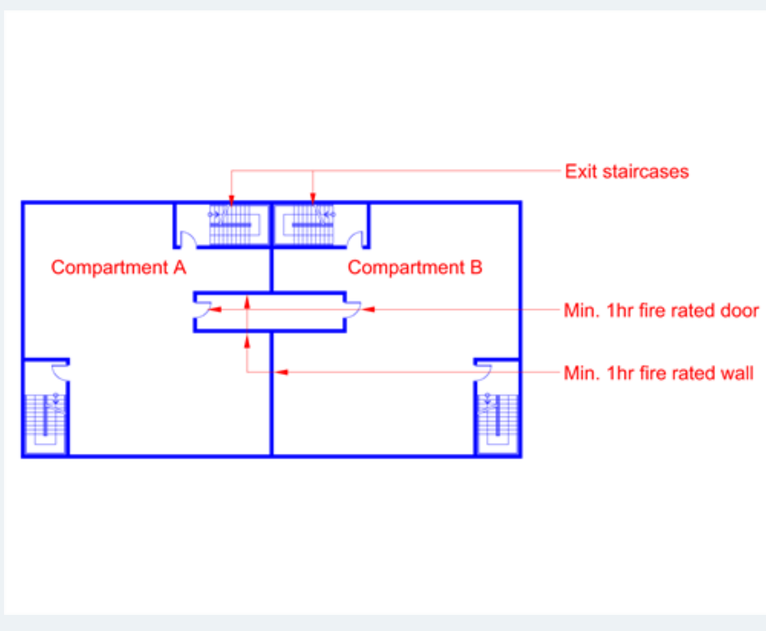


Figure 1.4.9 – 4 : Not acceptable proposal

Compartment B is acting as an area of refuge to compartment A which is not meeting the intent of the Fire Code, hence not acceptable.

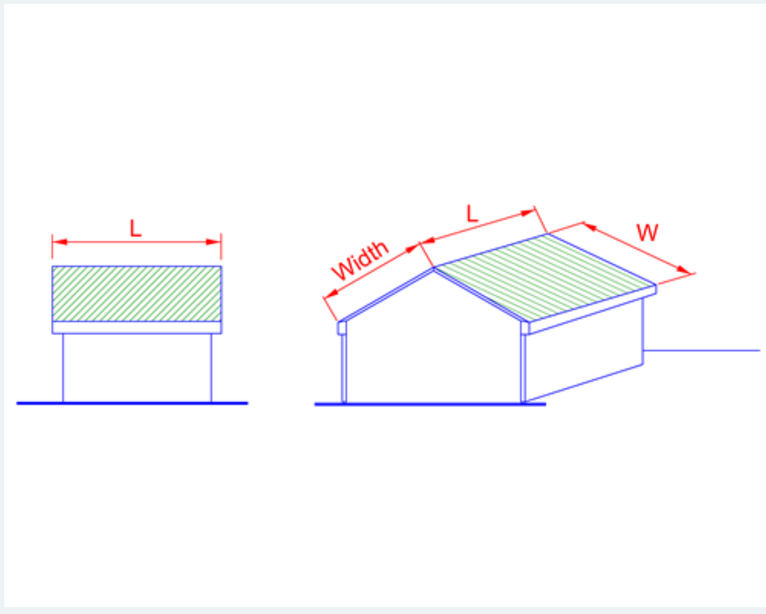
Note : It is critical that the area of refuge shall be accessible to evacuees in times of emergency. Where there is doubt that evacuees would not be able to gain access to the area of refuge

owing to locking of doors and different tenancies, the concept of area of refuge would not work.

"Area of refuge" refers to an area within a building, or in an adjoining building, where evacuees can temporarily take refuge, in lieu of the requirement for adequate exit staircase provision. It shall be adequately separated from the rest of the building or adjoining building by fire-resisting construction, and connected via an external corridor or open-sided linkway. The area of refuge shall be always accessible.

1.4.10 Area of roof

Explanation and Illustrations



Left Figure : Elevation
Right Figure : Axonometric view
Area of roof = 2(L x W)

Figure 1.4.10

Roof area computation

"Area of roof" refers to the visible roof area on a plane parallel to the pitch of the roof.

1.4.11 Area of storey

Explanation and Illustrations

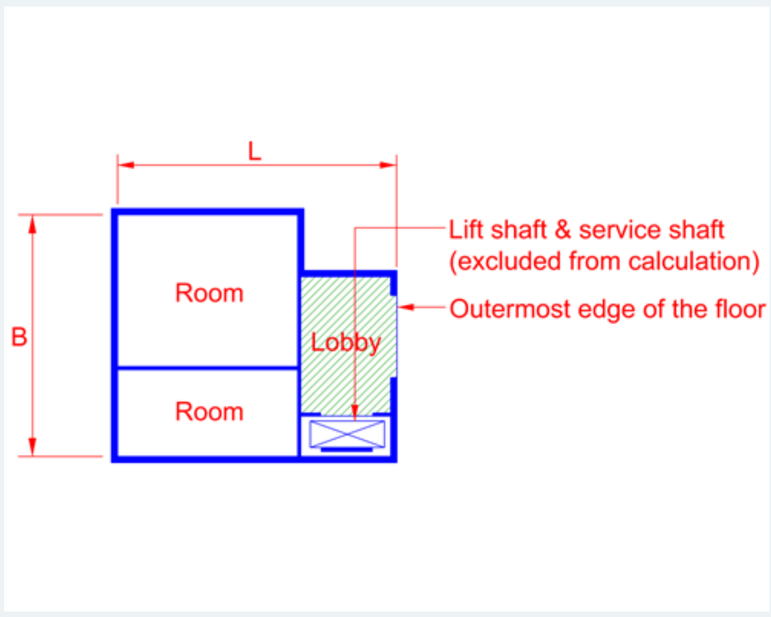


Figure 1.4.11

Storey area computation

"Area of storey" refers to the total area of that storey bounded by the inner finished surfaces of the enclosing walls. Where there is no enclosing wall on any one side, the area of storey shall be measured by the outermost edge of the floor on that side.

1.4.12 Assembly occupancy

Explanation and Illustrations

(No Illustration)

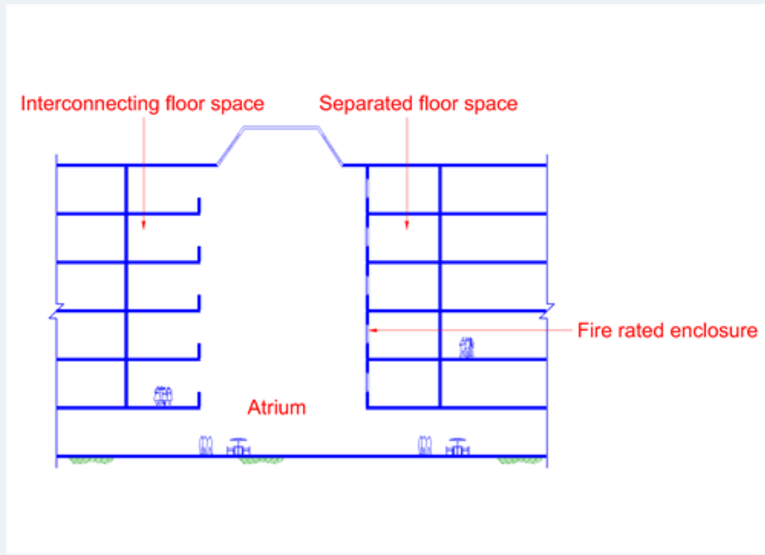
Not all buildings or portions of buildings used for assembly occupancy of more than 50 persons are considered as public building. Cl.1.4.84 defines "public building" as those buildings or part thereof used or constructed or adapted to be used as a shop, office, hospital or place of public resort, not being a church, chapel, mosque, temple or other place where public worship is or religious ceremonies are performed.

Assembly occupancy could be found in other purpose groups other than places of public resort, for example auditorium in office building, lecture theatre in school/institution, etc..

"Assembly occupancy" refers to buildings or portions of buildings used for gathering of more than 50 persons for such purpose as deliberation, worship, entertainment, eating, drinking, amusement or awaiting transportation.

1.4.13 Atrium

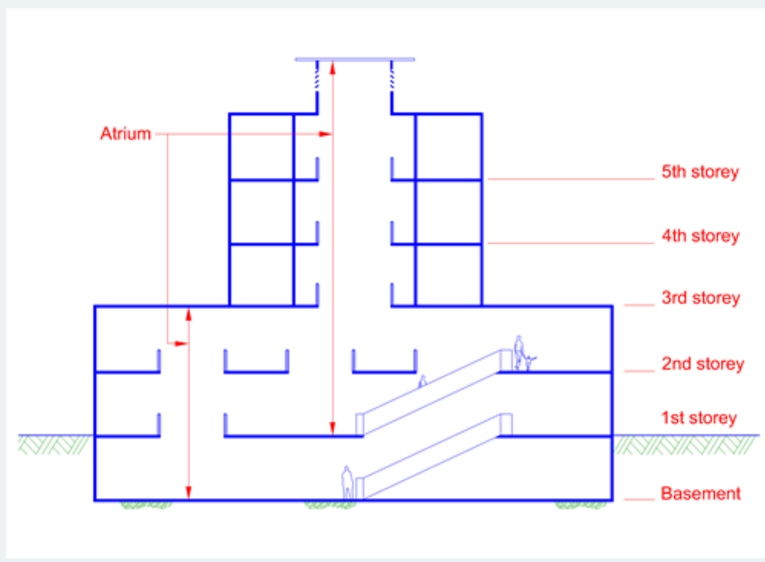
Explanation and Illustrations



Sectional view

Figure 1.4.13 - 1

Although atrium is defined as openings connecting 2 or more storeys, the requirements stipulated in *Cl.3.2.6.* is only applicable when the atrium is more than 3 storeys.



Section

Figure 1.4.13 - 2

The entire floor area of the interconnected space is open and unobstructed such that a fire in any part of the space will be readily obvious to the occupants of the space prior to the time it becomes a hazard to them.

"Atrium" refers to a large open space within a building created by an opening, or a series of openings, in floor assemblies, thus connecting two or more storeys. An atrium is covered at the top and is used for purposes other than those associated with small shafts, e.g., stairs, elevators and various services. The sides of the atrium can be open to all floors, to some floors or closed to all floors by non-rated or rated fire-resistant construction.

1.4.14 Authority having jurisdiction

"Authority having jurisdiction" refers to non-SCDF local entities, which may include an organisation, office, or individual responsible for enforcing the requirement of a code or standard, or for approving equipment, materials, an installation, or a procedure.

1.4.15 Basement storey

Explanation and Illustrations

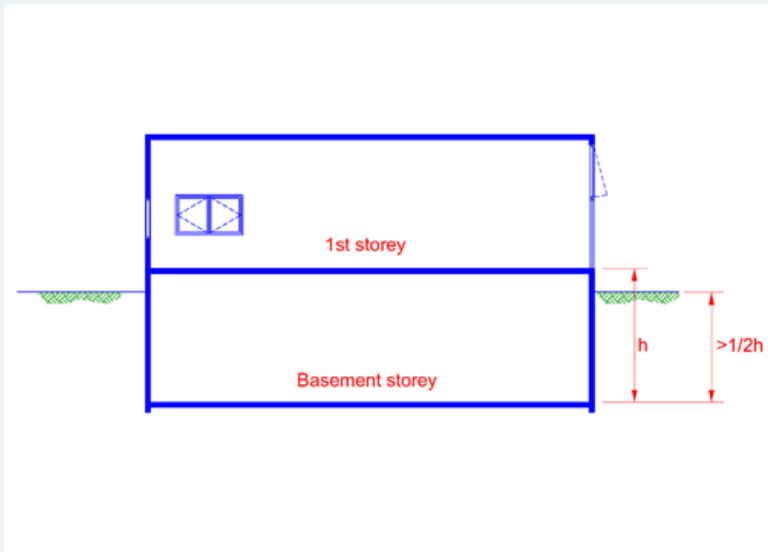


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Figure 1.4.15 – 1

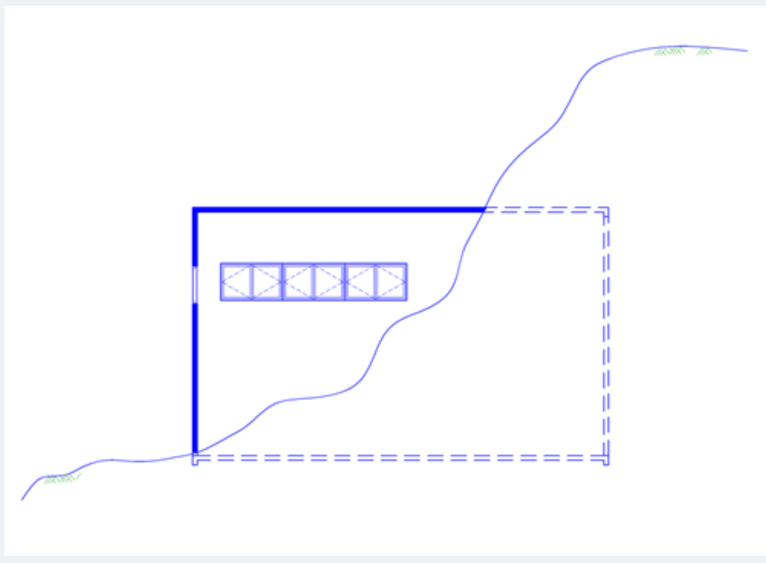

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Figure 1.4.15 – 2

Building built on slope and partially covered by surrounding ground

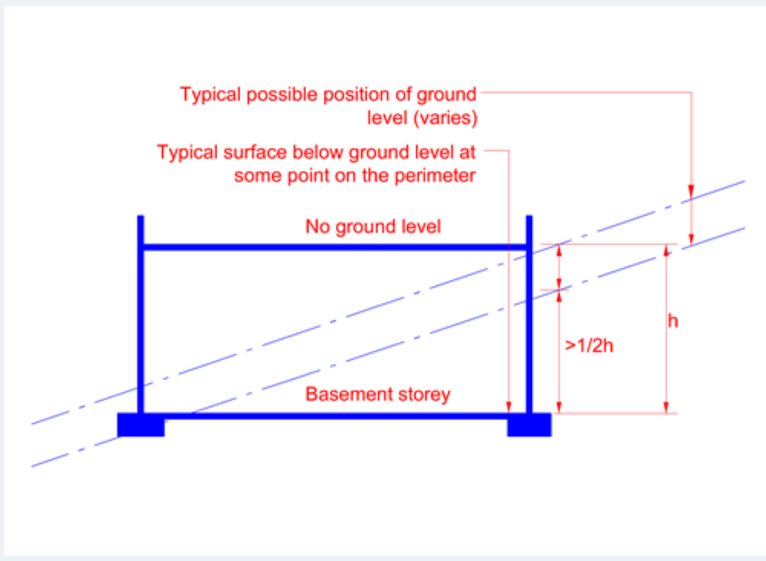

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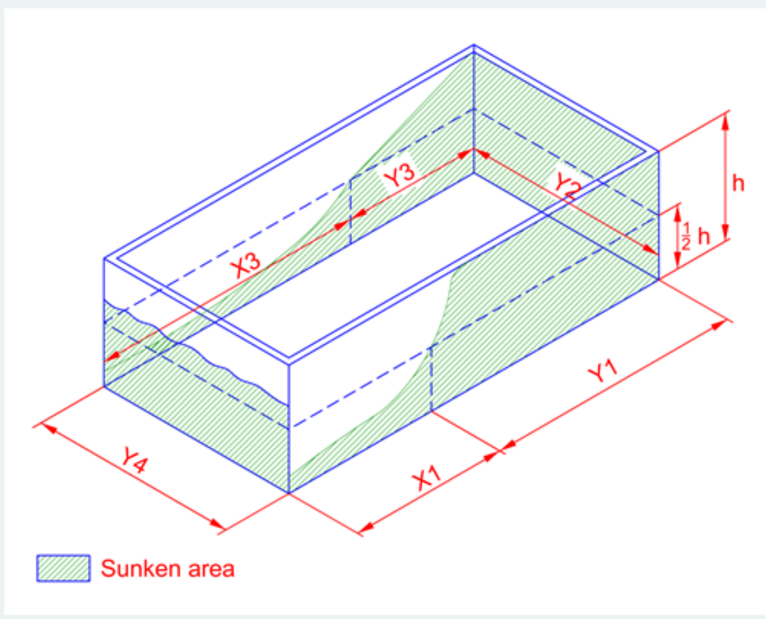
Figure 1.4.15 – 3

Building with no ground level



Axonometric view

Figure 1.4.15 – 4

As Y1+Y2+Y3+Y4 > X1+X3, this level is considered as a basement

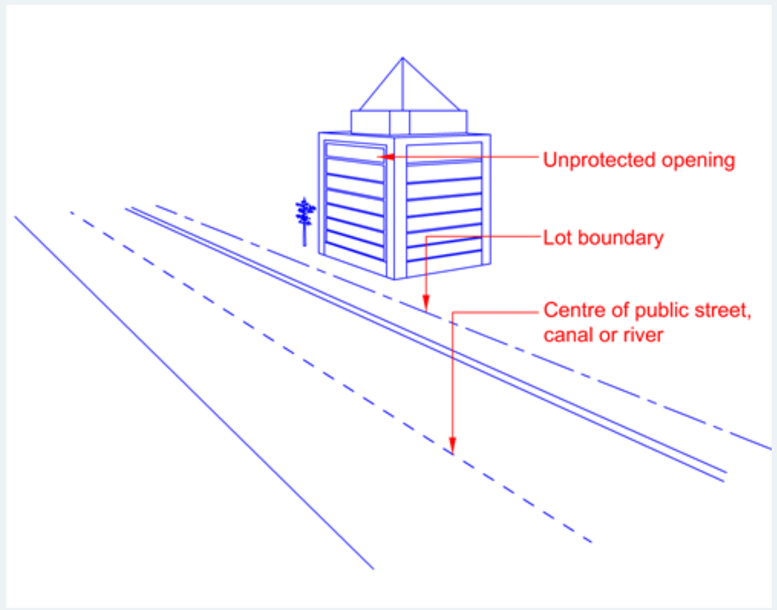
"Basement storey" refers to a storey of a building for which at least half the storey height is below the ground level, and which also adjoins its perimeter walls for at least half the length of such walls.

1.4.16 Biological Agent

"Biological Agent" refers to the biological agents stipulated in the First Schedule, Second Schedule and Third Schedule of the Biological Agents and Toxins Act.

1.4.17 Boundary

Explanation and Illustrations



Axonometric view

Figure 1.4.17 - 1

Buildings that are directly fronting or abutting a public street, canal or river can have the facade unprotected opening measuring up to the centre of the public street, canal or river.

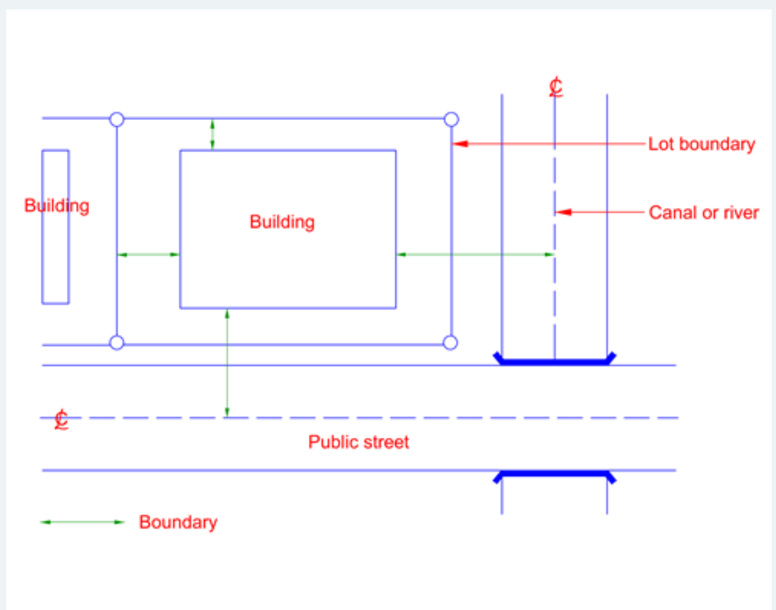


Figure 1.4.17 - 2

With regard to compliance of unprotected openings of the building that abuts a public street, it can be measured to the centre of public street instead of lot boundary.

"Boundary" refers to the border demarcating the area surrounding a building, and where applicable (in determining the relevant boundary), it includes the imaginary extension of the border up to the centre of an abutting street, canal or river.

1.4.18 Capsule hotel

"Capsule hotel" refers to a type of hotel where the bed spaces are enclosed individually. Each bed space is considered as a capsule and not as a loose furniture or fitting. The capsule has the following characteristics:

a. access opening to the bed space can be fitted with doors, curtains or other materials or left open; and

b. the bed space is provided with its individual electricity supply for amenities such as lighting, power points, TV, and other amenities.

1.4.19 Cavity barrier

Explanation and Illustrations

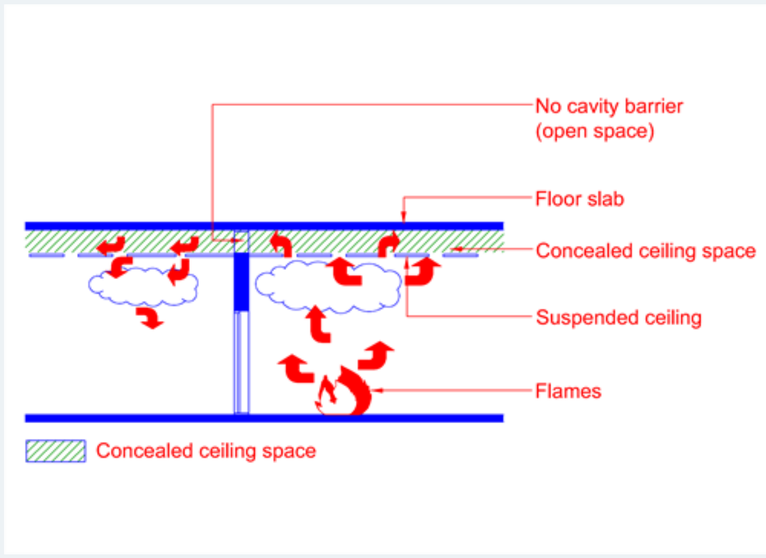


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Figure 1.4.19 – 1

Concealed ceiling space without cavity barrier

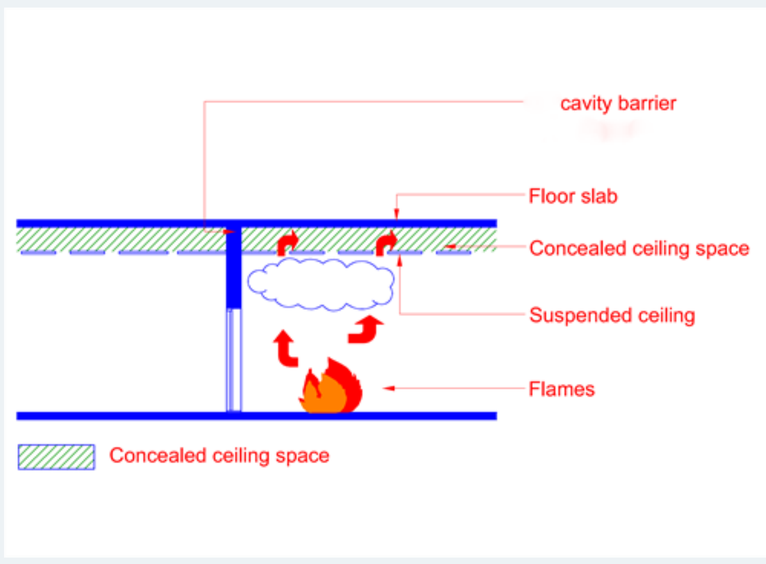

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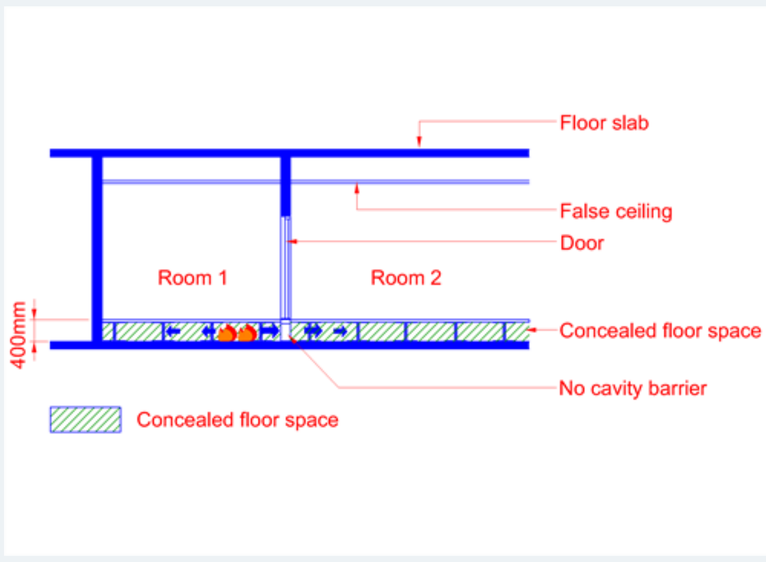
Figure 1.4.19 – 2

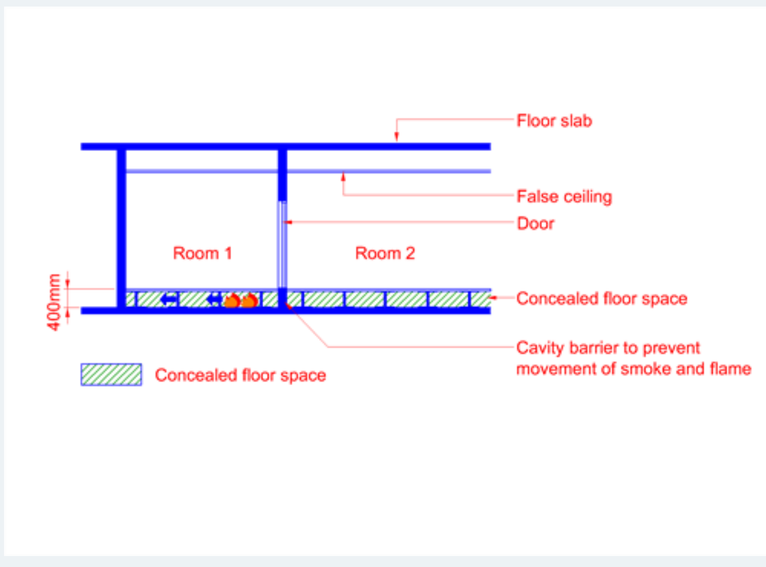
Concealed ceiling space with cavity barrier



Section

Figure 1.4.19 – 3

Concealed floor space without cavity barrier



Section

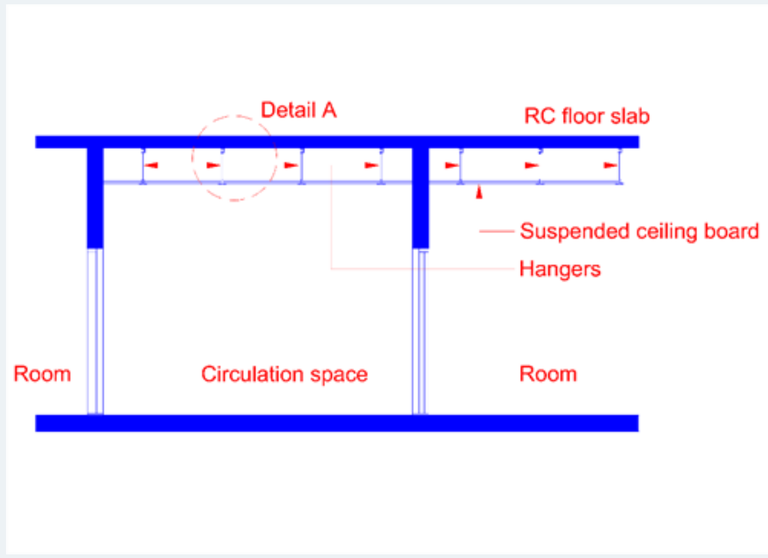
Figure 1.4.19 – 4

Concealed floor space with cavity barrier

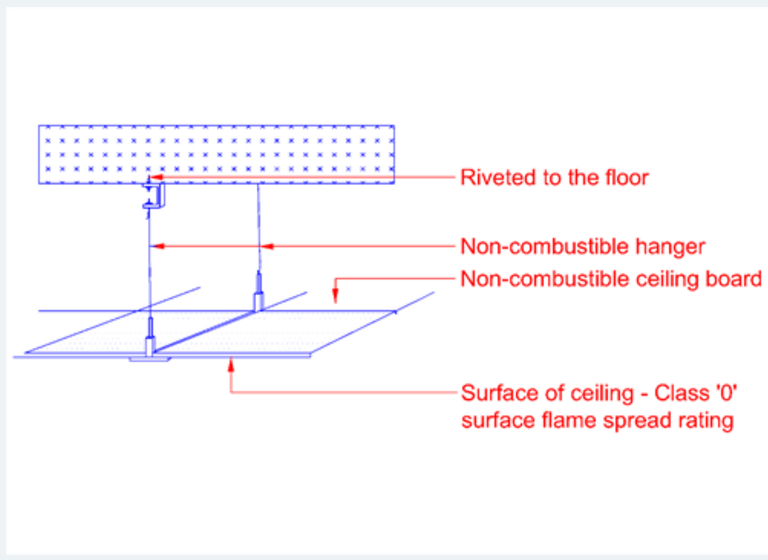
"Cavity barrier" refers to a fire-rated construction that seals or sub-divides a concealed space. The cavity barrier helps limit the spread of smoke and fire into or within that concealed space.

1.4.20 Ceiling

Explanation and Illustrations

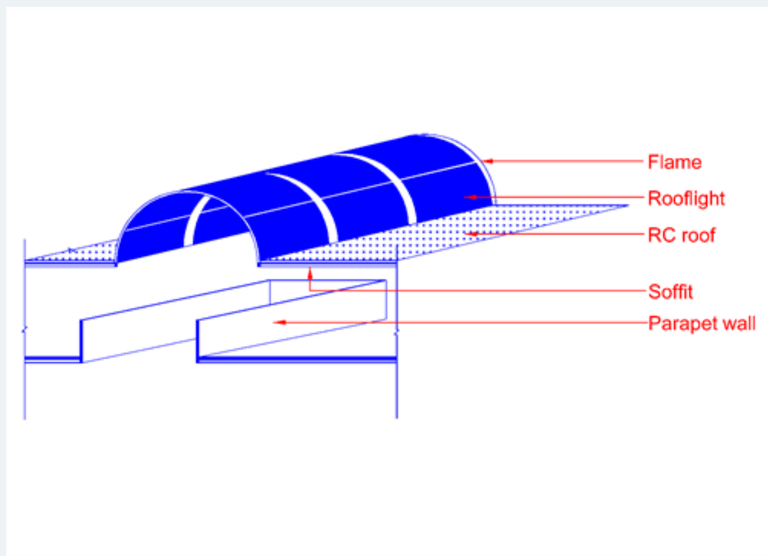


Section



Detail A

Figure 1.4.19 – 1



Axonometric Section

Figure 1.4.19 - 2

Soffit and roof light (skylight) is included as part of the ceiling surface, but not the frame of the roof.

"Ceiling" refers to a part of a building that encloses and is exposed overhead in a room, circulation space or protected shaft. A soffit or rooflight is regarded as part of its surface, but not the frame of a rooflight.

1.4.21 Circulation space

Explanation and Illustrations

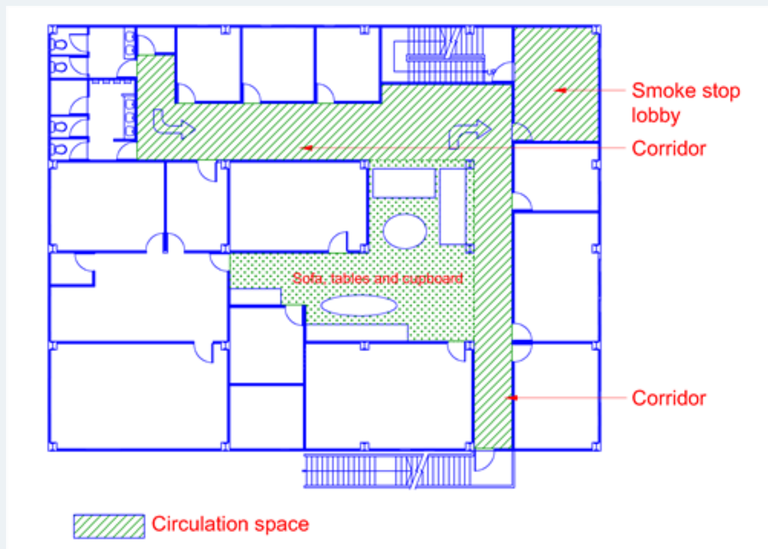


Figure 1.4.20

In general, circulation space refers to common corridors, lobbies, etc.. It is a common area for access of occupants from a room to an exit. Such common areas are normally separated from other area with partition/walls.

(Note that car park cannot be deemed as circulation space)

"Circulation space" refers to the means of access between a room or protected shaft and an exit from the building or compartment. It does not include areas used for any commercial activity, such as information and reception counters, or areas used for exhibitions.

1.4.22 Code of Practice (CoP)

Explanation and Illustrations

(No illustration)

It includes all subsequent amendments that may be issued by the SCDF. Examples of Codes of Practice or Standards that are acceptable to the SCDF are :

(a) Singapore Standards Codes of Practice

(b) British Standards Codes of Practice

(c) Australian Standards

(d) National Fire Prevention Association (NFPA) 130

For buildings which have been approved based on earlier Code of Practice for Fire Precautions in Buildings, the SCDF may consider applying the latest version to all new Additions and Alterations or Extension of works.

"Code of Practice" refers to the standard of practice acceptable to the authority having jurisdiction. The SCDF may adopt requirements stipulated in the stated year of publication of any referenced Code of Practice, or at its discretion adopt those specified in a later version.

1.4.23 Coldroom

"Coldroom" refers to a room, normally constructed of combustible insulation materials, used for the storage, processing or temporary holding of materials under cold conditions. If the floor area of cold storage space does not exceed 10m2 and its design does not permit persons to walk in, it shall be treated as an appliance and not a coldroom.

1.4.24 Compartment

Explanation and Illustrations

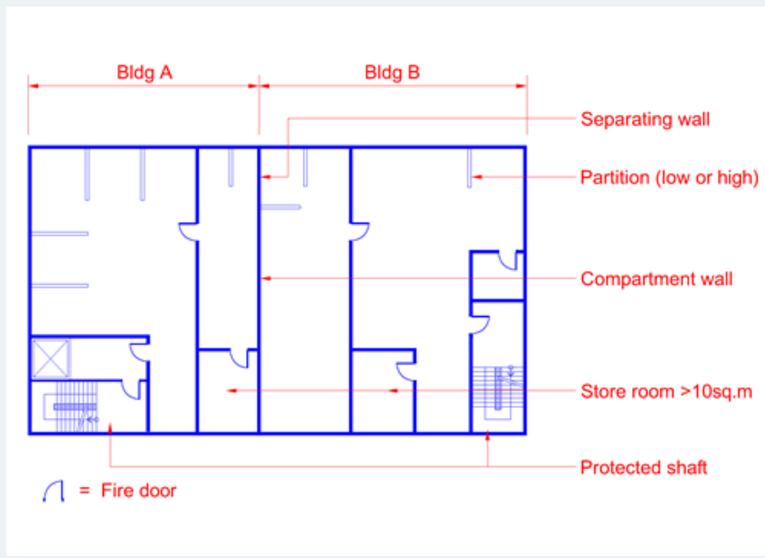
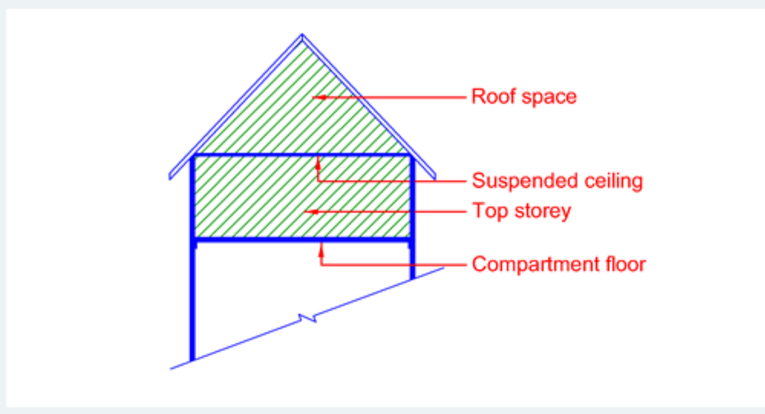
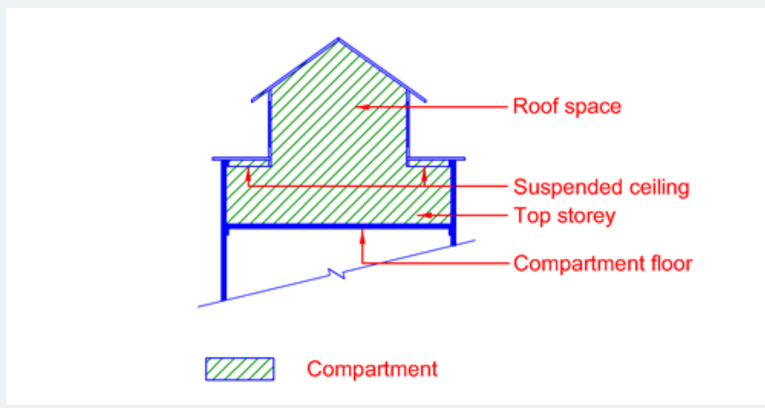


Figure 1.4.24 – 1



Section

Figure 1.4.24 – 2



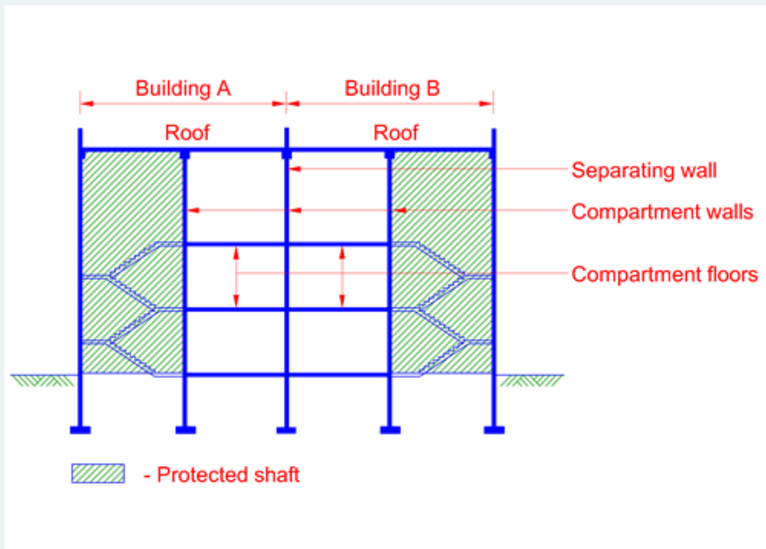
Sectional view

Figure 1.4.24 – 3

"Compartment" refers to a part of a building separated from all other parts of the same building by compartment walls and/ or compartment floors. The roof space above the top storey of a compartment is regarded as part of that compartment.

1.4.25 Compartment wall & Compartment floor

Explanation and Illustrations



Section

Figure 1.4.25

“Compartment wall” and “Compartment floor” refer to walls or floors of fire-rated construction provided for the purpose of dividing a building into compartments.

1.4.26 Composite panel

“Composite panel” refers to non-homogenous panel consisting of more than one layer of different materials used for partition, finishes to ceiling/ internal wall/ external walls/ roof covering, etc.

1.4.27 Concealed space/ Cavity

Explanation and Illustrations

See explanation & illustration for *Clause 1.4.18*

“Concealed space/ Cavity” refers to a space enclosed by elements of a building (including a suspended ceiling or raised floor) or contained within an element. It is not a room, cupboard, circulation space, protected shaft or space within a flue, chute, duct, pipe or conduit.

1.4.28 Corridor

Explanation and Illustrations

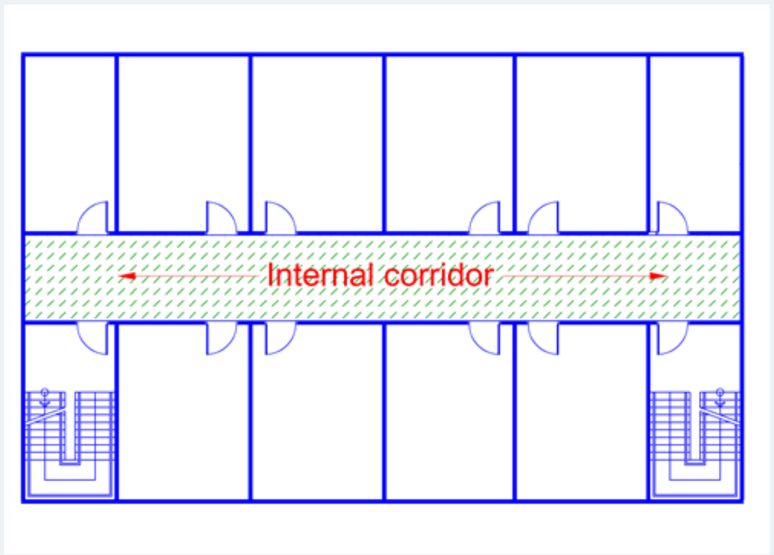


Figure 1.4.28 – 1

Internal corridor

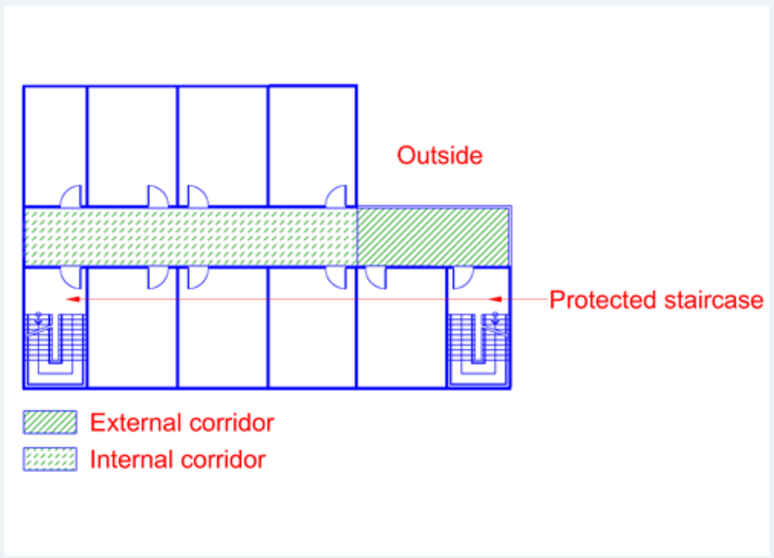


Figure 1.4.28 – 2

Internal corridor + External corridor

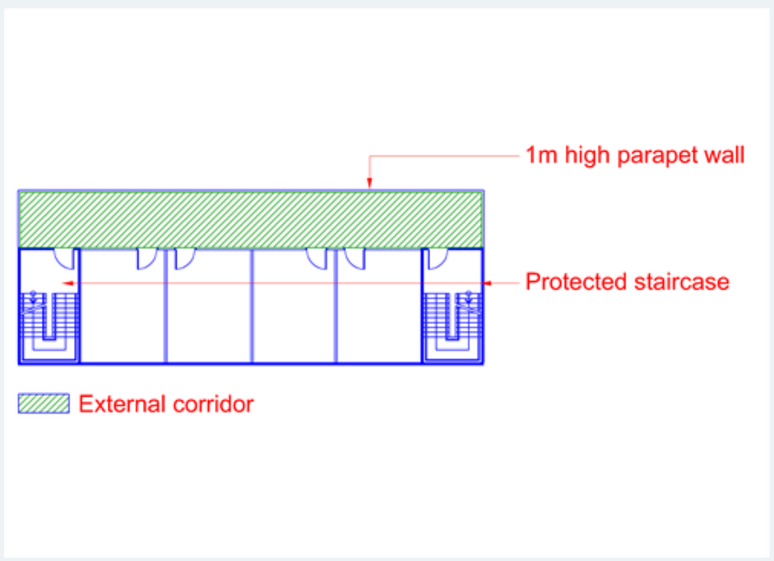


Figure 1.4.28 – 3

External corridor

"Corridor" refers to a passage providing means of access from rooms or spaces to an exit.

1.4.29 Cross ventilated corridor/ lobby

"Cross-ventilated corridor/ lobby" refers to a corridor/ lobby with fixed and unobstructed ventilation openings located on opposite facing walls, which face the external space, to allow for air circulation caused by outside breezes or wind.

1.4.30 Cubical extent

"Cubical extent" refers to the volume of a space within a building or compartment. This excludes protected lift walls, exit staircases and other accommodation (such as restrooms and locker rooms) which are enclosed with walls having at least 1-hr fire resistance, and openings protected by doors of ½-hr fire resistance fitted with an automatic self-closing device. It shall be measured according to the following dimensions:

a. the inner finished surfaces of the enclosing walls or, on any side where there is no enclosing wall, a plane extending vertically above the outermost edge of the floor on that side,

Explanation and Illustrations

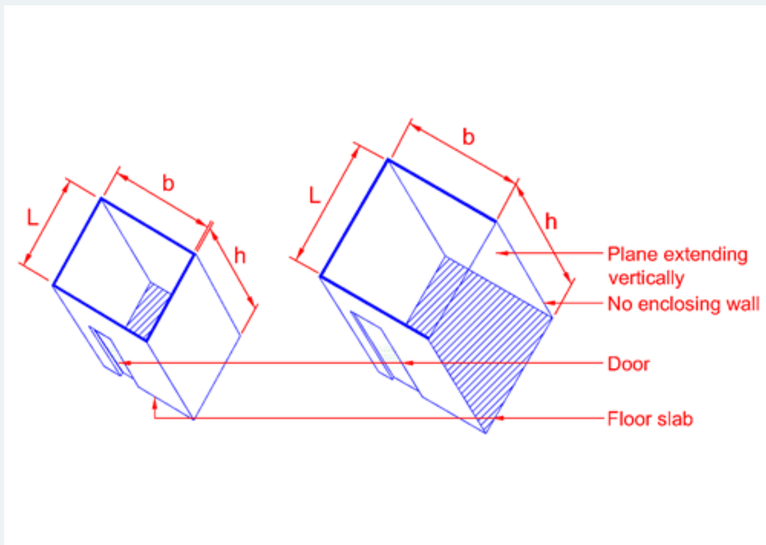
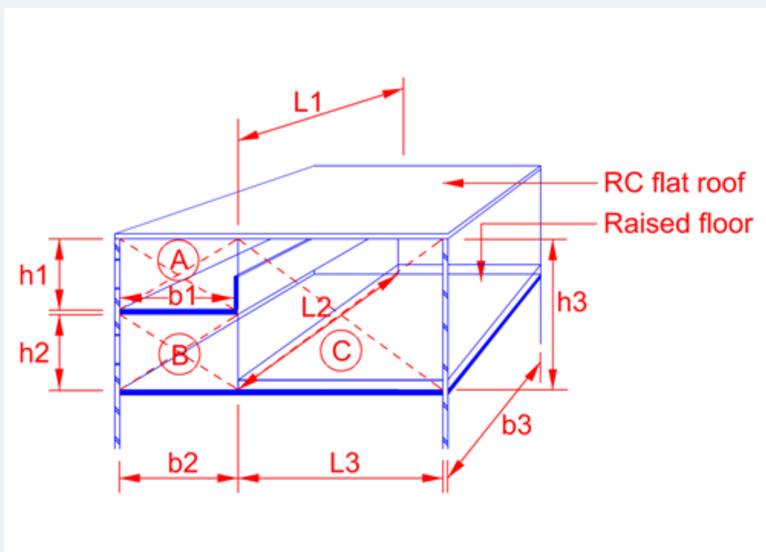


Figure 1.4.29a.

Cubical extent = L x b x h

b. the upper surface of its lowest floor; and

Explanation and Illustrations



Axonometric Section

Figure 1.4.29b.

Cubical extent of 3rd storey = A + B + C

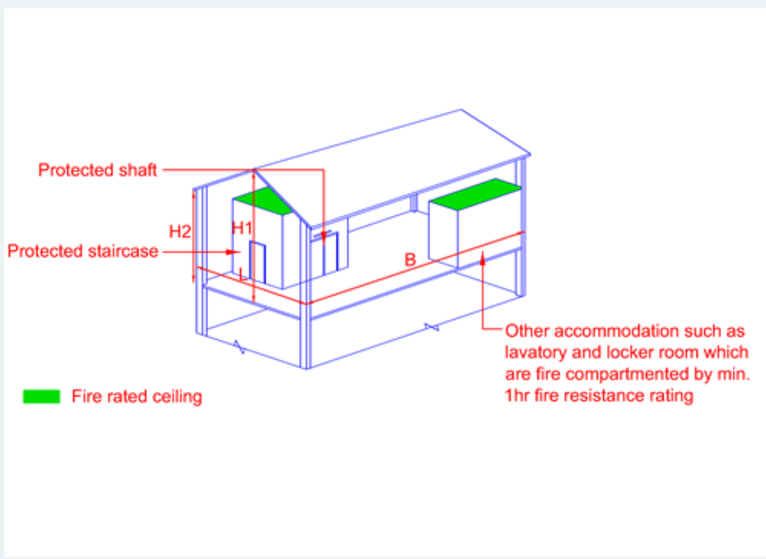
where : A = (L1 x b1 x h1)

B = (L2 x b2 x h2)

C = (L3 x b3 x h3)

c. where a building or compartment extends to a roof, the under-surface of the roof or the under-surface of the ceiling of the highest storey within the compartment, including the space occupied by any other wall, or any unprotected shafts, ducts or structure within the space to be so measured.

Explanation and Illustrations



Axonometric Section

Figure 1.4.29c.

Cubical extent = [(H1 + H2) / 2] x L x B

(less volume of protected shaft, protected staircase & separately compartmented lavatory/locker room)

1.4.31 Custodian care facility

"Custodian-care facility" is a building or part thereof, without stay in accommodation, used by persons who, because of age, or physical or mental disabilities, are unable to care for their self-preservation and safety. Such facilities include the followings:

a. Nurseries for children under 6 years of age (e.g., kindergarten, childcare day centres, infant care day centres, etc.;

b. Senior care day centres;

c. Mentally disabled day care centres;

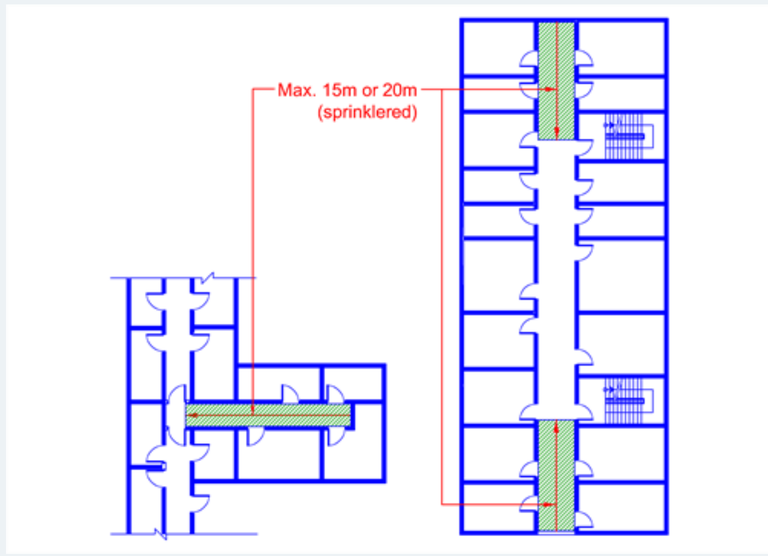
d. Intellectually disabled day care centres;

e. Mental rehabilitation day care centres; and

f. Psychiatric day care centres.

1.4.32 Dead-end

Explanation and Illustrations



Left Figure : 'T' junction with main corridor Right Figure : Continuation past stairway

Figure 1.4.31 : Dead-end

"Dead-end" refers to a situation within a common area, such as a corridor or lift lobby space, where exit is only possible from one end, with no possible escape from the other end.

1.4.33 Direct distance

Explanation and Illustrations

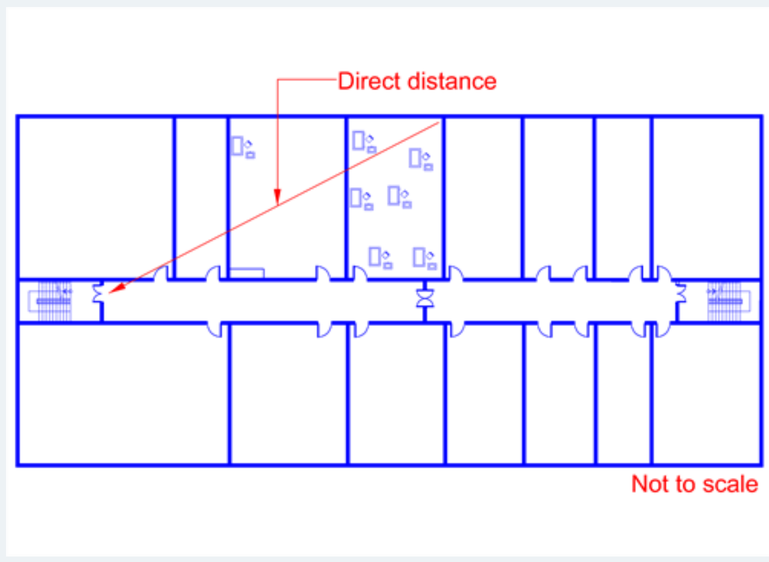


Figure 1.4.33 - 1 : Direct distance

"Direct Distance" means the shortest distance from any point within the floor area, measured with the external enclosures of the building, to the relevant exit ignoring walls, partitions and fittings other than the enclosing walls/partitions to protected staircases.

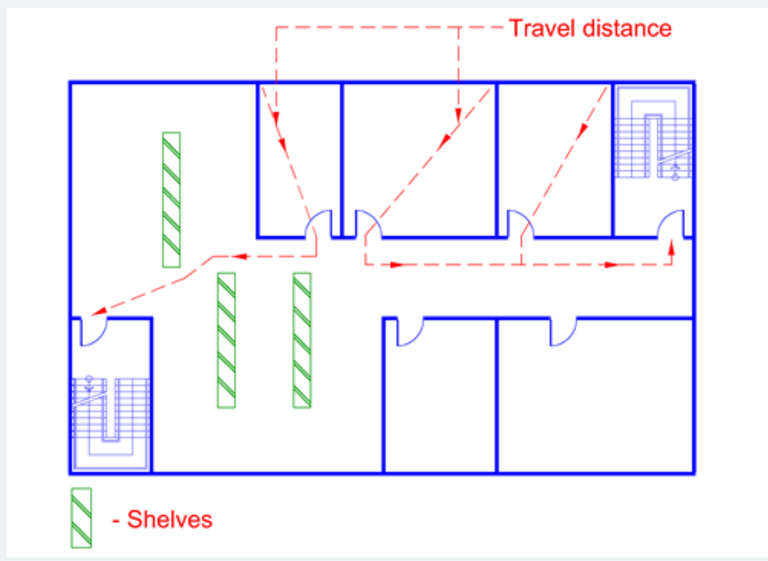


Figure 1.4.33 - 2 : Travel distance

"Travel Distance" means the actual distance to be travelled by a person from any point within a floor area to the relevant exit having regard to the layout of walls, partitions, fixtures and fitting.

"Direct distance" refers to the shortest distance from the most remote point in a room or space, measured within the external enclosures of the room or space to the relevant exits, ignoring internal walls, partitions and fittings other than the enclosure walls of exit passageways and exit staircases.

1.4.34 Door

"Door" refers to any shutter, cover or other form of protection to an opening in any wall, floor or in the structure surrounding a protected shaft, regardless of whether the door is constructed of one or more leaves.

1.4.35 Electromagnetic or electromechanical door-holding device

Explanation and Illustrations

See explanation/illustration for *Clause 1.4.36*

"Electromagnetic" or "electromechanical door-holding device" refers to a device which holds doors open. This device is designed to automatically close doors in the event of a fire, thereby helping to contain the spread of smoke and fire. Events which cause these devices to trigger include the detection of smoke, failure of power supply to the door, the triggering of a fire alarm, and manual triggering.

1.4.36 Electromagnetic or electromechanical locking device

Explanation and Illustrations

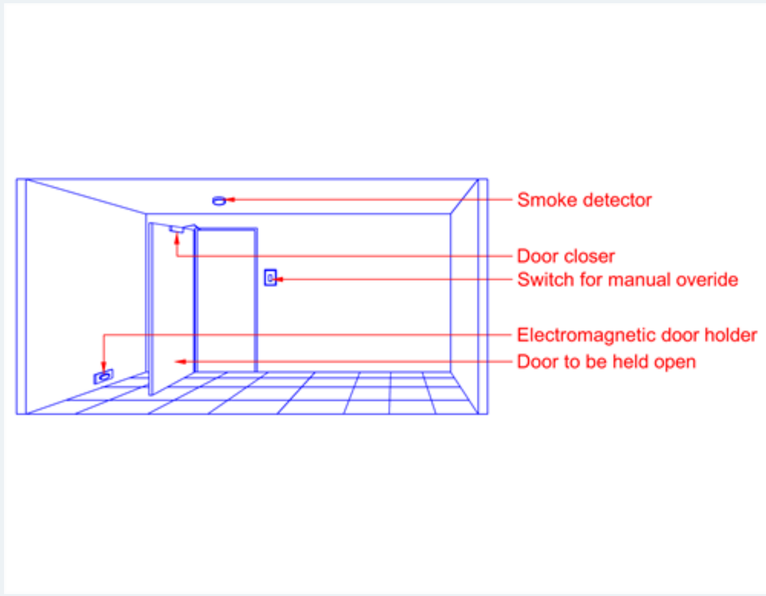


Figure 1.4.36

Door is held open position by Electromagnetic or electro-mechanical device

Where the fire door poses a hindrance to movement between a fire compartment and another , for example, fire door across access corridor, fire door to kitchen, it is permissible to hold the fire door in the open position by electromagnetic or electromechanical device.

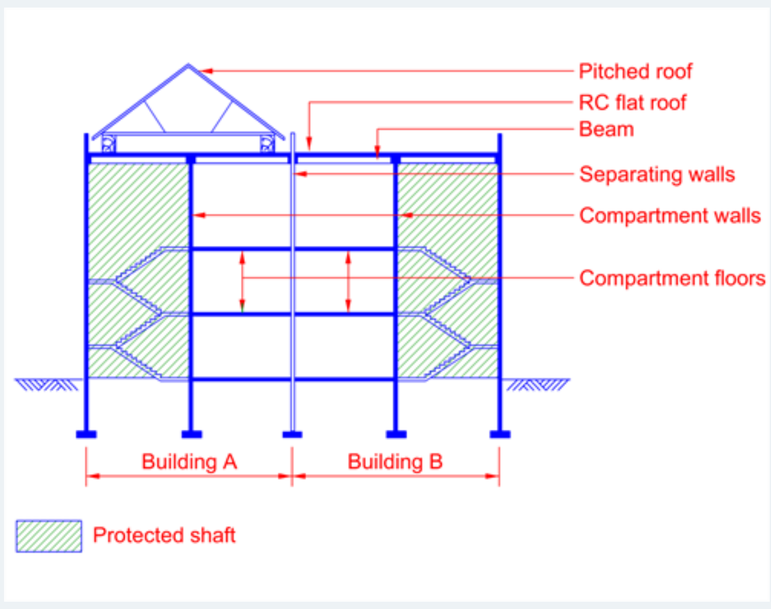
"Electromagnetic" or "electromechanical locking device" refers to a fail-safe device which provides egress access control. In the event of a fire alarm activation, failure of building power supply, and/ or any fault in the locking devices/ components, related to the release of locking mechanism, this device shall:

a. automatically unlock doors immediately to facilitate egress, and remain so until power supply is restored; and

b. be provided with a means of manual override located within the occupied space, 1.2m above the floor and within 1.5m of the door jamb.

1.4.37 Element of structure

Explanation and Illustrations



Section

Figure 1.4.37

For building A the pitched roof is not considered as part of the structural frame of the building. However, the RC slab and beam supporting the pitched roof are considered elements of structures as they help to carry the dead load imposed by the pitched roof. For building B the RC roof is not considered as an element of structure. However, the beams supporting the RC roof are considered to be elements of structure of the building.

The columns supporting the pitch roofs are not element of structure as they are not part of the column supporting the whole building. Hence the columns only need to be constructed of non-combustible material.

"Element of structure" refers to:

a. a member forming part of the structural frame of a building or any other beam or column but not a member forming part of a roof structure only,

b. a load-bearing wall or load-bearing part of a wall,

c. a floor, including a compartment floor, other than the lowest floor (in contact with the ground) of a building,

d. a separating wall, or

e. a structure enclosing a protected shaft (protecting structure).

1.4.38 Emergency generator

"Emergency generator" refers to emergency power-generating equipment that complies with the requirements stipulated in *SS 535*.

1.4.39 Emergency lighting

"Emergency lighting" refers to lighting provided with a secondary source of power supply to illuminate the exits and spaces within a building.

1.4.40 Engineered timber

"Engineered timber" refers to mass timber products that are manufactured according to established standards accepted by the SCDF. Examples of mass timber products are Cross Laminated Timber (CLT) and Glued Laminated Timber (GLT) structural elements manufactured in accordance with *EN 16351* and *EN 14080*, respectively.

1.4.41 Evacuee holding area

"Evacuee holding area" refers to a designated circulation area/ space on the refuge floor for temporary assembly of occupants during a fire emergency.

1.4.42 Exit

"Exit" refers to a means of egress from the interior of the building to an external space. An exit includes any of the following, either singly or in combination: a door opening leading to external space, exit staircase, exit ramp and/ or exit passageway, but not including an access stair, aisle, corridor door or corridor and an access door to a room or space.

1.4.43 Exit access

Explanation and Illustrations

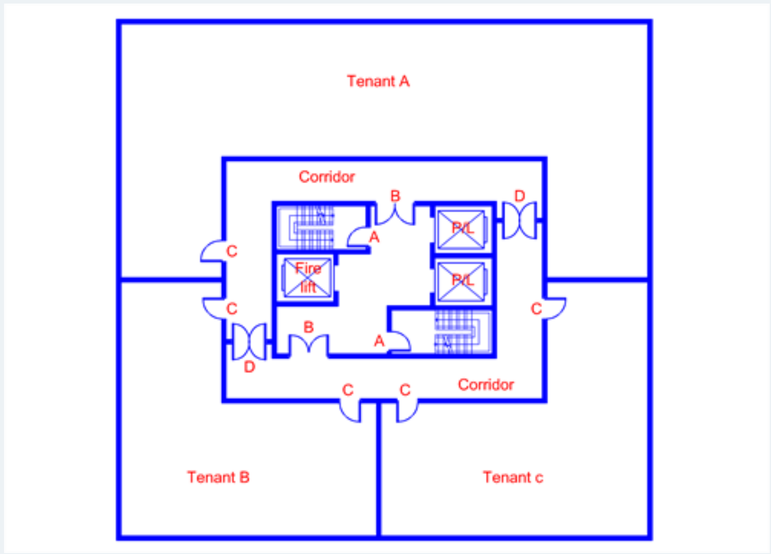


Figure 1.4.43 – 1

Door A = exit doors

Door B, C & D = exit access doors

Exit access door shall comply with all the requirements of an exit door and need not have fire resistance rating, unless it is specified.

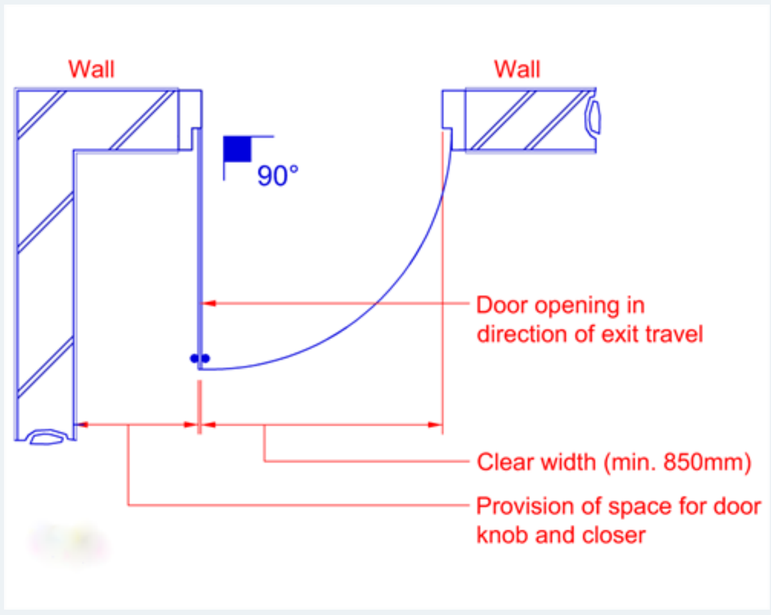


Figure 1.4.43 – 2

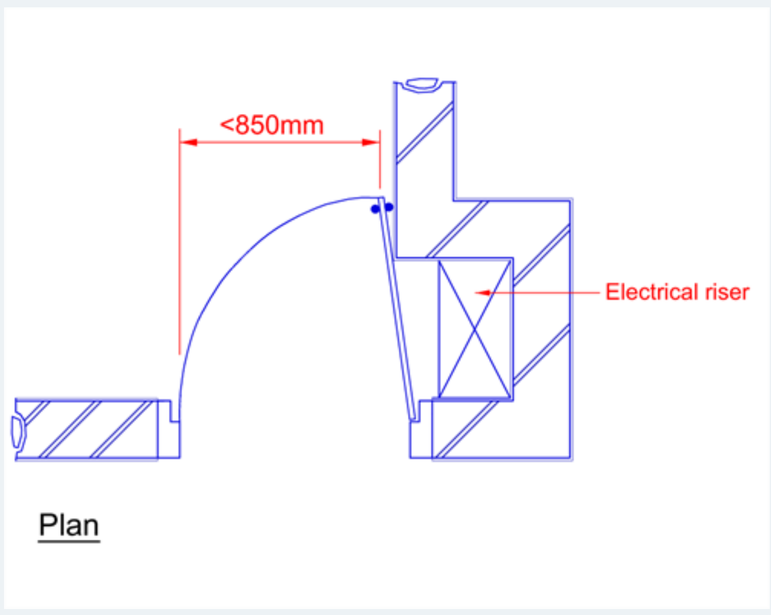


Figure 1.4.43 – 3

The layout is not acceptable.

The clear width of the exit door opening is less than 850mm and the door is opened at an angle of less than 90 degree.

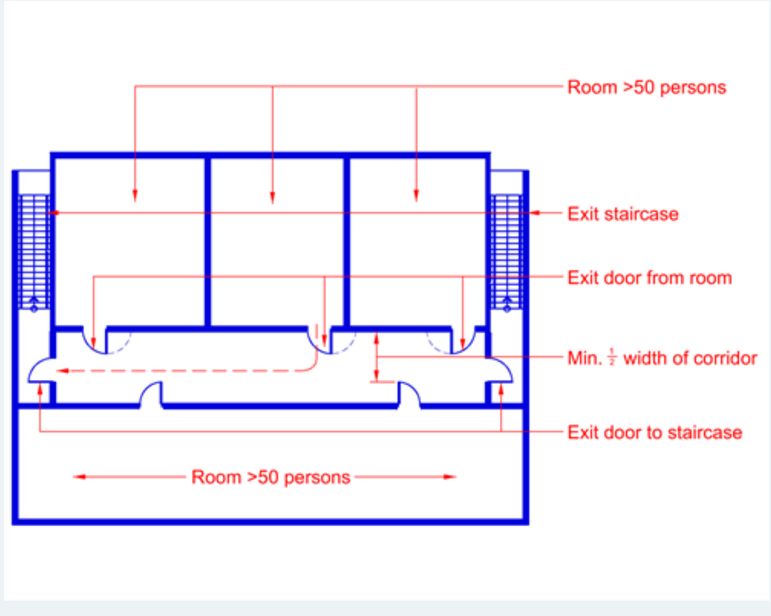


Figure 1.4.43 – 4

Exit doors which open into the common corridor should not cause obstruction to movement of occupants

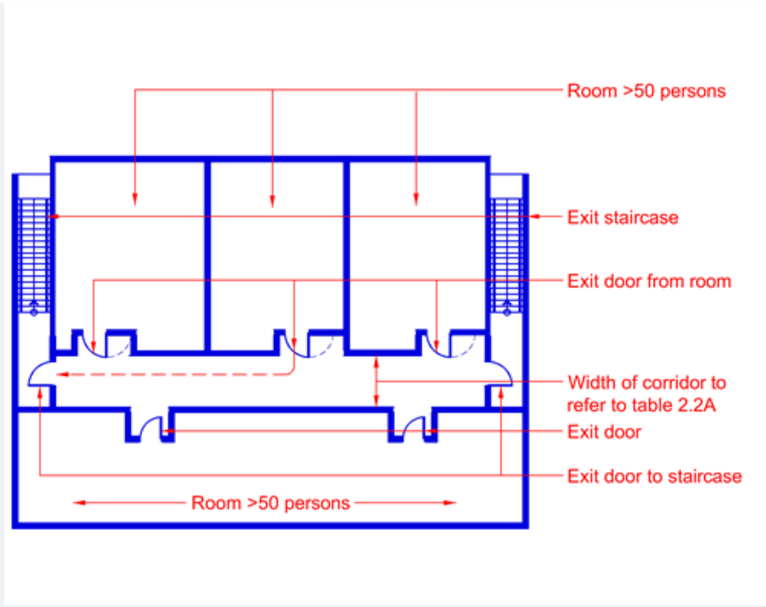


Figure 1.4.43 – 5

Exit doors which cause obstruction when open into the common corridor shall recessed

"Exit access" refers to the portion of a means of escape that leads to an exit. It includes the room and building spaces that people occupy, as well as the doors along the escape routes, lobbies, aisles, passageways, corridors, access stairs and ramps traversed in order to reach an exit.

1.4.44 Exit access door

Explanation and Illustrations

See explanation/illustration for *clause 1.4.42*

"Exit access door" refers to a door which provides access to a room or space (excluding a toilet cubicle, bedroom, storeroom, utility room, pantry and the like), or installed across the escape path leading to an exit.

1.4.45 Exit door

Explanation and Illustrations

See explanation/illustration for clause 1.4.42

"Exit door" refers to a door, including a door which opens to the external space, provided at the doorway of an exit for the passage of people, which forms part of the integrity of the exit.

1.4.46 Exit passageway

Explanation and Illustrations

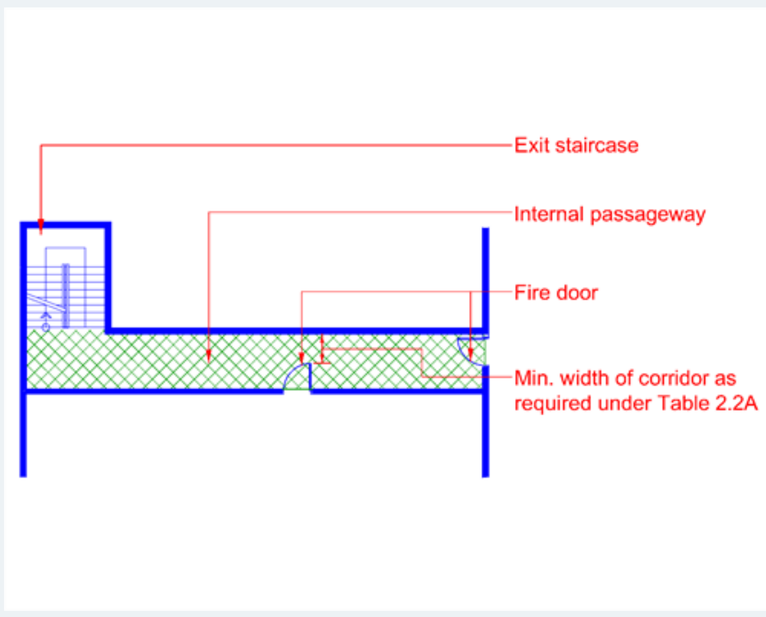


Figure 1.4.46 – 1

Horizontal extension of vertical exit

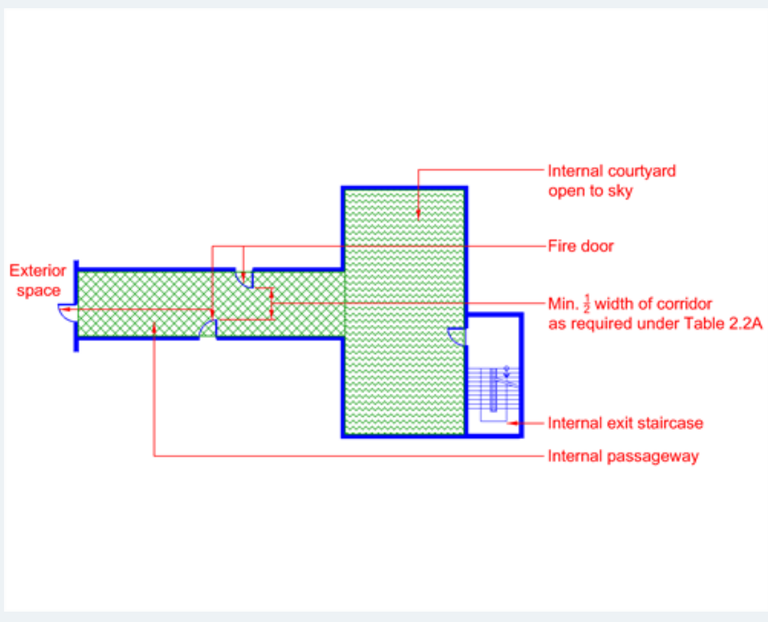


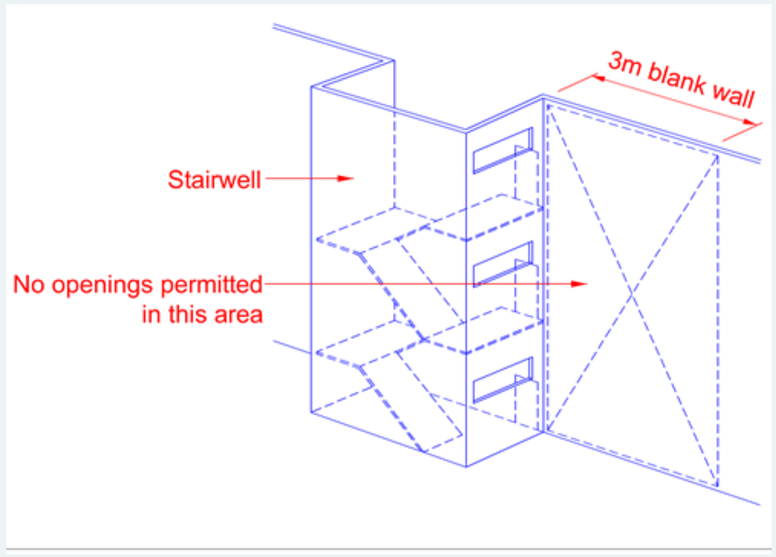
Figure 1.4.46 – 2

Exit passageway at 1st storey

"Exit passageway" refers to the horizontal extension of a vertical exit via an exit staircase or passage leading from a habitable area to an external space.

1.4.47 Exit staircase

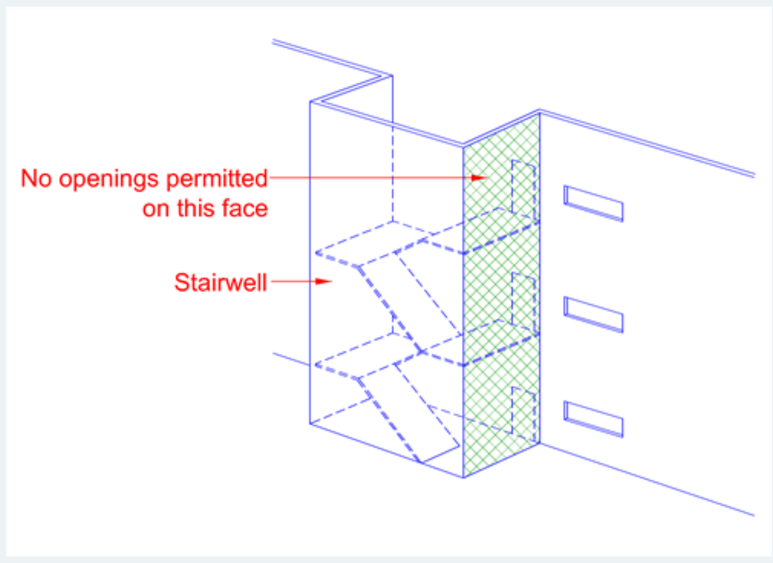
Explanation and Illustrations



Axonometric Section

Figure 1.4.47 - 1

Alternative method of protecting stairway enclosures



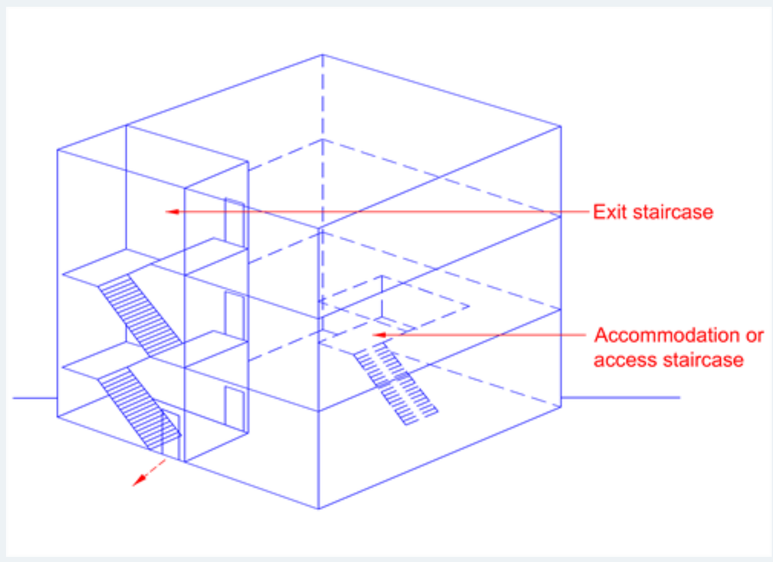
Axonometric Section

Figure 1.4.47 - 2

Where the stairway enclosure projects beyond the external wall of the building and is connected thereto, then either:

(a) the external wall or wall of any part of the building less than 3m from the stairway enclosure, or

(b) the external wall or walls of any part of the stairway enclosure within any 3m from the building should be imperforate and of not less than one hour fire resistance.



Axonometric Section

Figure 1.4.47 - 3

Accommodation or access staircases are provided solely for the convenience of moving easily and quickly from one floor to another are not considered as exit staircases.

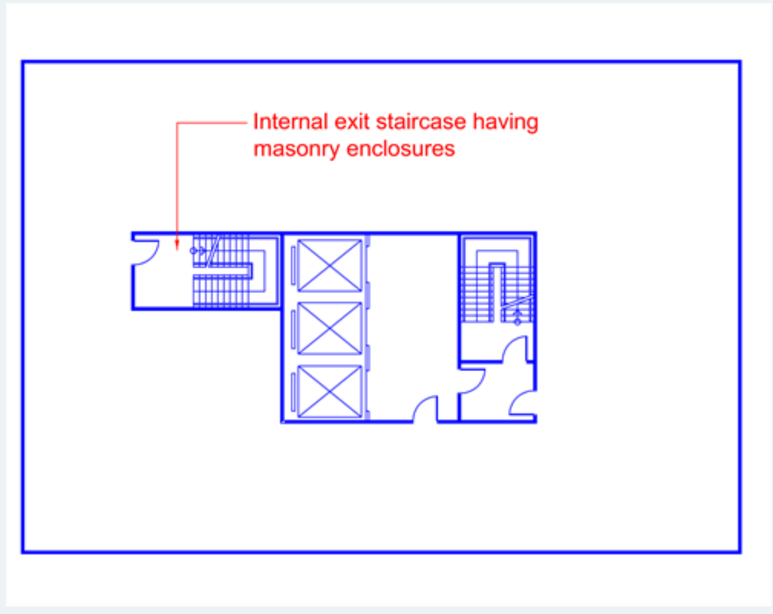


Figure 1.4.47 - 4

Internal exit staircases are required to be provided with masonry enclosures and mechanical ventilation. Masonry enclosures to internal exit staircases, mechanical ventilation is to be provided. Where the building exceeds 24m in habitable height, the staircases are to be pressurised.

All exit staircases are considered as protected shafts are required to be separated from other areas by masonry walls to have the necessary fire resistance rating required by Cl.3.3 for elements of structure for the part of the building in which they are located. Thus, the enclosures to staircases serving the basement would have higher fire resistance rating than that of

staircases serving upper storeys. Door opening into the exit staircase shall have min. ½-hr fire resistance rating.

"Exit staircase" refers to a staircase constructed of non-combustible material and protected from fire (by fire-rated construction or located at the external space) for the purpose of enabling egress to the external space.

1.4.48 External corridor

"External corridor" refers to a corridor with an unobstructed and uninterrupted ventilation opening that measures at least 1.2m in vertical height, the latter which is located above its parapet wall.

1.4.49 External exit passageway

Explanation and Illustrations

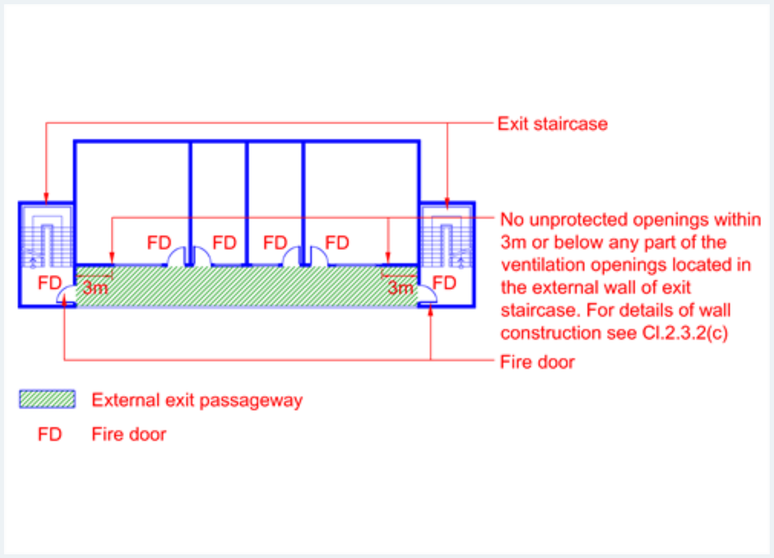


Figure 1.4.49 : External exit passageway

External exit passageway is an extension of the vertical exit. It is considered a protected area to allow occupants the safe egress. There is no control on the numbers of doors opening into an external exit passageway.

"External exit passageway" refers to an exit passageway that serves as required exit with at least one of its longest sides open to the external space or air well.

1.4.50 External exit staircase

Explanation and Illustrations

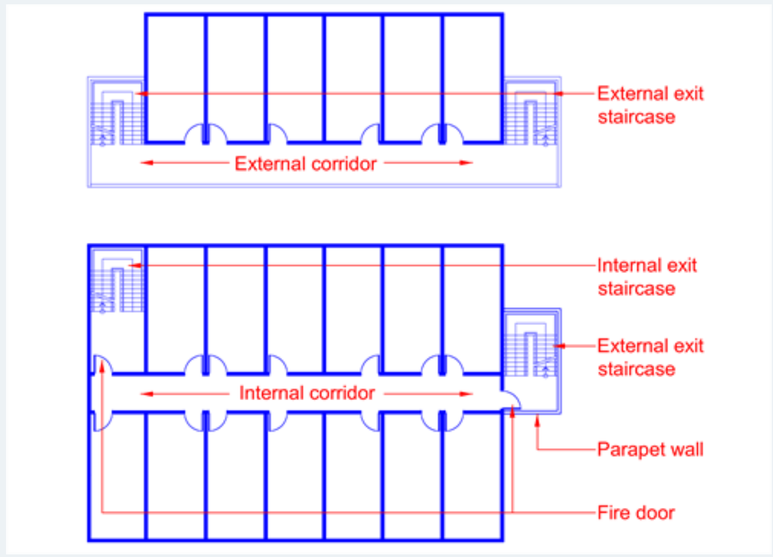


Figure 1.4.50 - 1

See *Cl.2.3.3b.* for requirements on separation of unprotected openings to external exit staircase and *Cl.2.3.3a.* for protection of internal exit staircase.

For a staircase to be considered as external staircase, it shall be:

(a) located outside the building;

(b) open to outdoor air; and

(c) enclosed by parapet or railing on at least 2 sides.

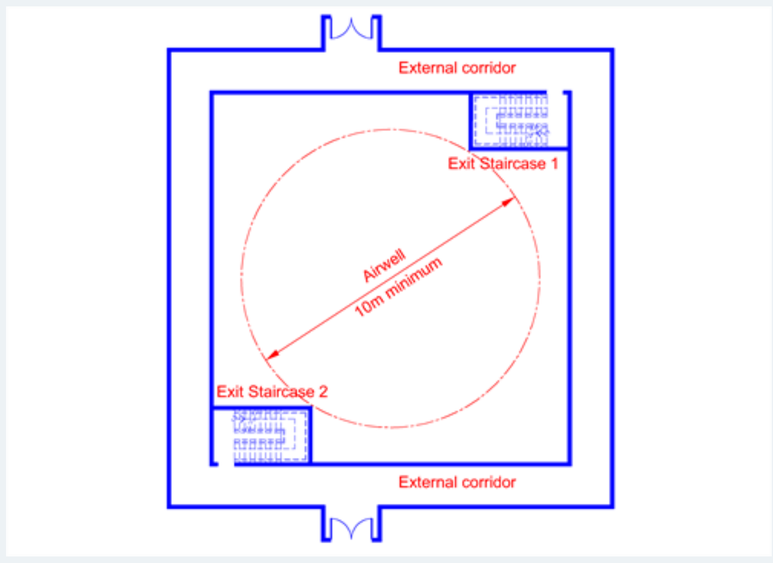
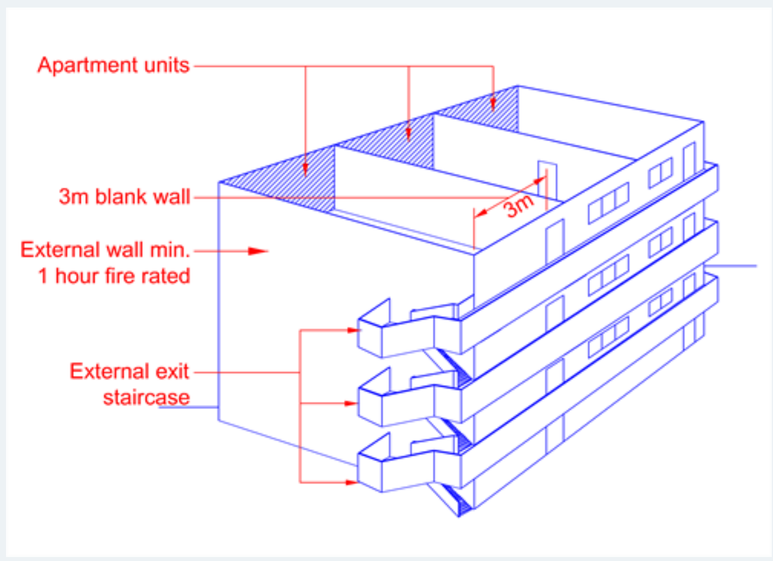


Figure 1.4.50 - 2

Siting of exit staircases or other services inside the air well is considered acceptable, provided there is a clear unobstructed space having a diameter that is equal to the required width of the air well i.e. if the required width of the air well is 12m, then the diameter of the unobstructed space shall be min. 12m to allow for effective venting of hot gases and smoke.



Axonometric Section

Figure 1.4.50 - 3

External exit staircase can be used as required exit in lieu of internal exit staircase, provided there shall be no unprotected openings within 3m horizontally or within 3m vertically below any part of the external exit staircase.

"External exit staircase" refers to an exit staircase located outside a building, open to the external space, and that:

a. is enclosed by parapet walls or railing of not more than 1.1m in height;

b. has at least two adjacent sides or one of its longest sides abutting the external space; and

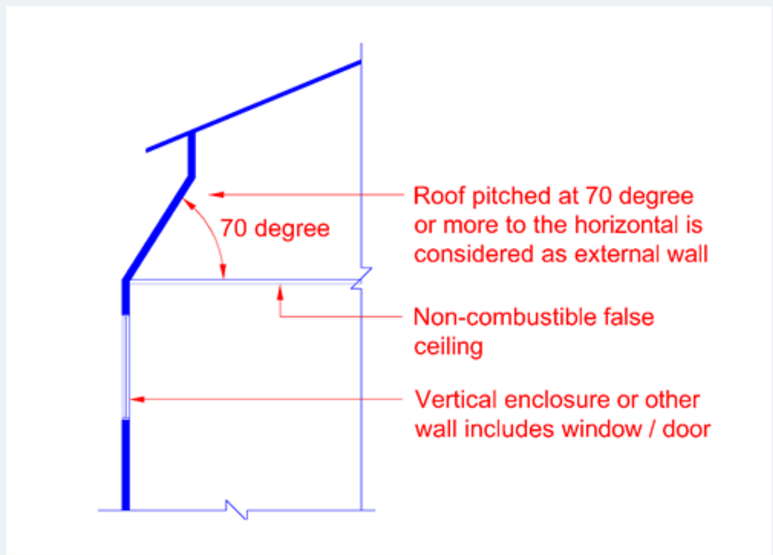
c. is recessed not more than 3m from the building facade.

1.4.51 External space

"External space" refers to an open space abutting the perimeter of a building, which includes an air well and which is vertically open to the sky without any roof or trellis.

1.4.52 External wall (or side of a building)

Explanation and Illustrations



Section

Figure 1.4.52 : External wall

Where that part of roof is treated as an external wall in accordance with the above definition, it shall comply with Cl.3.5 on the permitted limit of unprotected areas and the surface flame spread requirements. See also Cl.1.4.108 for the meaning of “unprotected areas”.

“External wall” or “external side of a building” refers to an outer wall or vertical enclosure. This includes a part of the roof pitched at an angle of 70° or more to the horizontal, if that part of the roof adjoins a space within the building to which persons have access.

1.4.53 External wall finishes

“External wall finishes” refers to materials/ components installed on the building facade for the purpose of providing thermal insulation, weather resistance and/ or to improve the appearance of buildings. They can be made of timber, metal, brick/stone granite, vinyl, composite materials, etc. It shall include cladding, fins and any decorative features mounted on the external walls of a building.

1.4.54 Fire lift lobby

Explanation and Illustrations

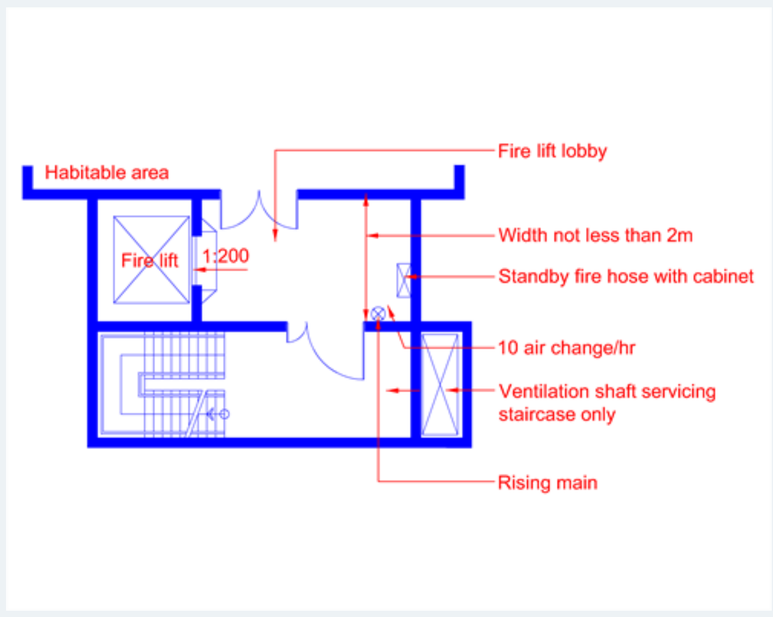


Figure 1.4.54 : Fire lift lobby

The lobby floor shall be graded from the lift landing door towards the lobby door with a fall not exceeding 1: 200 to prevent water from flowing into the lift shaft. The lobby provides a buffer zone to prevent smoke from streaming into the protected staircase. The lobby acts as a staging area for fire fighters in carrying out firefighting operation. For mechanical ventilation requirement, see Cl.7.1.10

“Fire lift lobby” refers to a protected and ventilated lobby into which a fire lift opens, and from which direct access to an exit staircase can be made for the purpose of firefighting.

1.4.55 Fire resistance

Explanation and Illustrations

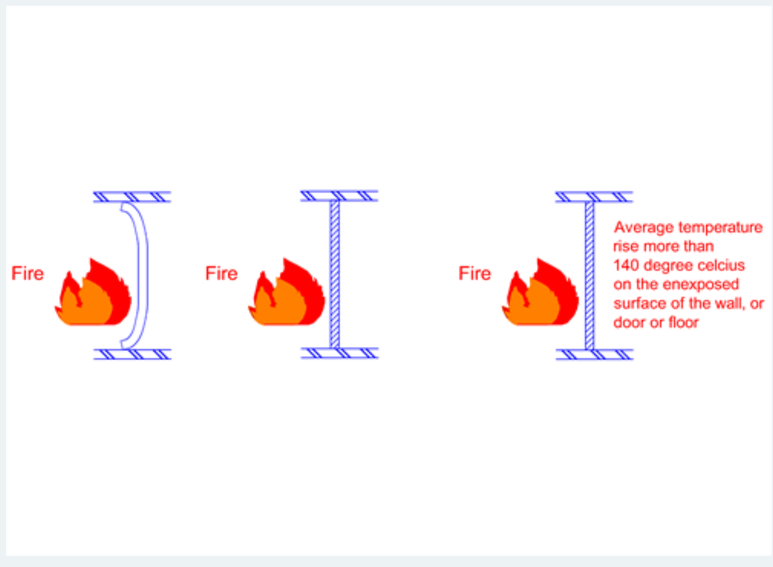


Figure 1.4.55 : Fire resistance

Fire resistance is a property, currently measured in BS 476: part 20 to 23 furnace test, of a particular element of building construction (it is not a property of a building material) and is the measure of its ability to satisfy for a stated period in minutes some or all of the following criteria:

(a) Stability - resistance to collapse or excessive deflection

(b) Integrity - resistance to passage of flames and hot gases

(c) Insulation - resistance to excessive temperature rise on exposed face

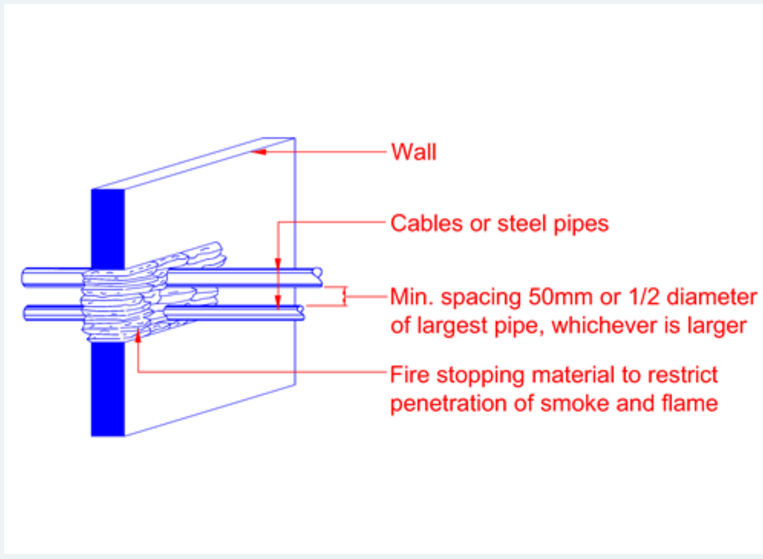
"Fire resistance" refers to the minimum period of time during which an element of structure or building element can be expected to function satisfactorily while subjected to a standard fire test.

1.4.56 Fire safety report

"Fire safety report" refers to a document that details the provision of fire protection systems, life safety features and fire safety management for a building, plant or installation.

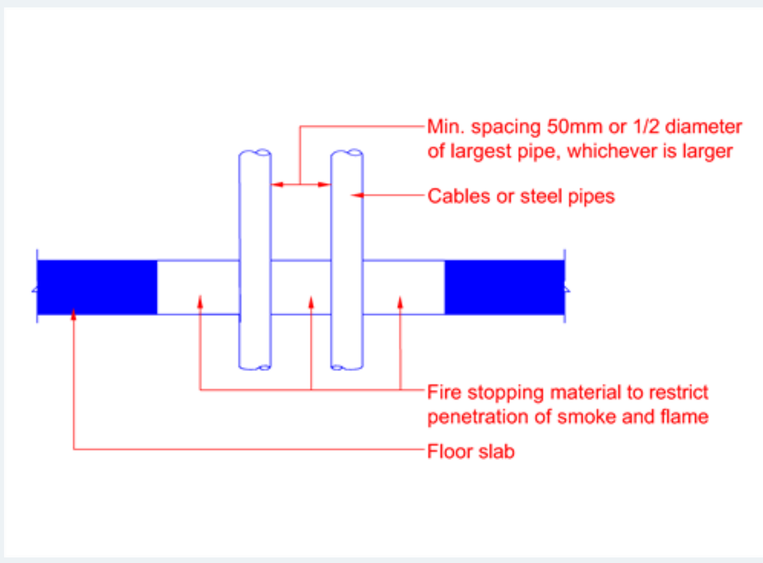
1.4.57 Fire stop

Explanation and Illustrations



Axonometric Section

Figure 1.4.57 – 1 : Wall penetration details



Section

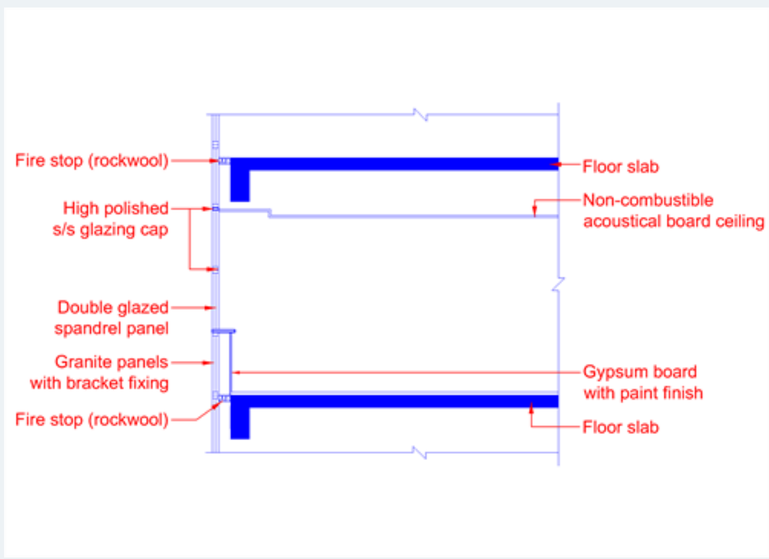
Figure 1.4.57 – 2 : Floor penetration details

To avoid weakening of the fire-rated wall/floor, openings for service penetration should be :

(a) kept as few in number as possible;

(b) as small as practicable; and

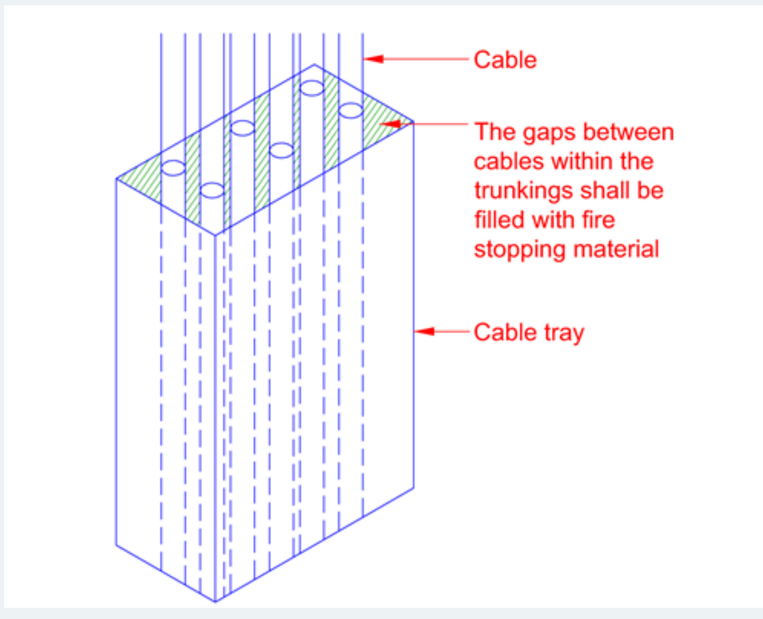
(c) all gaps shall be filled with fire-stopping materials.



Section

Figure 1.4.57 – 3 : Curtain wall detail

It is important that the gap between the edge of the structural floor slab and the curtain wall should be fire stopped to prevent migration of smoke and flame from floor to floor



Axonometric Section

Figure 1.4.57 - 4 : Cable trucking

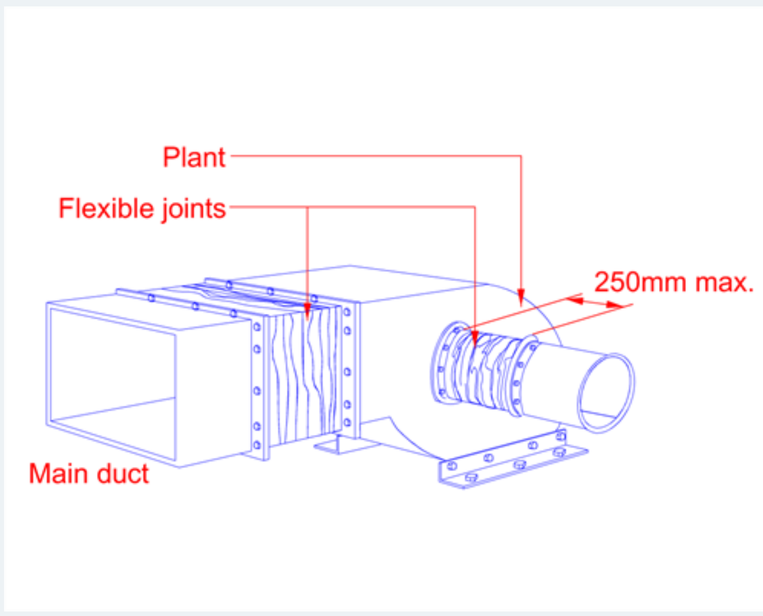
"Fire stop" refers to a seal provided to close an imperfection of fit or any joint between elements, components or construction in a building, which serves to prevent/ limit the passage of smoke and flame through that imperfection or joint.

1.4.58 Flammable refrigerant

"Flammable refrigerant" refers to the group of refrigerants with flammability classification of group 2 or 3 in accordance to *ISO 5149*. For refrigerant blends which have more than one flammability classification, the most unfavourable classification shall be taken for the purpose of this definition. Most of these flammable refrigerants are hydrocarbon (HC) based. Some examples of HC refrigerant include propane, butane and isobutane.

1.4.59 Flexible joints and Flexible connections

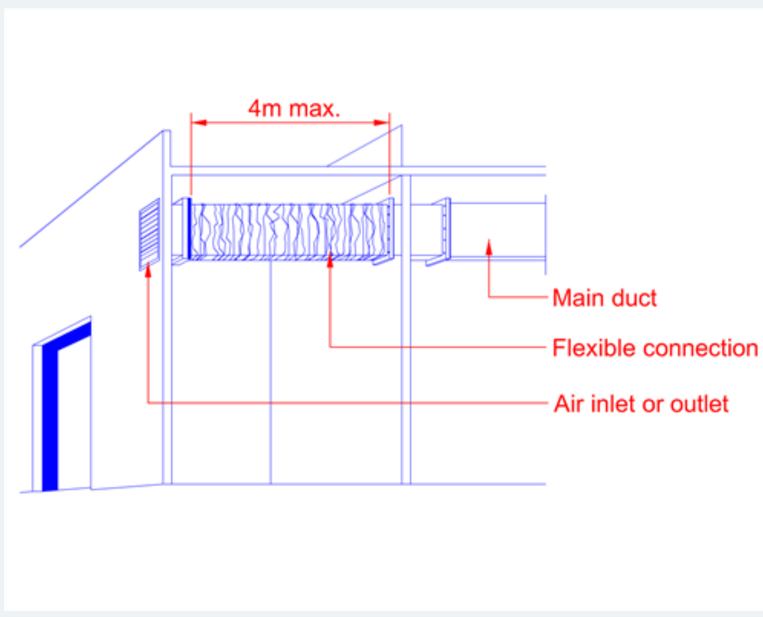
Explanation and Illustrations



Axonometric view

Figure 1.4.59- 1 : Flexible joint

Flexible joints shall not exceed 250mm in length and be made of materials classified as "not-easily-ignitable" when tested under BS 476 Pt. 5



Axonometric Section

Figure 1.4.59 - 2 : Flexible connection

Flexible connection material shall have a surface flame spread rating of not lower than Class '1'. However, in areas of building where Class '0' flame spread rating is required for the ceiling construction under the Fire Code, a Class '0' rating for the covering and lining materials shall be required. Flexible connection shall not exceed 4m in length. It shall not pass through fire resisting walls, floors or partitions and when involved in fire generates a minimum amount of smoke and toxic gases.

For air-conditioning and mechanical ventilation systems:

a. "flexible joints" refer to connections between ducts and equipment normally provided to isolate vibration and to allow thermal movement; and

b. "flexible connections" refer to flexible sections of ducts provided to connect the extremity of ventilation ductwork to terminal units, extract units and grilles.

1.4.60 Fire engine access road

"Fire engine access road" refers to a road designed for firefighting appliances gain access to, and travel within a development for firefighting operations.

1.4.61 Fire engine accessway

"Fire engine accessway" refers to a metalled or paved road located along the perimeter of a building to allow a firefighting appliance to carry out firefighting operations. Compared to a fire engine access road, a fire engine accessway is designed to withstand a higher tonnage, and with a larger width, for the purpose of deploying firefighting appliances during an operation.

1.4.62 Fully Automated Mechanised Car Park (FAMCP)

"Fully automated mechanised car park" refers to a building or part of a building that is intended for the storage/ parking of passenger vehicles employing fully automated mechanical facilities to move the vehicle from the point of entry to the parking deck and vice-visa. The parking area would be accessible by trained staff when carrying out maintenance works only. The automatic parking system is to be deactivated during the maintenance operations.

1.4.63 General warehouse

"General warehouse" refers to a building or space used for storing various types of goods or materials. It includes warehouses for storing chemicals, fresh/ perishable food products (coldroom), etc. Store having floor area more than 100m^2 shall be classified as warehouse.

1.4.64 Habitable floor

Explanation and Illustrations

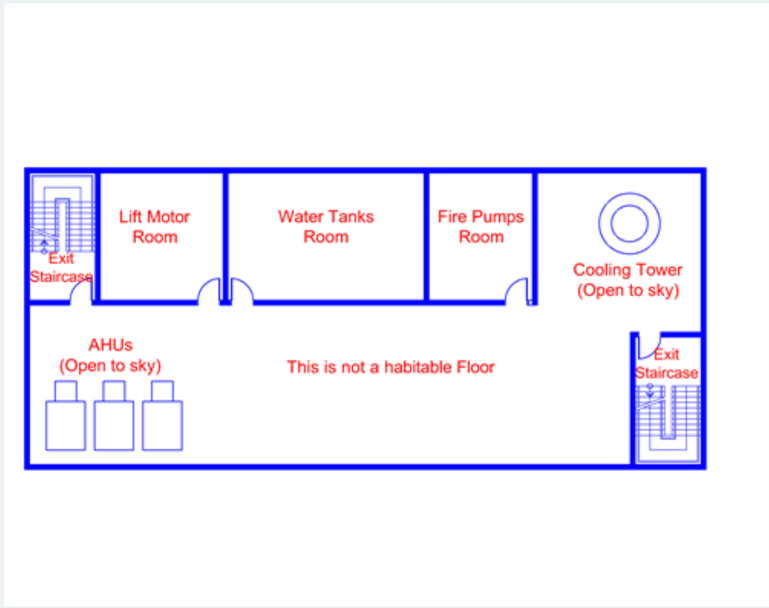


Figure 1.4.64 - 1

In the calculation of habitable height, rooms housing lift motors, fire pumps, water supply pumps, cooling towers and water tanks located on roof level irrespective of the room sizes are not considered as habitable floor.

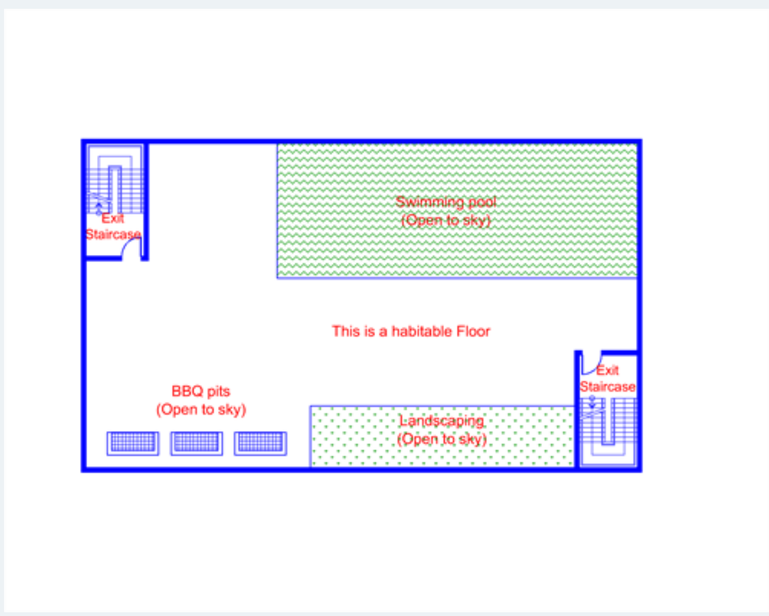


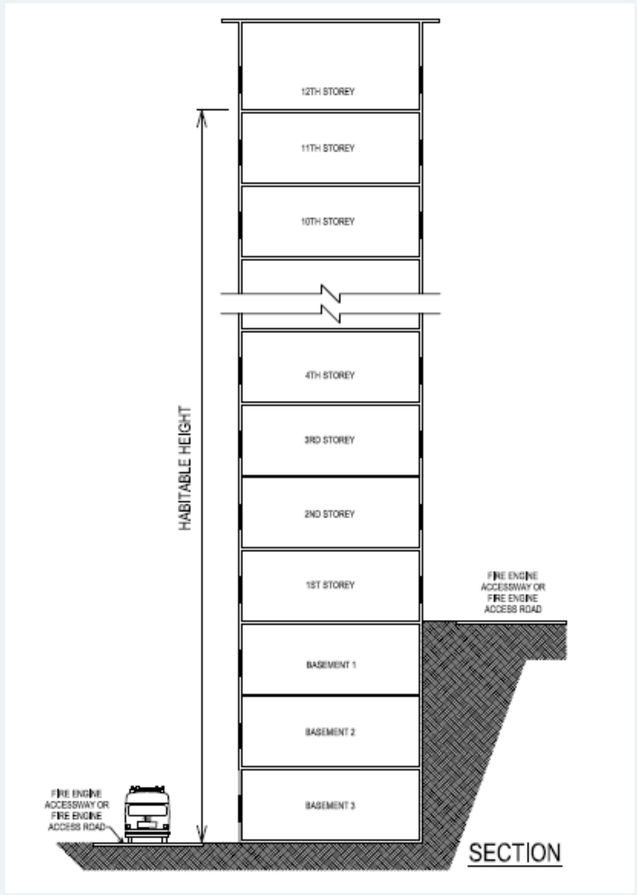
Figure 1.4.64 - 2

In all other situation where the floor level has a functional usage in a room or open to sky, it will be a habitable floor.

"Habitable floor" refers to all floors in a building, including the roof level. The roof level can be taken as non-habitable if it is not used for any purpose/ activity other than housing M&E plants/ equipment, e.g. lift motors, fire pumps, generators, fire hose reel pumps, water supply pumps, water tanks, cooling towers, solar photovoltaic panels, supply/ exhaust fans with associated ductwork, air-con condensing units, telecommunication equipment, satellite dishes, public warning sirens, green roofs inaccessible to public and for maintenance access only, etc

1.4.65 Habitable height

Explanation and Illustrations



Section

Figure 1.4.65 : Habitable height

Habitable height of a building is measured from the lowest level of fire engine accessway/fire engine access road serving the building to the finished floor level of the highest habitable floor. Where attic is permitted under *Cl.9.2.1b.(2)* and located on the highest floor, the habitable height shall be extended to the finished floor level of the attic. Habitable height is used to determine the provision of fire protection system and other related requirements to a building. If the habitable height of a building exceeds 24m, the following shall be provided:

(a) Rising mains

(b) Sprinkler system*

(c) Fire lift/Fire command centre*

(d) Voice communication system*

(e) Alarm system

(f) Pressurisation of internal exit staircases

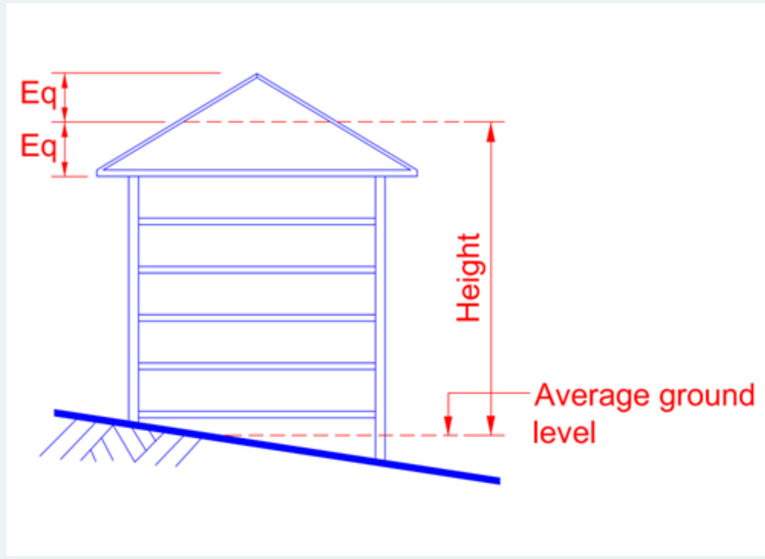
Note :

*not required for PG II building, unless requested by the SCDF

"Habitable height" refers to the height measured from the level of fire engine accessways or fire engine access roads, whichever is the lowest, to the finished floor level of the highest habitable floor.

1.4.66 Height of building

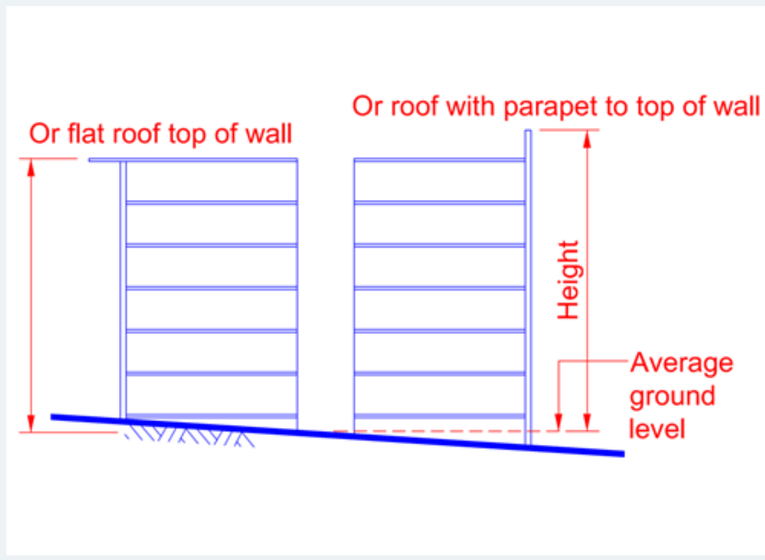
Explanation and Illustrations



Section

Figure 1.4.66 - 1

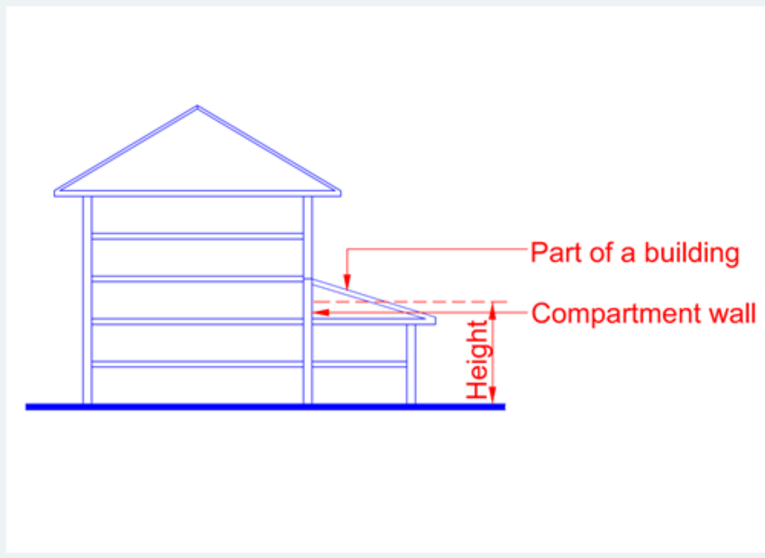
Average ground level to half the vertical height of the pitch roof



Section

Figure 1.4.66 - 2

Average ground level to flat roof and the top of walls of parapet



Section

Figure 1.4.66 - 3

Average ground level to half the vertical height of the pitch roof of a part of a building

"Height of building" refers to the vertical distance measured from the average level of the ground adjoining the outside of the external walls of the building to the level of half the vertical height of the roof of the building or part, or the top of the walls or of the parapet (if any), whichever is higher.

1.4.67 High containment facility

"High containment facility" refers to containment laboratory, including the interstitial space, waste treatment area, anteroom, etc.) of Bio-safety Level 3 [BSL-3] and maximum containment laboratory of Bio-safety Level 4 [BSL-4] as defined in the WHO Laboratory Bio-Safety Manual. They are designed to comply with the requirements of WHO and authorities having jurisdiction for storing or handling of biological agents.

1.4.68 High hazard occupancy

"High hazard occupancy" refers to any occupancy in which the contents or activities include one or more of the following:

a. materials with auto-ignition temperature lower than 200°C, or

b. materials that produce poisonous, noxious fumes, or flammable vapour, or

c. materials that cause explosions, or

d. high hazard occupancies stipulated under *SS CP 52*, or

e. highly combustible substances and/ or flammable liquids.

1.4.69 Hospital

"Hospital" is a building used for medical and surgical care and shall include healthcare facilities with 24-hr or inpatient services, such buildings include the following:

a. General hospitals;

b. Psychiatric hospitals (Institute of Mental Health)

c. Children/ Women hospitals; and

d. Community hospitals.

1.4.70 Load-bearing wall

"Load-bearing wall" refers to a wall which supports any load in addition to its own weight.

1.4.71 Masonry

"Masonry" refers to brick or concrete construction.

1.4.72 Mechanical ventilation

"Mechanical ventilation" refers to any system that uses mechanical means such as ventilation fan, to introduce outdoor air to a space when natural ventilation mode cannot be achieved during normal and fire emergency situations. This includes supply ventilation, exhaust ventilation, pressurisation, smoke purging, mechanical engineered smoke control systems, balanced systems that consist of both supply and exhaust ventilations, etc.

1.4.73 Non-combustible material

Explanation and Illustrations

(No illustration)

Material can also be considered as non-combustible or limited combustibility achieving Class "A1" or "A2" in accordance with EN 13501 classification.

"Non-combustible material" refers to any material which neither burns nor gives off flammable vapour in sufficient quantity to ignite when subjected to the test for combustibility prescribed in *BS 476 Part 4*, and includes materials of limited combustibility, such as:

a. any material of density 300kg/m^3 or more, which when tested in accordance with *BS 476: Part 11*, does not flame, and the rise in temperature on the furnace thermocouple is not more than 20°C;

b. any material with a non-combustible core at least 8mm thick having combustible facings (on one or both sides) not more than 0.5mm thick; and

c. any material of density less than 300kg/m^3, which when tested in accordance with *BS 476: Part 11*,

(1) does not flame for more than 10 sec;

(2) the rise in temperature on the centre (specimen) thermocouple is not more than 35°C; and

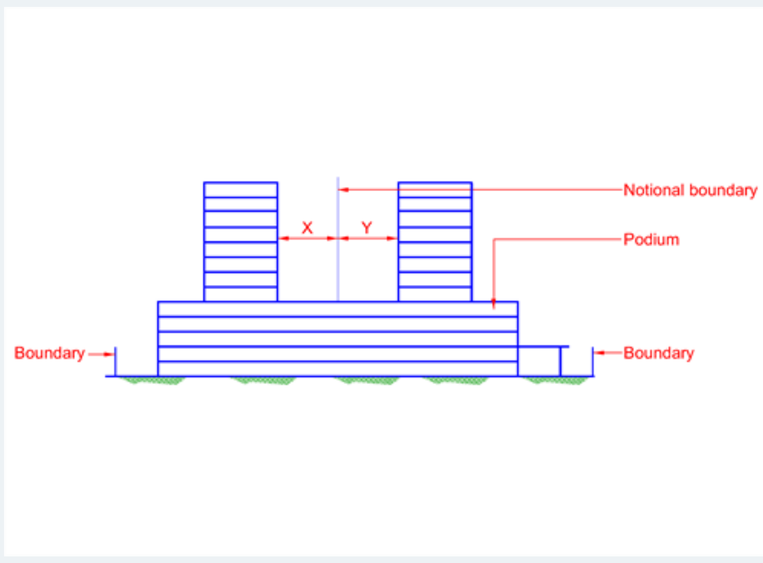
(3) the rise in temperature on the furnace thermocouple is not more than 25°C.

1.4.74 Non-load-bearing wall

"Non-load-bearing wall" refers to a wall which supports no load other than its own weight.

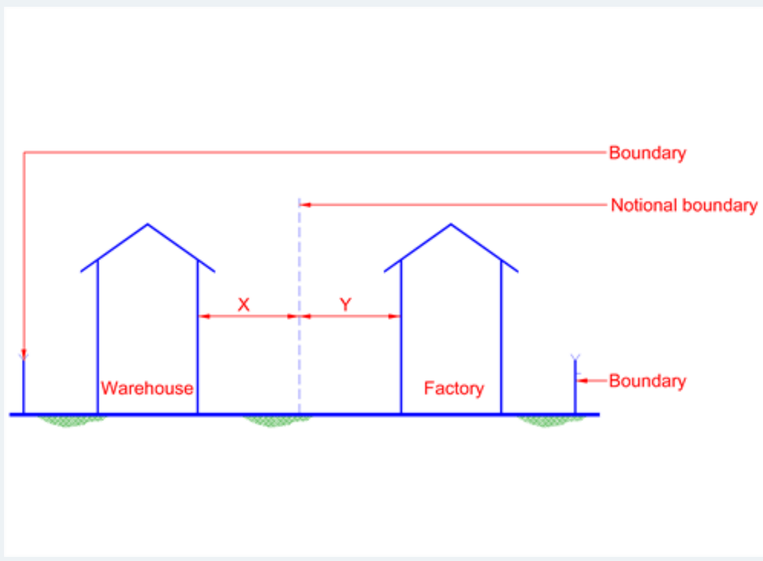
1.4.75 Notional boundary

Explanation and Illustrations



Section

Figure 1.4.75 – 1 : Notional boundary between 2 tower blocks, either sitting on podium deck or ground level



Section

Figure 1.4.75 – 2 : Notional boundary between a warehouse and factory sited within a development plot of land bounded by common boundaries

The extent of unprotected openings e.g. windows in the external wall of a building is controlled by the space separation between the building and the boundary. The greater the building setback, the higher the extent of unprotected openings that would be allowed in the external wall. This is to address the concern of spread of fire from one building to another. The use of the boundary instead of another building makes it possible to work out the extent of unprotected openings even where another building does not exist.

In some situations, the distance to other building on the same site needs to be considered to prevent spread of fire. This is done by assuming a boundary called notional boundary. A notional boundary should be so situated that all buildings comply with the safe distance requirements as annotated in X and Y in the above diagrams. The boundary, which a wall faces (at an angle of 80° or less) whether it is the boundary of the site or a notional boundary is called the relevant boundary.

In the diagram, if the total setback distance for warehouse and factory is more than or equal to X + Y, then the setback distance is considered complied with provided that both buildings are within the same lot.

"Notional boundary" refers to an imaginary boundary which exists at equal distance between buildings on the same site, or the centre of the width of a public road/ drain/ sewer reserve, provided that the boundary is fronting the respective reserves.

1.4.76 Nursing care facility

'Nursing care facility' refers to a building, or part thereof, used for the housing and nursing care of persons on a 24-hr basis who, because of physical incapacity, may be unable to care for their own needs and safety without assistance of other persons. These facilities provide inpatient medical care and include the followings:

a. Nursing homes;

b. Convalescent homes; and

c. Hospice.

1.4.77 Occupant load

Explanation and Illustrations

(No illustration)

(a) *Table 1.4B* gives a range of occupant load factors. To calculate the occupant load of a floor space for example an office, apply the formula:

Occupant load
= Floor area office (1000m^2) / Occupant load factor for office (10m^2)
= 1000m^2 / 10m^2/person
= 100 persons

(b)

(i) The occupant load for theatre or cinema where there is fixed seating, the posted occupant load based on number of seats can be taken.

(ii) The back stage areas shall be separately calculated based on floor area.

(iii) Where there are spaces provided for flexible seating, the occupant load for these spaces shall be separately calculated based on floor area.

"Occupant load" of a building, or part thereof, refers to the total number of persons that can occupy such a building, or part thereof, at any one time. The "occupant load" shall be determined by:

a. multiplying the floor area(s) available for occupation with the appropriate areas per person as stated in Table 1.4B, unless prior approval is obtained from SCDF for any other occupancy load factors not stated in this table, or

b. the number of fixed seating, if applicable, for assembly occupancies.

1.4.78 One-way travel

"One-way travel" refers to a situation where occupants within a space can only travel in a single route/ direction, from the most remote point, to an exit or a splitting point to reach multiple exits.

1.4.79 Outdoor Display Area (ODA)

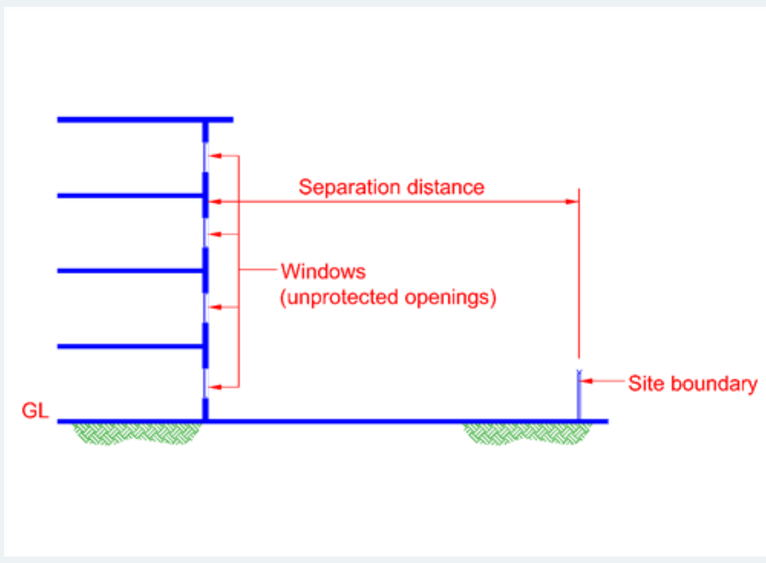
"Outdoor display area" refers to an area along the common walkways in front of their shops where the shop owner/ operator displays his merchandises. The area can be open- to-sky, covered or roofed-over with extended awning/ canopy.

1.4.80 Outdoor Refreshment Area (ORA)

"Outdoor refreshment area" refers to an area along the common walkways in front of their eating houses, restaurants, coffee shops, hawker centres, fast food outlets, cafeterias, canteens, pubs, bars and the like by their respective food & beverage outlet's owner/ operator. The area can be open-to-sky, covered or roofed-over with umbrella or extended awning/ canopy.

1.4.81 Permitted limit of unprotected area

Explanation and Illustrations



Section

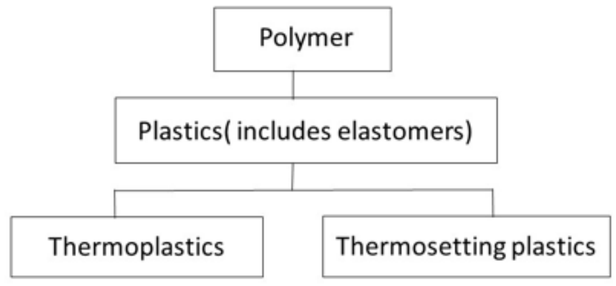
Figure 1.4.81 : Permitted limit of unprotected area

The main concern of unprotected openings in external walls is to ensure that spread of fire through heat radiation from one building to another would be minimised. However, Cl.3.5.3 does permit relaxation for buildings, which are sprinkler-protected or solely used as car parks.

"Permitted limit of unprotected area" refers to the maximum aggregate area of unprotected areas in any side or external wall of a building or compartment

1.4.82 Plastic

"Plastic" refers to any group of organic materials which, though stable in use at ambient temperatures, are plastic at some stage in their manufacture and then can be shaped by the application of heat and/ or pressure. Plastics can be categorised as either thermoplastics or thermosetting plastics.



Categorisation of plastics

1.4.83 Pressurisation

"Pressurisation" refers to a mechanical ventilation system that introduce positive differential pressure to a space/ room to prevent smoke ingress during a fire emergency.

1.4.84 Private lift

Explanation and Illustrations

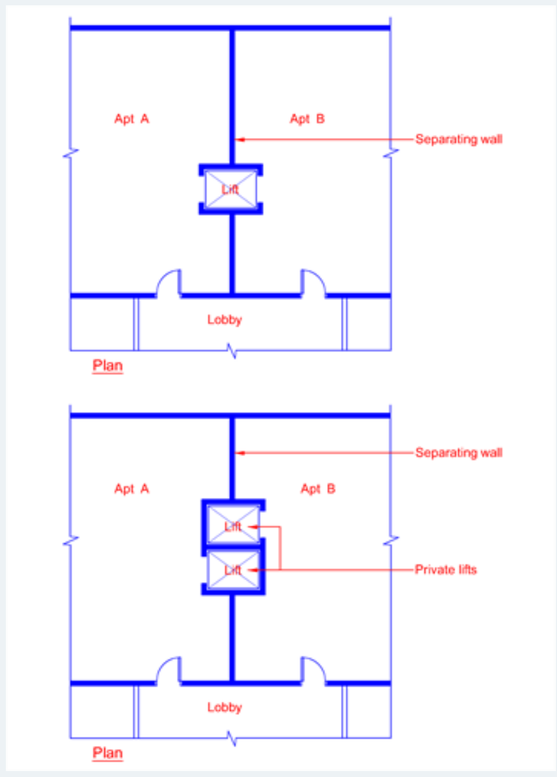


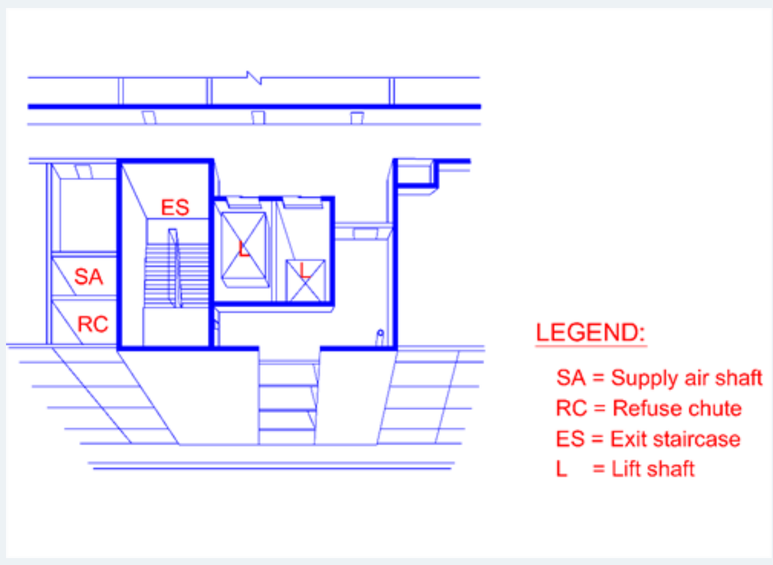
Figure 1.4.84 : Private lift

Emergency power supply from a generating plant shall be provided to home the privates lifts to the designated/alternate designated floor during a power failure or fire emergency in the building. See *Cl.3.8.8h.* for more information.

"Private lift" refers to a passenger lift which is meant for the exclusive use of occupants in the building, and is located to open its door directly into private enclosed spaces. Vehicle lifts, home lifts and stair lifts are not considered private lifts.

1.4.85 Protected shaft

Explanation and Illustrations



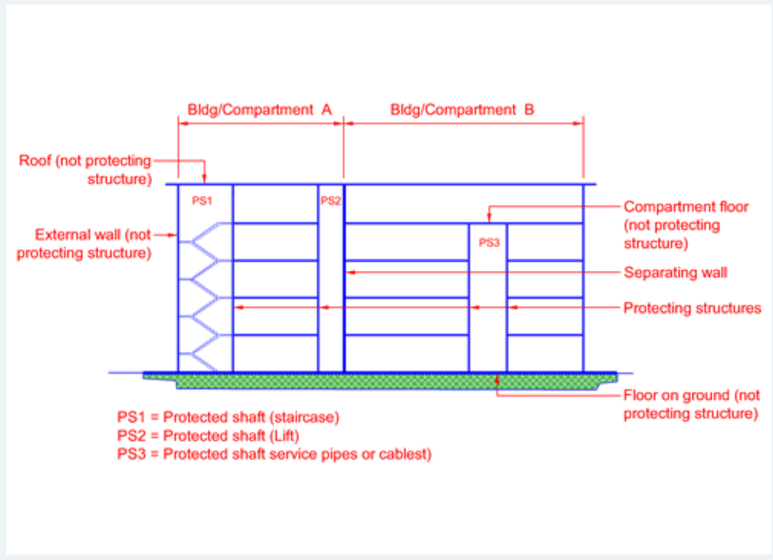
Axonometric Section

Figure 1.4.85 : Protected shaft

"Protected shaft" refers to an exit staircase, exit passageway, lift, chute, duct or other shaft which enables persons, things or air to pass from one compartment to another.

1.4.86 Protecting structure

Explanation and Illustrations



Section

Figure 1.4.86 : Protecting structure

There is a need to differentiate protecting structure to shaft from other elements of structures such as compartment walls, separating walls and external walls. This is for the purpose of working out differently the necessary period of fire resistance rating to the protecting structures. For example, Cl.3.8.6 permits door to protected shaft to have ½ the period of fire resistance rating of the enclosing protecting structures to an exit staircase.

"Protecting structure" refers to a wall, floor or other part of the building which encloses a protected shaft. The following are not considered protecting structure:

a. a wall which also forms part of an external wall, separating wall or compartment wall, or

b. a floor which is also a compartment floor or a floor laid directly on the ground, or

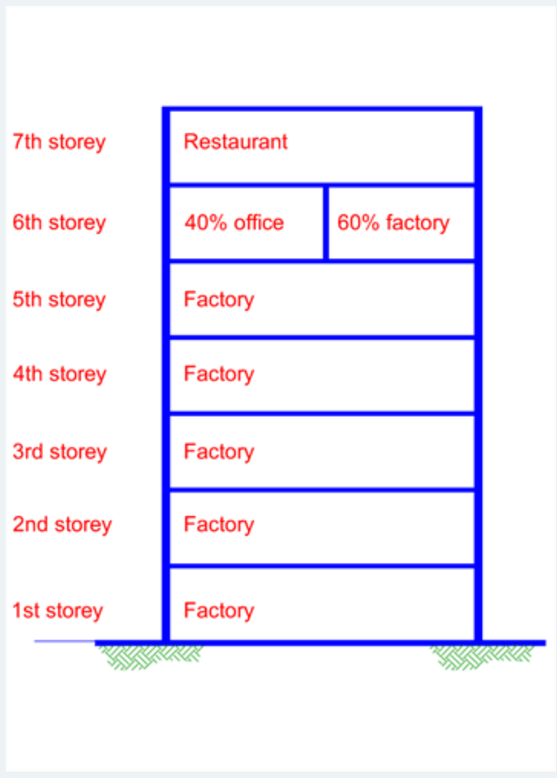
c. a roof.

1.4.87 Purpose Group (PG)

Explanation and Illustrations

(a) For the purpose of complying with fire safety requirements under this Code, every building or compartment shall be treated according to its use or intended use as prescribed under *Table 1.4A*.

(b) Flatted factory building



Section

Figure 1.4.85

Each floor is a compartment with 6th storey being further divided into 2 compartments, having 40% office and 60% factory use. The main purpose of use of 6th storey is factory, thus 6th storey is to be treated as factory use. Similarly, a building may have shops, offices and restaurants, but it is classified as shopping centre as the main purpose of use of the building is shopping.

(c) Townhouses

Under the Fire Safety (Exemption) order, proposal for detached, semi- detached, terraced and linked houses which do not exceed 3 storeys or levels, including basement or attic are not required to be submitted to the SCDF for approval. The Qualified Person in charge of the project shall self-regulate to ensure that all relevant fire safety requirements are complied with on site. However, townhouses, which are treated as under PG I for the purpose of complying with fire safety requirements that are applicable to detached, semi-detached terraced and linked houses, are not covered by the Fire Safety (Exemption) Order, hence, submission of plans to the SCDF is required.

(d) Serviced apartments/maisonettes

Serviced apartments/maisonettes would be treated as hotels or boarding houses under PG VII at the outset. However, the SCDF may consider to reclassify it under PG II if the floor layout of the units and escape corridors is similar to that of a typical apartments/maisonettes building.

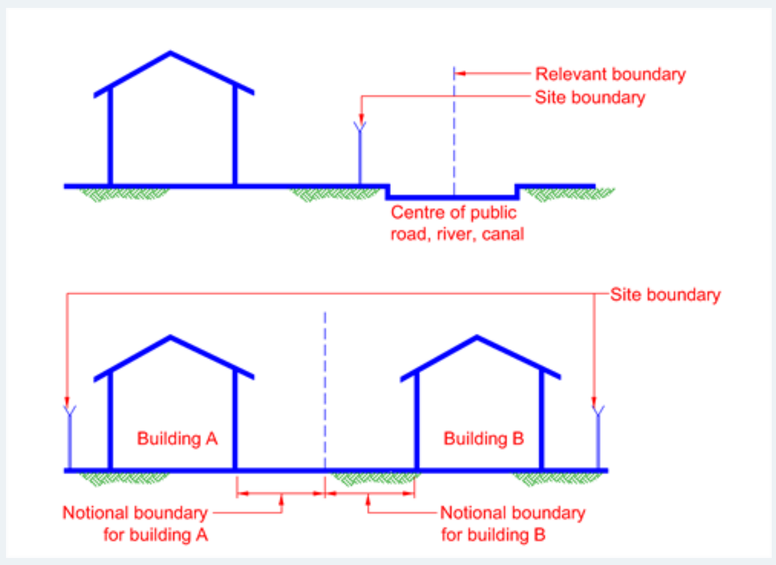
"Purpose Group" refers to the categorisation of buildings in this Code, with the aim of specifying relevant fire safety criteria for that building type. Where a building is divided into compartments used for different purposes, the purpose group of each compartment shall be determined individually, provided that where the whole or part of a building or compartment is used for more than one purpose, only the main purpose of that building or compartment shall be taken into account in determining into which purpose group it falls. See *Table 1.4A*.

1.4.88 Refuge floor

"Refuge floor" refers to a floor adequately separated from the rest of the building by fire-resisting construction. It serves as an area where evacuees can temporarily take refuge for buildings with long vertical evacuation routes to the building's external space.

1.4.89 Relevant boundary

Explanation and Illustrations



Section

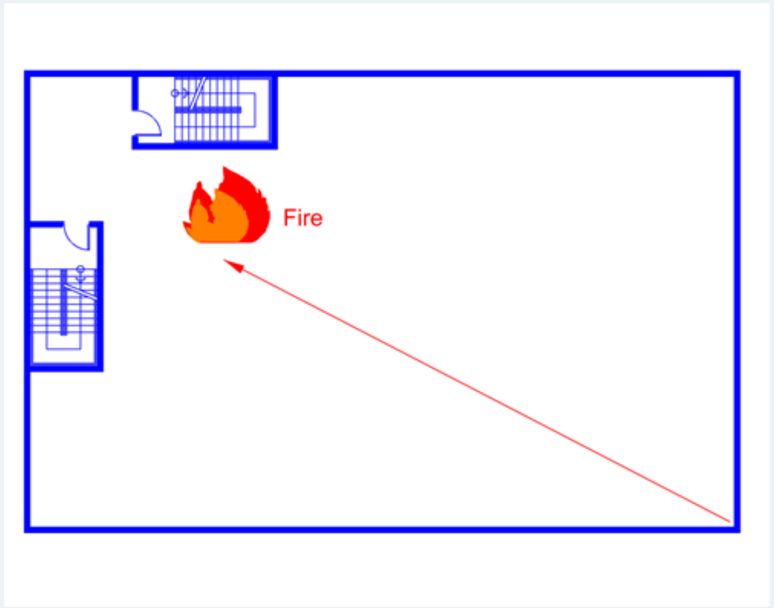
Figure 1.4.89 : Relevant boundary

The boundary which a side or external wall of a building faces whether it is the boundary of the site or a notional boundary is called the relevant boundary.

"Relevant boundary" refers to the lot boundary in relation to a building's external wall or compartment. For the purpose of unprotected openings setback calculation, it may also be the notional boundary.

1.4.90 Remoteness of exits

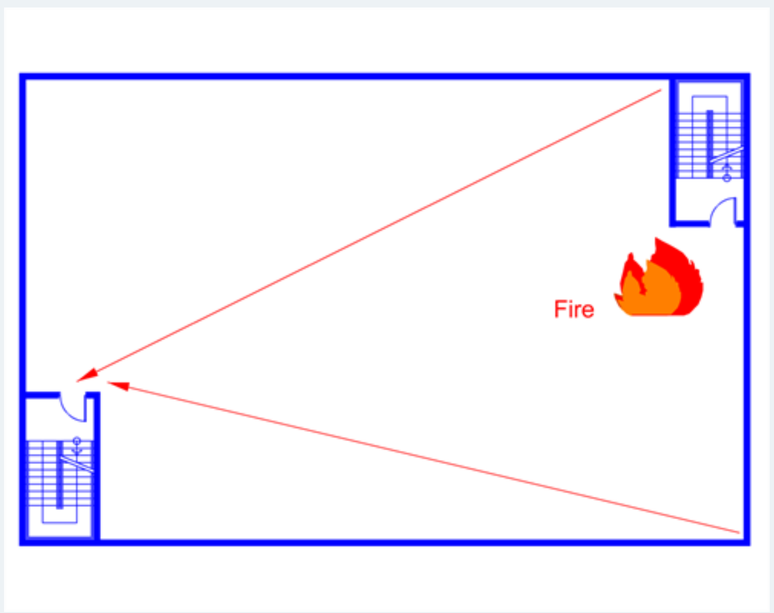
Explanation and Illustrations



Incorrect

Figure 1.4.90 - 1

Incorrect : Access to the protected staircases will be blocked by a fire occurring in the vicinity of the staircase.



Correct

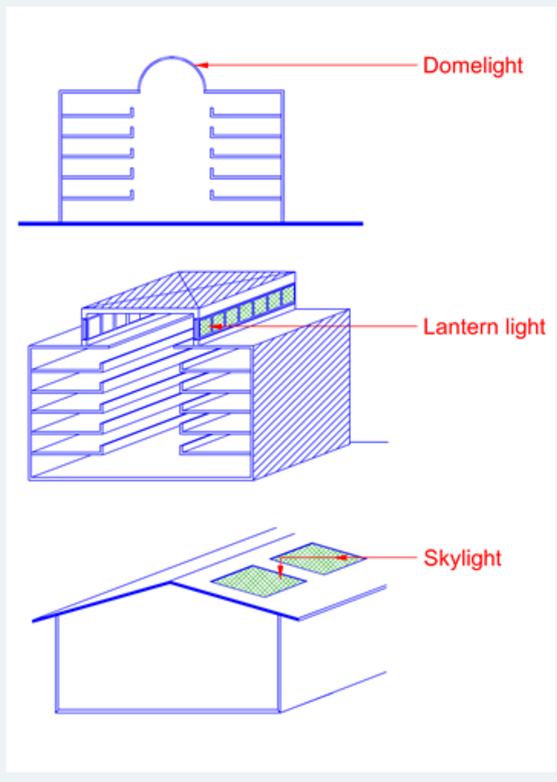
Figure 1.4.90 - 2

Correct : Access to an alternate staircase is available if a fire occurred in the vicinity of the exit door to one of the staircases.

"Remoteness of exits" refers to exits which are remotely located from each other, arranged and constructed to minimise the possibility that more than one would be rendered unusable during a fire, or other emergency conditions.

1.4.91 Roof light

Explanation and Illustrations



Top Figure : Section

Middle Figure : Axonometric Section

Bottom Figure : Axonometric view

Figure 1.4.91 : Roof light

Rooflights are part of roof coverings, which permit light to enter a building to provide natural lighting. Rooflights could be designed to be openable by automatic devices to provide the necessary openings for smoke venting. The inner surface of dome light and skylight is considered as ceiling for the purpose of meeting the class of surface flame spread under *Cl.3.13.5b.*.

"Roof light" refers to any elements in a roof intended to admit daylight.

1.4.92 Room

Explanation and Illustrations

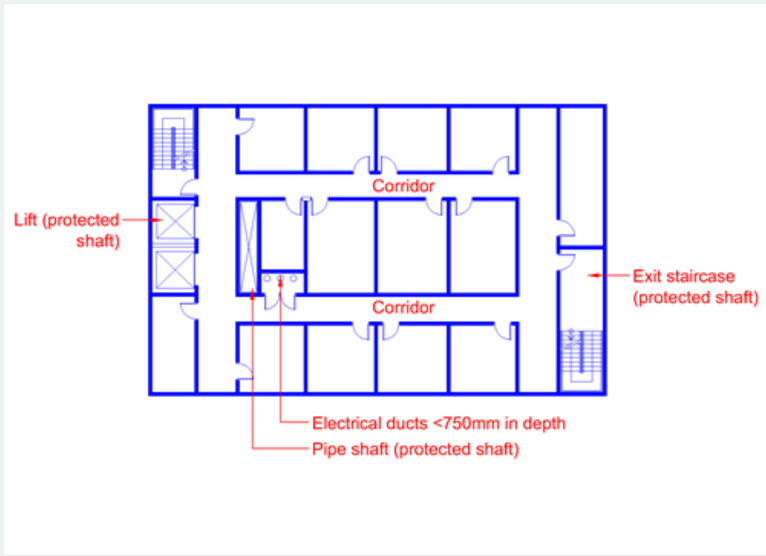


Figure 1.4.92 - 1 : Enclosed space

An enclosed space not considered as a room. This includes exit staircase (protected shaft), enclosed circulation space such as A/C, MV shafts, pipe/cable shafts and accessible electrical ducts not exceeding 750mm in depth.

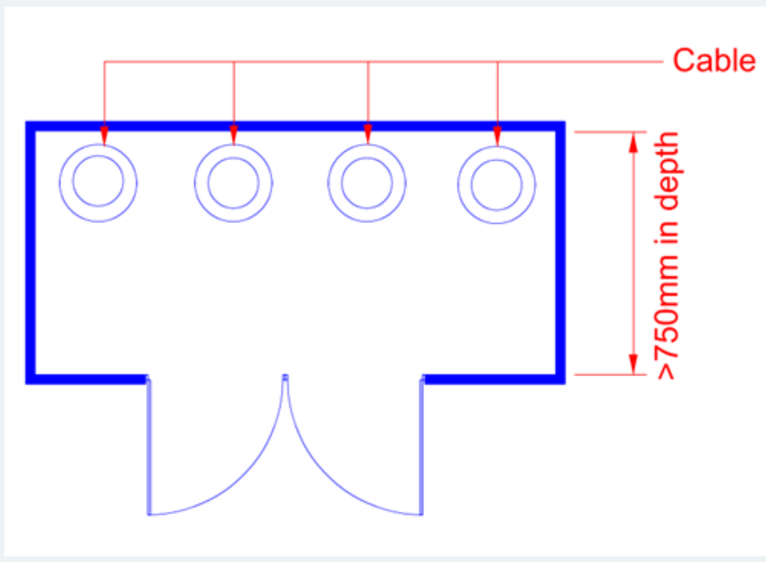


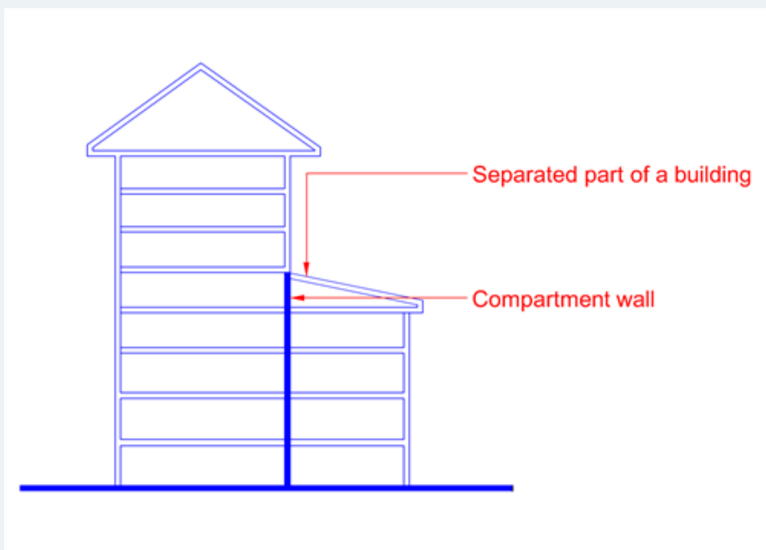
Figure 1.4.92 - 2 : Electrical riser

An electrical riser having a depth of >750mm is considered a room.

"Room" refers to an enclosed space bounded by walls that is not an enclosed circulation space or protected shaft at most 750mm in depth.

1.4.93 Separated part (of a building)

Explanation and Illustrations



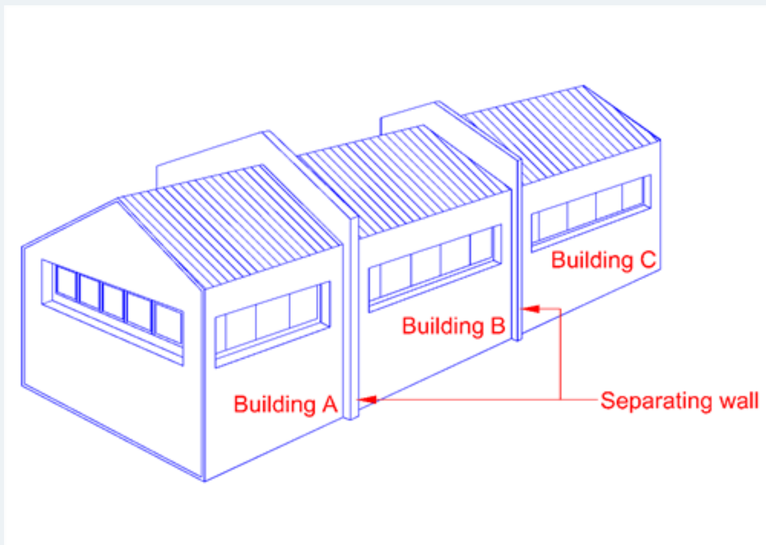
Section

Figure 1.4.93 : Separated part of a building

"Separated part" refers to a form of compartmentation from another part of the same building by a compartment wall which runs full height of the part and is in one continuous plane.

1.4.94 Separating wall

Explanation and Illustrations



Axonometric view

Figure 1.4.94 : Separating wall

"Separating wall" refers to a wall used to divide or portion adjoining buildings under different ownership.

1.4.95 Setback distance

"Setback distance" refers to the distance between a building and its relevant boundary, which is meant for the purpose of preventing fire spread between buildings/ properties.

1.4.96 Singapore Civil Defence Force (SCDF)

"Singapore Civil Defence Force" refers to the Commissioner of Singapore Civil Defence Force and includes officers authorised by him generally or specifically to exercise the powers, functions and duties conferred by the Fire Safety Act.

1.4.97 Single point emergency lighting

"Single point emergency lighting" refers to an emergency lighting system employing self-contained emergency luminaires

1.4.98 Smoke-check door

Explanation and Illustrations

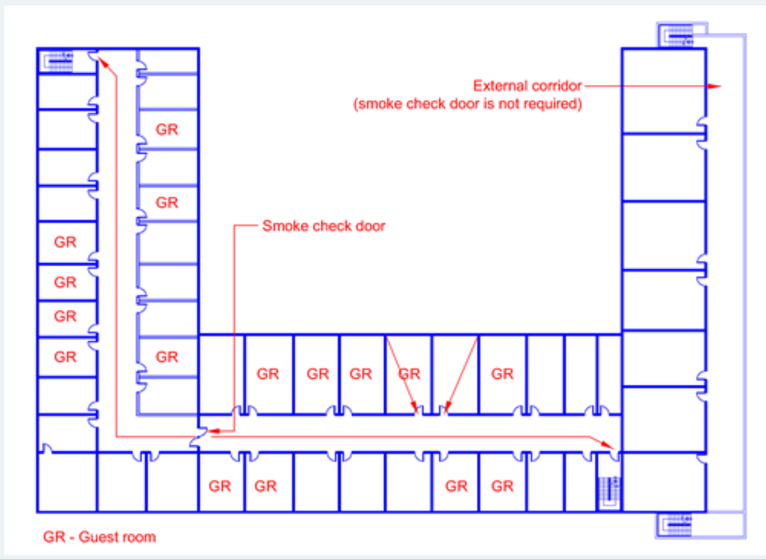


Figure 1.4.98 : Smoke-check door

The provision of smoke-check door is applicable to hotel occupancy. It is provided to subdivide the internal corridor to the hotel guest rooms floor into the following lengths:

(a) Building protected by sprinkler system --- 45m

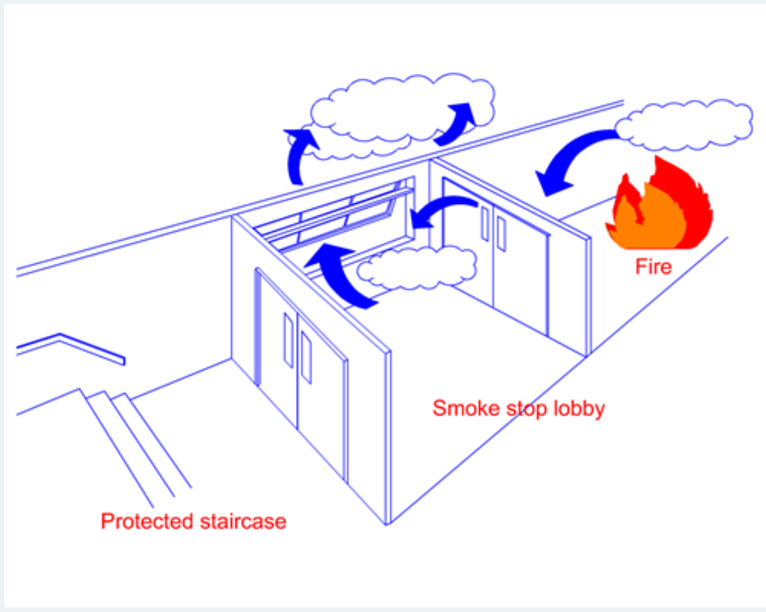
(b) Building not protected by sprinkler system --- 30m

Internal corridors which are not naturally ventilated shall be subdivided by smoke barrier and smoke-check door to prevent the whole corridor being filled with smoke very quickly should there be any migration of smoke from any guestroom. Smoke-check door is not required to have fire resistance rating.

"Smoke-check door" refers to a door or set of doors placed in an internal corridor to restrict the spread of smoke by reducing draft.

1.4.99 Smoke-free lobby

Explanation and Illustrations



Axonometric view

Figure 1.4.99 : Smoke-stop lobby

If smoke which finds its way into the smoke-stop lobby, the natural ventilation provided by the window will help to prevent the smoke from infiltrating into the protected staircase. In the case of mechanical ventilated smoke-stop lobby, smoke will be prevented from entering the lobby by the exertion of air pumped into it by the air shaft.

"Smoke-free lobby" refers to a lobby located at the entrance of an exit staircase. It is designed to help prevent or minimise the entry of smoke into the staircase.

1.4.100 Storey

"Storey" refers to any floor or part thereof, including platforms, mezzanines, attic levels and M&E floors.

1.4.101 Super high-rise residential building

"Super high-rise residential building" refers to a residential building with more than 40 storeys/ levels.

1.4.102 Supervisory care facility

"Supervisory care facility" refers to a building or part thereof, used for the housing, on a 24-hr basis, of mental health patients, natal cares, aged and individuals under welfare cares, who may be capable of self-preservation but require supervision and are receiving therapy, training or other health-related care and for whom there may be security measures not under their control. Such facilities shall include the followings:

a. Homes for intellectually disabled;

b. Psychiatric rehabilitation homes;

c. Dementia homes;

d. Pre/ post natal care centres; and

e. Welfare homes.

1.4.103 Tenancy unit

Explanation and Illustrations

Figure 1.4.103 : Tenancy unit

"Tenancy unit" refers to an individual unit or subdivided unit within a building or a compartment, and which is managed by a different operator registered with the authority having jurisdiction.

1.4.104 Thermoplastics

"Thermoplastic" refers to a class of plastic materials that is capable of being repeatedly softened by heating and hardened by cooling. A material can be considered as thermoplastic if it is a synthetic polymeric material which has a softening point below 200°C when tested to *BS EN ISO 306 Method A120 Plastics– Thermoplastic materials – Determination of Vicat softening temperature*.

1.4.105 Thermosetting plastic

"Thermosetting plastic" refers to a class of plastic materials that will undergo a chemical reaction by the application of heat, pressure, catalysts, etc., leading to a relatively infusible, non-reversible state.

1.4.106 Toxin

"Toxin" refers to the toxins stipulated in the Fifth Schedule of the Biological Agents and Toxins Act.

1.4.107 Travel distance

Explanation and Illustrations

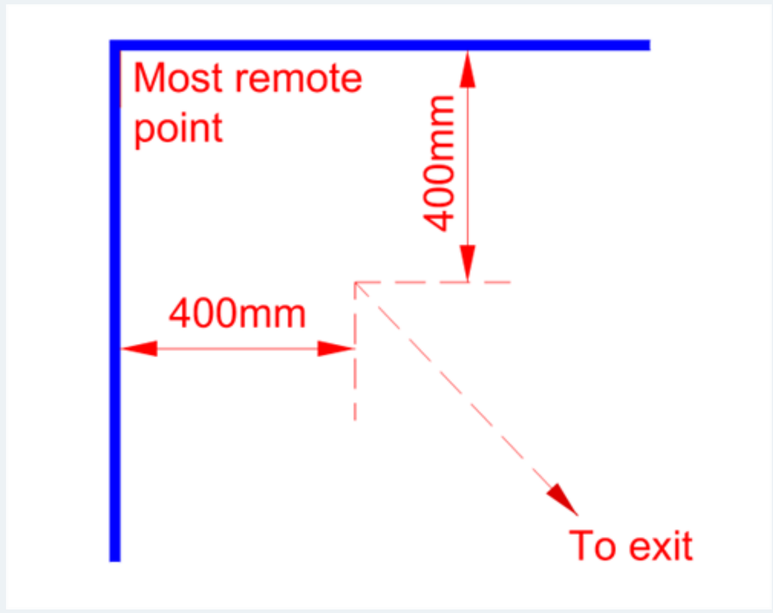


Figure 1.4.107 – 1

Measurement starts at 400mm from enclosure of wall.

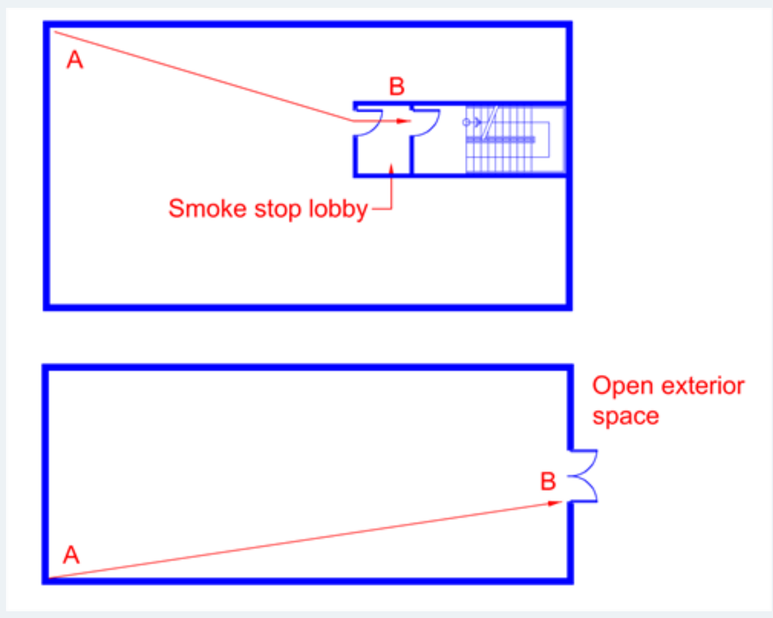


Figure 1.4.107 – 2

Travel distance from the most remote point to open exterior space. Travel distance shall be measured to the door of the exit staircase i.e. from point A to B.

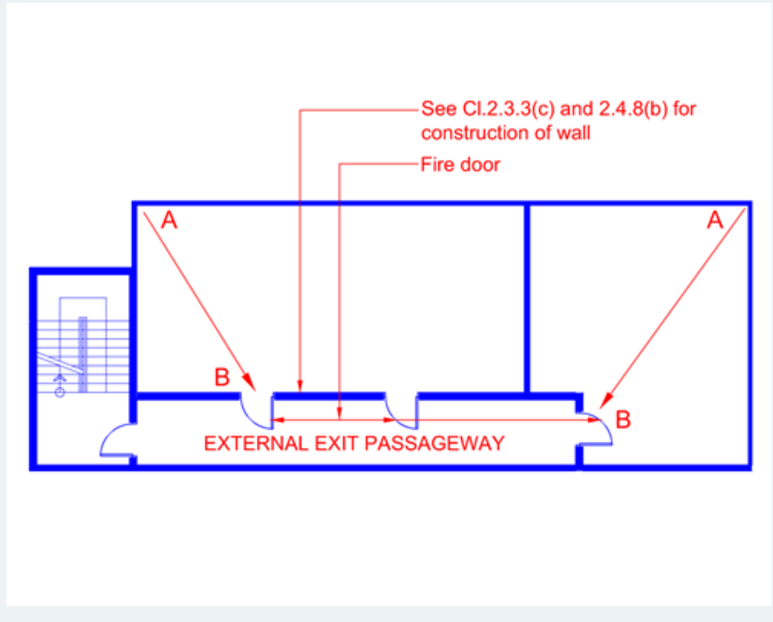


Figure 1.4.107 – 3

Travel distance from the most remote point to an external exit passageway (i.e. from point A to B).

"Travel distance" refers to the distance required to be traversed from the most remote point in any room or space to the edge of a door opening, directly to:

a. an exit staircase, or

b. an exit passageway, or

c. an open external space,

unless otherwise permitted under this Code as in the case of residential apartments, maisonettes and exits to areas of refuge.

1.4.108 Two-way travel

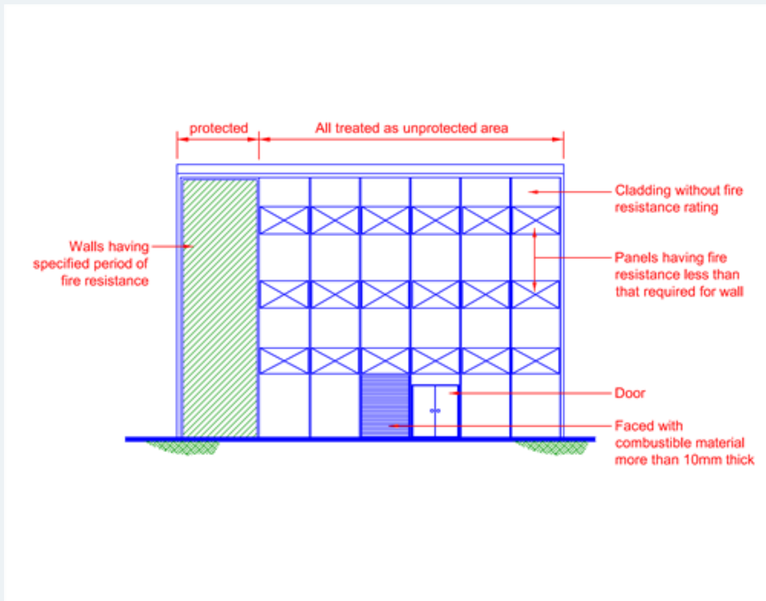
"Two-way travel" refers to a situation where occupants within a space have the choice of more than one route/direction from a splitting point to reach multiple exits.

1.4.109 Unmanned building

An "unmanned building" refers to a building which is not manned by operation or security personnel after office or operating hours.

1.4.110 Unprotected area

Explanation and Illustrations



Elevation

Figure 1.4.110 : Unprotected area

"Unprotected area", in relation to a side or external wall of a building, refers to:

a. a window, door or other opening;

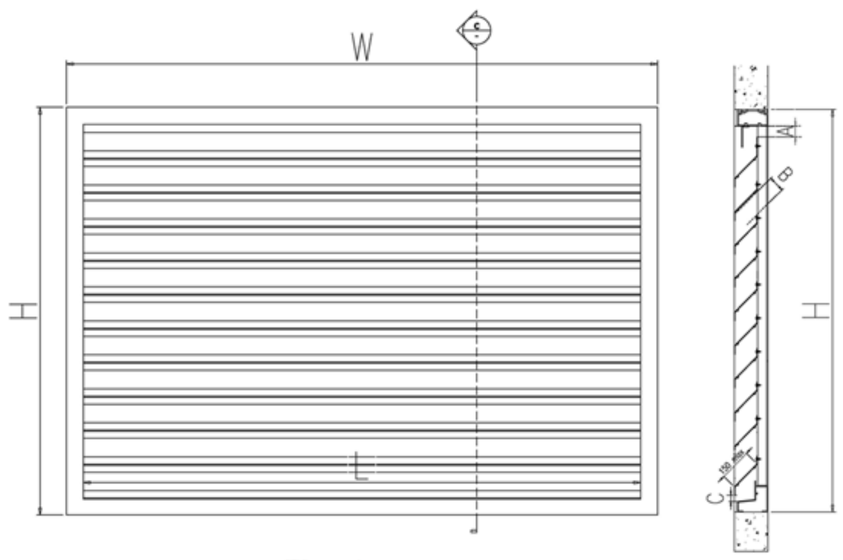
b. any part of the external wall which has less than the relevant fire resistance; and

c. any part of the external wall which has combustible material more than 1mm thick attached or applied to its external face, whether for finishes or any other purpose.

1.4.111 Ventilation openings

"Ventilation openings" refer to fixed natural ventilation openings located in external walls for any space, which shall be unobstructed at all times, and exclude windows or louvres that are openable or operable. The fixed louvres shall consist of a single bank of louvres with blade width not exceeding 150mm, with effective ventilation openings calculated based on the free area calculation stated below:

Ventilation opening size for single bank louvres = Free Area = L [A + C + (B x n)]

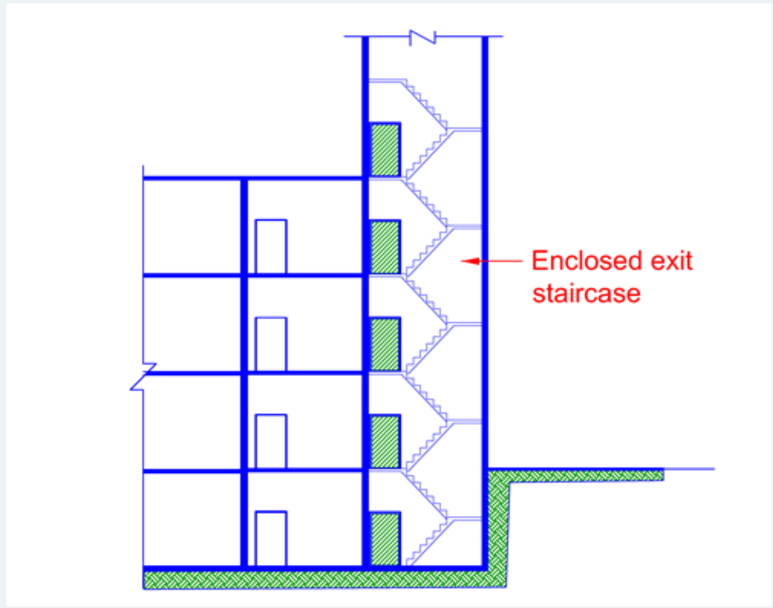


Elevation **Section C**

A = Min opening distance between the top frame and top blade
C = Min distance between the sill and bottom blade
B = Min distance between blades
n = Number of B openings
L = Min distance between louvres jambs

1.4.112 Vertical exit

Explanation and Illustrations



Section

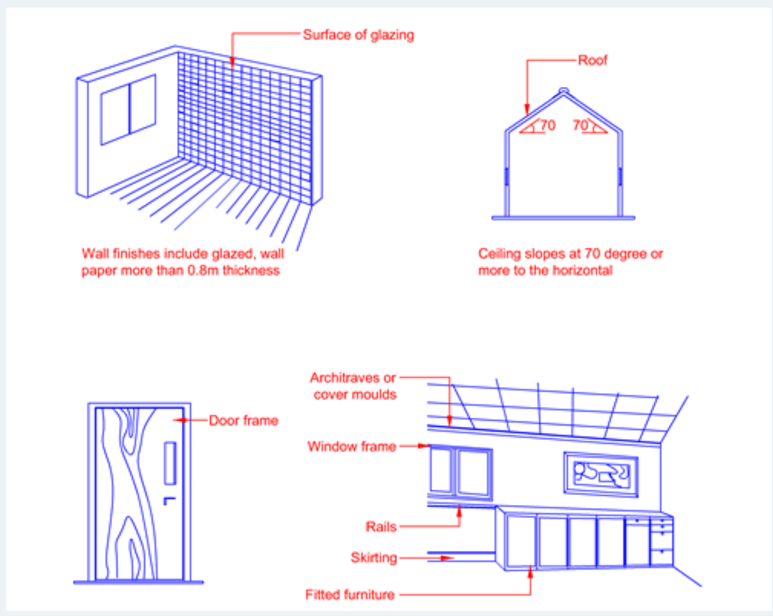
Figure 1.4.112 : Vertical exit

The protecting structure, excluding external wall of exit staircase or exit ramp shall be constructed of masonry.

“Vertical exit” refers to an exit staircase or exit ramp which serves as a required exit from one or more storeys above or below ground level.

1.4.113 Wall surface

Explanation and Illustrations



Top Figure : Includes

Bottom Figure : Excludes

Figure 1.4.113 : Wall surface

“Wall surface”, in the context of internal surfaces, refers to the surface of glazing, and any part of the ceiling sloping at an angle of 70° or more to the horizontal. It does not include:

a. door frames and unglazed parts of doors, or

b. window frames and frames in which glazing is fitted, or

c. architraves, cover moulds, picture rails, skirtings and similar narrow members, or

d. fitted furniture.

1.4.114 Workers’ dormitories

Explanation and Illustrations

Figure 1.4.111

Owing to different uses and risks, cooking is not allowed in the dormitory, which is meant for resting and sleeping. All cooking activities shall be carried out in the kitchen. This will eliminate the risk of fire occurring in any dormitory arising from cooking activities.

“Workers’ dormitories” refers to buildings or spaces in buildings where group sleeping accommodation is provided for workers.

RELATED TABLES AND DIAGRAMS OF CHAPTER 1

TABLE 1.2A : CODES & STANDARDS

TABLE 1.2A : CODES & STANDARDS		
Name	**Description**	**Remarks**
SINGAPORE STANDARDS		
SS CP 52	CoP for Automatic Fire Sprinkler System	
SS 99	Specifications for Welded Low Carbon Steel Cylinders for Storage and Transportation of Low-Pressure Liquefiable Gases	
SS141	Specification for Unplasticised PVC pipe for Cold Water Services and Industrial Uses	
SS 213	Unplasticised PVC Pipes and Fittings for Soil, Waste and Vent Application	
SS 232 Pt 1 to 6	Portable Fire Extinguishers	Replaced by SS EN 3 - 7 to 10
SS 233	Specifications for Flexible Rubber Tubing, Rubber Hose and Rubber Hose Assemblies for Use in LPG Vapour Phase Installations	
SS 254	Electrical Apparatus for Explosive Gas Atmospheres	Replaced by IEC 60079
SS 263 Pt 2	Luminaires - Particular Requirements for Luminaires for Emergency Lighting	Replaced by IEC 60598-2-22
SS 281	Specifications for Pressure Regulators for LPG	
SS 286	Caution Labelling for Hazardous Substances	Replaced by SS 586
SS 294	Specifications for Valves for Use with Domestic and Industrial LPG Cylinders	
SS 299	Fire Resistant Cables	
SS 332	Specification for Fire Door	
SS 333	Specification for Fire Dampers	
SS 489	Specification for Fire Shutters	
SS 508	Graphical Symbols - Safety Colours & Safety Signs	Formerly SS 217 & SS 364
Pt 1	Design Principles for Safety Signs & Safety Markings	
Pt 2	Design Principles for Product Safety Labels	
SS 512	CoP for the design, construction and operation of pipeline service corridors	
SS 532	CoP for the Storage of Flammable Liquids	Formerly CP 40
SS 535	CoP for Installation, Operation, Maintenance, Performance Constructional Requirements of Mains Failure Standby Generating Systems	Formerly CP 31
SS 546	CoP for Emergency Voice Communication Systems in Buildings	Formerly CP 25
SS 550	CoP for Installation, Operation and Maintenance of El Passenger and Goods Lifts	Formerly CP 2
SS 551	CoP for Earthing	Formerly CP 16
SS 563	CoP for the Design, Installation & Maintenance of Em Lighting and Power Supply Systems in Building	Formerly CP 19
Pt 1	Emergency lighting	
Pt 2	Installation Requirements and Maintenance Procedures	
SS 572	CoP for the Use of Timber in Buildings	Formerly CP 1
SS 575	CoP for Fire Hydrant, Rising Mains and Hose Reel System	Formerly CP 29
SS 578	CoP for the Use and Maintenance of Portable Fire Extinguishers	Formerly CP 55
SS 586	Specification for Hazard Communication for Hazardous Chemicals and Dangerous Goods	Replaces SS 286
SS 608	CoP for Gas Installation	Formerly CP 51
SS 634	CoP for Fire Safety for Open Plant Processing Facilities in Oil, Chemical and Process Industries	
SS 638	CoP for Electrical Installations	Formerly CP 5

SS 641	CoP for Fire Safety for Laboratories Using Chemicals	
SS 645	CoP for the Installation and Servicing of Electrical Fire Alarm Systems	Formerly CP 10
SS EN 3-7	Portable Fire Extinguishers -	Replaces SS 232 Pt 1 to 6
	Part 7: Characteristics, performance requirements and test methods	
SS EN 3-8	Portable Fire Extinguishers -	
	Part 8: Additional requirements to SS EN 3-7 for the construction, resistance to pressure and mechanical tests for extinguishers with a maximum allowable pressure equal to or lower than 30 bar	
SS EN 3-9	Portable Fire Extinguishers -	
	Part 9: Additional requirements to SS EN 3-7 for pressure resistance if CO extinguishers	
SS EN 3-10	Portable Fire Extinguishers -	
	Part 10: Provisions for evaluating the conformity of a portable fire extinguisher to SS EN 3-7	
SS EN 1992	Design of Concrete Structures	Formerly CP 65
Pt 1	Planning and Performance Assessment of Electrical Energy Storage Systems – General Specification	
Pt 2	Safety Considerations for Grid- Integrated EES Systems – General Specifications	
TR 77	Electrical Energy Storage (EES) Systems	
Pt 1	Planning and Performance Assessment of Electrical Energy Storage Systems – General Specification	
Pt 2	Safety Considerations for Grid-integrated EES Systems – General Specification	
AMERICAN STANDARDS		
ANSI	American National Standard Institute	
A14.3	American National Standards for Ladders - Fixed - Safety Requirements	
ASTM D635	Standard Test Method for Rate of Burning and/ or Extent & Time of Burning of Plastics in a Horizontal Position	
ASTM E108	Standard Test Methods for Fire Tests of Roof Coverings	
ASTM E119	Standard Test Methods for Fire Tests of Building Construction & Materials	
ASTM E 662	Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials	
ASTM E814	Standard Test Method for Fire Tests of Penetration Firestop Systems	
ASTM E2307	Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate – Scale, Multi-story Test Apparatus	
NFPA 16	Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems	Formerly NFPA 16A
NFPA 30	Flammable & Combustible Liquids Code	
NFPA 33	Standard for Spray Application Using Flammable or Combustible Materials	
NFPA 45	Standard on Fire Protection for Laboratories Using Chemicals	
NFPA 54	National Fuel Gas Code	
NFPA 55	Compressed Gases and Cryogenic Fluids Code	
NFPA 58	Liquefied Petroleum Gas Code	
NFPA 251	Standard Methods of Tests of Fire Resistance of Building Construction & Materials	
NFPA 253	Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant heat Energy Source	
NFPA 258	Recommended Practice for Determining Smoke Generation of Solid Material	
NFPA 262	Standard Methods of Tests for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces	
NFPA 285	Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components	
NFPA 400	Hazardous Materials Code	
NFPA 430	Code for the Storage of Liquids & Solid Oxidizers	Replaced by NFPA 400
NFPA 432	Code for the Storage of Organic Peroxide Formulations	
NFPA 495	Explosive Materials Code	
NFPA 502	Standard for Road Tunnels, Bridges and other Limited Access Highways	
NFPA 750	Standard on Water Mist Fire Protection Systems	
NFPA 2001	Standard on Clean Agent Fire Protection Systems	
UL 132	Standard for Safety Relief Valves for Anhydrous Ammonia and LP-Gas	
UL 144	Standard for LP-Gas Regulators	
UL 217	Standard for Smoke Alarms	
UL 300	Standard for Fire Testing of Fire Extinguishing Systems for Protection of Commercial Cooking Equipment	
UL 448	Standard for Safety Centrifugal Stationary Pumps for Fire Protection Service	
UL 555	Fire Dampers	

UL 924	Standard for Emergency Lighting and Power Equipment	
AUSTRALIAN STANDARDS		
AS 1530	Methods for Fire Tests on Building Materials, Components & Structures	
Pt 4	Fire-resistance Test of Elements of Construction	
AS 2208	Safety Glazing Materials in Buildings	
AS/NZS 2293	Emergency Lighting and Exit Signs for Buildings	
Pt 1	System Design, Installation and Operation	
AS 2714	The Storage & Handling of Organic Peroxides	
AS 2941	Fixed Fire Protection Installations - Pumpset Systems	
AS 3786	Smoke Alarms Using Scattered Light, Transmitted Light or Ionization	
AS 4391	Smoke Management Systems - Hot Smoke Test	
AS 4326	The Storage & Handling of Oxidizng Agents	
AS 4587	Water Mist Fire Protection Systems - System Design, Installation and Commissioning	
BRITISH STANDARDS		
BR 186	Design Principles for Smoke Ventilation in Enclosed Shopping Centres	Published by Fire Research Station, Building Research Establishment, Borehamwood, Herts WD62BL
BR 258	Design Approaches for Smoke Control in Atrium Buildings	
BR 368	Design Methodologies for Smoke and Heat Exhaust Ventilation	Published by Construction Research Communications Ltd by permission of Building Re- search Establishment Ltd
BS 476	Fire Tests on Building Materials and Structures	
Pt 3	Classification and Method of Test for External Fire Exposure to Roofs	
Pt 4	Non-Combustibility Test for Materials	
Pt 5	Method of Test for Ignitability	
Pt 6	Method of Test for Fire Propagation for Products	
Pt 7	Method of Test to Determine the Classification of the Surface Spread of Flame of Products	
Pt 11	Method for Assessing the Heat Emission from Building Materials	
Pt 20	Method for Determination of the Fire Resistance of Elements of Construction (General Principles)	
Pt 21	Methods for Determination of the Fire Resistance of Load- Bearing Elements of Construction	
Pt 22	Method for Determination of the Fire Resistance of Non-Load- Bearing Elements of Construction	
Pt 23	Methods for Determination of the Contribution of Components to the Fire Resistance of a Structure	
Pt 24	Method for Determination of the Fire Resistance of Ventilation Ducts	
BS 1230 Pt 1	Specification for Plasterboard Excluding Materials Submitted to Secondary Operations	Replaced by BS EN 520
BS 2594	Specification for Carbon Steel Welded Horizontal Cylindrical Storage Tanks	Withdrawn
BS 3016	Specifications for Pressure Regulators for LPG	Replaced by BS EN 16219
BS 4514	Specification for Unplasticized PVC Soil and Ventilating Pipes of 82.4mm Minimum Mean Outside Diameter, and Fittings and Accessories of 82.4mm and of Other Sizes	
BS 5041	Fire Hydrant Systems Equipment	
Pt 1	Specification for Landing Valves for Wet Risers	
Pt 3	Specification for Inlet Breechings for Dry Riser Inlets	
BS 5234	Partitions (including matching linings)	
Pt 2	Specification for Performance Requirements for Strength and Robustness including Methods of Test	

BS 5345	Selection, Installation and Maintenance of Electrical Apparatus for Use in Potentially Explosive Atmosphere (Other than Mining Applications or Explosive Processing and Manufacturing)	Replaced by BS EN 60079-14
Pt 1	General Recommendations	
Pt 3	Installation and Maintenance Requirements for Electrical Apparatus with Type of Protection 'd'. Flameproof Enclosure	
BS 5499	Fire Safety Signs, Notices and Graphic Symbols	
Pt 2	Specification for Self-Luminous Fire Safety Signs	Withdrawn
BS 5588	Fire Precautions in the Design, Construction and Use of Buildings	
Pt 5	CoP for Firefighting Stairways and Lifts	Withdrawn
BS 5852	Methods of Test for Assessment of the Ignitability of Upholstered Seating by Smouldering and Flaming Ignition Source	
BS 6206	Specification for Impact Performance Requirements for Flat Safety Glass and Safety Plastics for Use in Buildings	Replaced by EN 12600
BS 6387	Test Method for Resistance to Fire of Cables Required to Maintain Circuit Integrity under Fire Conditions	
BS 6391	Specification for Non-Percolating Layflat Delivery Hoses and Hose Assemblies for Fire Fighting Purposes	
BS 7346	Components for Smoke and Heat Control Systems	
Pt 2	Specification for Powered Smoke and Heat Exhaust Ventilators	Withdrawn
Pt 3	Specification for Smoke Curtains	Withdrawn
BS 7346	Components for Smoke and Heat Control Systems	
Pt 7	CoP on Functional Recommendations and Calculation Methods for Smoke and Heat Control Systems for Covered Car Parks	
BS 7846	Electric Cables. Thermosetting Insulated, Armoured, Fire-resistant Cables of Rated Voltage 600/1000V for Fixed Installations, Having Low Emission of Smoke and Corrosive Gases when Affected by Fire. Specification	
BS 8202	Coatings for Fire Protection of Building Elements	
Pt 2	CoP for the Use of Intumescent Coating Systems to Metallic Substrates for Providing Fire Resistance	
EN 54	Fire Detection and Alarm Systems	
Pt 2	Control and Indicating Equipment	
Pt 4	Power Supply Equipment	
BS EN 520	Gypsum Plasterboards. Definitions, Requirements and Test Methods	Replaces BS 1230 Pt 1
BS EN 12101-1	Smoke & Heat Control Systems – Specification for Smoke Barriers	Replaces BS 7346 Pt 3
BS EN 12101-3	Smoke & Heat Control Systems – Specification for Powered Smoke & Heat Control Ventilators (Fans)	Replaces BS 7346 Pt 2
BS EN 13501-1	Fire Test to Building Materials - Classification	
BS EN 50054	Electrical Apparatus for the Detection and Measurement of Combustible Gases. - General Requirements and Test Methods	
BS EN 50057	Electrical Apparatus for the Detection and Measurement of Combustible Gases. - Performance Requirements for Group II Apparatus Indicating up to 100% Lower Explosive Limit	
BS EN 50272-2	Safety Requirements for Secondary Batteries and Battery Installations. Stationary Batteries	Withdrawn
BS EN 50272-3	Safety Requirements for Secondary Batteries and Battery Installations. - Traction Batteries	Withdrawn
BS EN 60079-14	Explosive Atmosphere. Electrical Installations Design, Selection and Erection	Replaces BS 5345 Pt 1 & 3
BS EN IEC 62485-2	Safety Requirements for Secondary Batteries and Battery Installations - Stationary Batteries	Replaces BS EN 50272-2
BS EN IEC 62485-3	Safety Requirements for Secondary Batteries and Battery Installations - Traction Batteries	Replaces BS EN 50272-3
EUROPEAN STANDARDS		
EN ISO 1182	Reaction to Fire Tests for Products – Non-Combustibility Test	
EN ISO 1716	Reaction to Fire Tests for Building Products - Determination of the Gross Heat of Combustion (Calorific Value)	
EN ISO 11925 – 2	Reaction to Fire Tests – Ignitability of Products subjected to Direct Impingement of Flame - Part: Single Flame Source Test	

EN ISO 5659	Plastics – Smoke Generation	
Pt 2	Determination of Optical Density by a Single-chamber Test	
EN 3	Portable Fire Extinguishers	
Pt 8	Additional Requirements to EN 3 – 7 for the Construction, Resistance to Pressure and Mechanical Tests for extinguishers with a Maximum Allowable Pressure Equal to or Lower than 30 Bar	
Pt 9	Additional Requirements to EN 3 – 7 for Pressure Resistance of $C0_2$ Extinguishers	
EN 54 - 2	Fire Detection and Alarm Systems - Control and Indicating Equipment	
EN 54 - 4	Fire Detection and Alarm Systems - Power Supply Equipment	
EN 81 - 58	Safety Rules for the Construction and Installation of Lifts. Examination and Tests	
Pt 58	Landing Doors Fire Resistance Test	
EN 179	Building Hardware – Emergency Exit Devices Operated by a Lever Handle or Push Pad	
EN 520	Gypsum Plasterboards – Definitions, Requirements and Test Methods	
EN 671 - 1	Fixed Firefighting Systems. Hose Systems. Hose Reels with Semi-Rigid Hose	
EN 1125	Building Hardware – Panic Exit Devices Operated by a Horizontal Bar	
EN 1154	Building Hardware – Controlled Door Closing Devices	
EN 1155	Electrically Powered Hold Open Devices for Swing Doors	
EN 1158	Building Hardware – Door Coordinator Devices – Requirements and Test Standards	
EN 1303	Building Hardware – Cylinders for Locks	
EN 1363	Fire Resistance Tests. General Requirements	
EN 1364	Fire Resistance Test for Non-loadbearing Elements	
Pt 1	Walls	
EN 1365	Fire Resistance Test for Loadbearing Elements. Floors and Roofs	
EN 1366	Fire Resistance Test for Service Installations	
Pt 1	Ventilation Ducts	
Pt 3	Penetration Seals	
Pt 4	Linear Joint Seals	
Pt 8	Smoke Extraction Ducts	
Pt 9	Single Compartment Smoke Extraction Ducts	
EN 1634-1	Fire Resistance and Smoke Control Tests for Door and Shutter Assemblies, Openable Windows and Elements of Building Hardware	
Pt 1	Fire Resistance Test for Door and Shutter Assemblies and Openable Window	
EN 1751	Ventilation for Buildings – Air Terminal Devices – Aerodynamic Testing of Damper and Valves	
EN 1906	Building Hardware. Lever Handles and Knob Furniture. Requirements and Test Method	
EN 1935	Building Hardware. Single-axis Hinges. Requirements and Test Methods	
EN 12051	Building Hardware. Door and Window Bolts. Requirements and Test Methods	
EN 12101	Smoke and Heat Control Systems	
Pt 1	Specification for Smoke Barriers	
EN 12209	Building Hardware. Mechanically Operated Locks and Locking plates. Requirements and Test Methods	
EN 12600	Glass in Building. Pendulum Test. Impact Test Method and Classification for Flat Glass	
EN 13501	Fire Classification of Construction Products and Building Elements	
Pt 5	Classification Using Data from External Fire Exposure to Roofs Tests	
EN 13823	Reaction to Fire Tests for Building Products - Building Products excluding Floorings exposed to the Thermal Attack by a Single Burning Item	
EN 14041	Resilient, Textile and Laminate Floor Coverings. Essential Characteristics	
EN 14064 - 1	Thermal Insulation Products for Buildings. IN-situ Formed Loose-fill Mineral Wool (MW) Products. Specifications for the Loose-fill Products Before Insulation	
EN 14064	Smoke Alarm Devices	
EN 14846	Building Hardware. Locks and Latches. Electromechanically Operated Locks and Striking Plates. Requirements and Test Methods	
EN 15684	Building Hardware – Mechatronic Cylinders – Requirements and Test Methods	
EN 16623	Paints and Varnishes. Reactive Coatings for Fire Protection of Metallic Substrates. Definitions, Requirements, Characteristics and Marking	
EN 45545	Railway Applications – Fire protection on Railway Vehicles	
Pt 2	Determination of Optical Density by a Single-chamber Test	
IEC STANDARDS		
IEC 60079	Explosive Atmospheres	

IEC 60331	Tests for Electric Cables Under Fire Conditions – Circuit Integrity	
Pt 25	Procedures and Requirements – Optical Fibre Cables	
IEC 60332	Tests on Electric and Optical Fibre Cables Under Fire Conditions – All Parts	
Pt 1	Test for Vertical Flame Propagation for a Single Insulated Wire or Cable - Apparatus	
Pt 3	Test for Vertical Flame Spread of Vertically-Mounted Bunched Wires or Cable - Apparatus	
IEC 60598-2-22	Luminaries – Part 2-22: Particular Requirements - Luminaries for Emergency Lighting	
IEC 60754	Test on gases Evolved during Combustion of Materials From Cables	
Pt 1	Determination of the Halogen Acid Gas Content	
IEC 61034	Measurement of Smoke Density of Cables Burning Under Defined Conditions	
IEC 61730	Photovoltaic (PV) Module for Safety Qualification	
Pt 2	Requirements for Testing	
ISO STANDARDS		
ISO 834	Fire resistance Tests - Elements of Building Construction	
Pt 1	General Requirements	
Pt 5	Specific Requirements for Loadbearing Horizontal Separating Elements	
Pt 7	Specific Requirements for Columns	
Pt 8	Specific Requirements for Non-loadbearing Vertical Separating Elements	
Pt 9	Specific Requirements for Non-loadbearing Ceiling Elements	
ISO 1896	Thermal Insulating Asbestos Boards	
ISO 3864	Graphical Symbols – Safety Colours and Safety Signs	
Pt 1	Design Principles for Safety Signs and Safety Markings	
Pt 2	Design Principles for Product Safety Labels	
Pt 3	Design Principles for Graphical Symbols for Use in Safety Signs	
ISO 5149	Refrigerating Systems and Heat Pumps - Safety and Environment Requirements	
ISO 5167	Measurement of Fluid Flow by Means of Differential Pressure Devices	
ISO 7010	Graphical Symbols – Safety Colours and Safety Signs – Registered Safety Signs	
ISO 7244	Air Distribution and Air Diffusion – Aerodynamic Testing of Dampers and Valves	
ISO 30061	Emergency Lighting	
FACTORY MUTUAL RESEARCH COPORATION		
FM 1311	Centrifugal Fire Pumps Spilt-close Type (Axial or Radial)	
FM 1319	Centrifugal Fire Pumps (Horizontal, END Suction Type)	
Note: - The Standards stated above are non-exhaustive, - SCDF shall not be held responsible for the accuracy of the standard titles shown in Table.		

TABLE 1.3A : ABBREVIATIONS

TABLE 1.3A : ABBREVIATIONS	
Abbreviation	**Definition**
ACMV	Air-Conditioning & Mechanical Ventilation
AFA	Accessible Floor Area
AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
AS	Australian Standard
ASHRAE	American Society of Heating, Refrigerating & Air-conditioning Engineers
ASTM	American Society for Testing and Materials
BRE	Building Research Establishment
BS	British Standard
BSL	Bio-Safety Level
CD	Civil Defence
CoC	Certificate of Conformity
CoP	Code of Practice
Cl.	Clause
CERT	Company Emergency Response Team
DIN	German Institute for Standardization

DoC	Declaration of Compliance
EC	Exit Capacity
EN	European Standard
FAMCP	Fully Automated Mechanised Car Park
FCC	Fire Command Centre
FM	Factory Mutual
FMRC	Factory Mutual Research Corporation
FSC	Fire Safety Certificate
FSE	Fire Safety Engineer
HFAD	Home Fire Alarm Device
HR	Hour
IEC	International Electrotechnical Commission
ISO	International Organisation for Standardisation
LPG	Liquid Petroleum Gas
MAQ	Maximum Allowable Quantity
MCST	Management Corporation Strata Title
MRA	Mutual Recognition Arrangement
MSDS	Material Safety Data Sheet
MV	Mechanical Ventilation
NFPA	National Fire Protection Association
NoA	Notice of Approval
NZS	New Zealand Standard
ODA	Outdoor Display Area
OL	Occupant Load
ORA	Outdoor Refreshment Area
PE	Professional Engineer
PG	Purpose Group
PLS	Product Listing Scheme
Pt	Part
PWDs	Persons With Disabilities
QP	Qualified Person
RI	Registered Inspector
SAC	Singapore Accreditation Council
SCDF	Singapore Civil Defence Force
SS	Singapore Standard
SS EN	Singapore Standard implementation of a European Standard
TFP	Temporary Fire Permit
UL	Underwriters Laboratories
VIFDS	Video Image Fire Detection System
WHO	World Health Organisation

TABLE 1.4A : DESIGNATION OF PURPOSE GROUPS

TABLE 1.4A : DESIGNATION OF PURPOSE GROUPS			
Purpose Group (PG)	**Descriptive Title**	**Purpose for which building or part of the building is used or intended to be used**	
I	Small residential	Residential dwelling house, such as:	
		• bungalow • detached house	• semi-detached house • terrace house
II	Other residential	Accommodation for residential purposes other than any premises comprised in PG I, such as:	
		• apartment • cluster housing • condominium	• flat • maisonette • town house

<table>
<tr><td>III</td><td>Institutional</td><td colspan="2">Establishments used for treatment, care or maintenance of persons suffering from disabilities, such as:</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>• community hospital
• convalescent home
• home for intellectually disabled
• home for the aged</td><td>• home for the spastic
• hospice
• hospital
• psychiatric hospital
• nursing home</td></tr>
<tr><td colspan="2">Establishments used for care or maintenance of young/ dependent persons, such as:</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>• children's home
• correction centre
• daycare centre
• detention centre
• dialysis centre</td><td>• infant-care centre
• rehabilitation centre
• school for the spastic
• senior activity centre
• orphanage</td></tr>
<tr><td colspan="2">Establishments used for educational/ training purposes, such as:</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>• college
• commerical/ private • school
• enrichment centre
• kindergarten/nursery
• military camp</td><td>• polytechnic
• public school
• tuition centre
• university
• vocational institution</td></tr>
<tr><td colspan="2">Establishments used for worker lodging purposes, such as:</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>• workers' dormitory</td><td></td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>IV</td><td>Office</td><td colspan="2">Premises/ areas/ spaces/ floors used for the purposes of administration and clerical work, or as premises occupied with an office for the purposes of the activities therein carried on, such as:</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>• banking
• insurance
• publisher</td><td>• stock broker
• telephone/ telegraph operating</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>V</td><td>Shop</td><td colspan="2">Premises/ areas/ spaces/ floors used for the following purposes (and/or any other similar trades or businesses):</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>• beauty salon
• book store
• boutique
• confectionary outlet
• departmental store
• drugstore
• gift shop
• hairdressing salon
• jewellery shop
• laundry
• outpatient clinic
• pawnshop</td><td>• pet shop/ clinic
• polyclinic
• provisional shop
• shopping arcade
• shopping centre
• show flat
• showrooms for sale of goods
• supermarket
• take-away F&B • outlet/ kiosk
• ticketing agency
• travel agency</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>VI</td><td>Factory</td><td colspan="2">Premises/ areas/ spaces/ floors with manufacturing, processing, servicing or testing activities, such as:</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>• aircraft hangar
• chemicals
• consumable products
• data/ server centre
• electrical switching/ transmitting
• fireworks
• food products
• glassware
• highly combustible substances
• highly flammable products
• incineration
• metalwork</td><td>• oil refinery
• pharmaceutical
• power generation
• recycling
• rubber
• ship building
• telecommunication exchange
• vehicle repair/ servicing
• wafer
• waste treatment/ pumping
• woodwork</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td>VII</td><td>Place of public resort</td><td colspan="2">Premises/ areas/ spaces/ floors used for public accommodation purpose, such as:</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>• backpacker hotel
• boarding house
• hotel
• staff quarters</td><td>• holiday resort
• serviced apartment
• student hostel</td></tr>
<tr><td colspan="2">Premises/ areas/ spaces/ floors used for educational purpose, such as:</td></tr>
<tr><td rowspan="2"></td><td rowspan="2"></td><td>• auditorium
• convention centre
• exhibition centre</td><td>• museum
• public art gallery
• public library</td></tr>
<tr><td colspan="2">Premises used for social purpose such as:</td></tr>
<tr><td></td><td></td><td>• community centre</td><td>• private club</td></tr>
</table>

VII	Place of public resort	Premises/ areas/ spaces/ floors used for entertainment purpose, such as:	
		• casino • cinema • concert hall • discotheque	• internet gaming centre • karaoke lounge • night club • theatre
		Premises/ areas/ spaces/ floors used for religious purpose, such as:	
		• church • mosque	• temple
		Premises/ areas/ spaces/ floors used for body treatment purpose, such as:	
		• body massage • foot reflexology	• gymnasium • Spa
		Premises/ areas/ spaces/ floors used for recreational purpose, such as:	
		• amusement centre • billiard/ snooker centre • bowling centre • roof garden/ terrace • sky garden/ terrace	• public sport complex • public swimming complex • stadium
		Premises/ areas/ spaces/ floors used for F&B purpose, such as:	
		• cafeteria • canteen • coffee shop • eating house • fast food outlet	• food court • hawker centre • Pub/ bar • restaurant
		Premises/ areas/ spaces/ floors used for transportation purpose, such as:	
		• airport terminal • bus terminal	• ferry terminal • train station
VIII	Storage	Premises/ areas/ spaces/ floors used for the purposes of storing, depositing or parking of goods, materials and/ or vehicles, such as:	
		• coldroom • godown • store	• vehicle park • warehouse
Note: Requirements for buildings not listed in this Table, including but not limited to buildings used for the manufacture and/ or storage of highly combustible substances and/ or flammable liquids, etc., shall be consulted with the SCDF			

TABLE 1.4B : OCCUPANT LOAD FACTORS

TABLE 1.4B : OCCUPANT LOAD FACTORS		
FUNCTIONAL SPACES	**FACTOR (m ²/person)**	**REMARKS**
Amusement park	1	excluding machine areas
Apartment, residential	15	
Area of refuge		
ambulatory care facility	1.4	
custodian care facility	1.4	
hospital	2.8	
hospital	0.56	for area of refuge without patient accommodation
nursing care facility	2.8	
nursing care facility	0.56	for area of refuge without patient accommodation
supervisory care facility	0.56	
Archive room		
reading area	5	
stack area	10	
Atrium floor	3	
Audio visual area	3	
Auditorium/ theatre		
With individual fixed seating	1.5	occupant load can be based on number of fixed seating
With fixed bench seating	---	occupant load based on 450mm of length of the benches per person
Audio visual control room for theatres/ cinemas/ concert halls	5	
Ball room	1.5	
Banking hall	3	
Bar/ pub	1	
Bath room	---	non-simultaneous
Bazaar	5	
Billiards room	5	
Book/ general storage	30	
Bowling alley	1	excluding bowling lanes
Business centre/ office	10	

Cafeteria	1.5	
Canteen	1.5	including staff canteen
Car parking area	30	
Changing room	---	non-simultaneous
Children playground	5	including playground equipment
Classroom		
Computer classroom	1.5	
Nursery classroom for children under 7 years of age	1.5	or higher OL factor as required by the authority having jurisdiction
Others	1.5	
Club room	1.5	
Concourse	3	
Conference room	1.5	
Consultant room	5	
Common room	1.5	
Computer room	5	
Corridor	---	non-simultaneous
Crematoria	1.5	
Dance studio	5	
Department store	5	
Deposit/strong room	30	
Design studio	5	
Detention room	3	
Dining area		
Hawker centre	1.5	
Fast food outlet	1	
others	1.5	
Discotheque	1	including dine & dance area
Examination room	5	
Exposition/ Trade fair area	1.5	
Fast food outlet	1	
Filing room/ store	10	
Foyer Bus/ Airport/ Ferry terminal or station	1.5	
Fitness club/ centre	5	
Function room	1.5	
Gallery		
exhibits	2.5	
choir	1.5	
prayer	1.5	
seating	1.5	occupant load can be based on number of fixed seating
trading	1.5	
viewing	1.5	
surgical viewing	3	
General storage	30	
Goods storage	30	
Grandstand/ seating area	1.5	
Guestroom/ accommodation unit		
Dormitory	4.2	or occupant load factor between 3.6m²/person and 4.2m²/person if permitted by the authority having jurisdiction (sleeping area & living area only, excluding toilet, etc.)
Backpacker hotel/ hostel	3	max. 20 persons per room (including living area and excluding toilet, etc.)
Hotel, Boarding house, Serviced apartment, Student hostel, Staff hostel/ quarter	15	min. 2 persons per room or 15m²/person, whichever OL is higher
Capsule hotel	3	maximum AFA of not exceeding 60m²; and occupant load not exceeding 20 persons per guestroom

Gymnasium	3.5	
Health club/ centre	5	
Hobby room	1.5	
Housekeeping	10	
Indoor games room	1.5	
Indoor sport hall		
school with multi-purpose hall	3	
school without multi-purpose hall	1	
others	3	
Karaoke lounge	1.5	including dine & dance areas
Kitchen/ service area	10	
Laboratory		
healthcare occupancy	20	
schools/ colleges/ tertiary institutions	5	
others	5	
Laundry		
with machine operation	15	
others	10	
Lecture room	1.5	
Library room		
stack area	10	
reading area	5	
Lighting control room		
theatres/ cinemas/ concert halls	5	
others	5	
Loading/ unloading area	4 per bay	
Lobby	---	non-simultaneous
Locker room	---	non-simultaneous
Lounge	2.5	
Machine/ printing room	10	
Maisonettes, residential	15	
Mechanical plant room	30	
Meeting room	1.5	
Mortuary	30	
Multi-purpose hall/ room		
school/ colleges	1	
others	1.5	
Multi-purpose sports hall		
public sport complex	3	
public swimming complex	3	
stadium	3	
others	3	
Night club	1.5	including dine & dance area
Nursing station	10	
Office		
Admin/ general	10	
director/ manager room	15	
drafting room/ area	5	
Operation theatre	7.5	
Orchestral pit	1.5	
Out-patient waiting area	1.5	
Packing/ distribution area	10	
Pantry	---	non-simultaneous
Passenger arrival/ departure areas		

Bus/ Airport/ Ferry terminal or station	1.5	
Patient accommodation		
intensive care	20	
room	10	
ward	10	
Pedestrian linkways (aboveground or underground)		
with commercial activities	2	
building to Rapid Transit Stations (e.g., Mass Rapid Transit (MRT)) without commercial activities	3.5	
building to building without commercial activities	5	
standalone type without commercial activities	---	non-simultaneous
Pharmacy		
staff area	10	
public waiting area	2	
Prayer hall	1.5	
Pre-function room	---	non-simultaneous
Production area	10	automated or non-automated
Projection room		
theatres/ cinemas/ concert halls	5	
others	5	
Promotion area	1.5	
Pub	1	
Reading room	5	
Reception area	3	
Recreation room	1.5	
Refreshment area	1.5	
Restroom	---	non-simultaneous
Restaurant	1.5	
Roof	---	access for maintenance only
Roof garden/ roof terrace, private	---	non-simultaneous part of individual residential unit
Roof garden/ roof terrace, public		
health/ exercise corner	5	with exercise equipment
jogging track/ designated foot path<=3m in width	3	
planter box <300m high	1.5	
planter box =>300mm	---	fully covered with trees/ shrubs
planter box =>300mm & <= 500mm high	1.5	turf
planter box >500mm high	---	without step/ ramp access
sunken/ elevated water feature <300mm in depth/height	3	permanent or fixed structure
sunken/ elevated water feature =>300mm in depth/height	---	permanent or fixed structure
sunken planting area	---	fully covered with trees/ shrubs
sunken planting area	1.5	turf
other areas	1.5	
Seminar room	1.5	
Server room	30	
Service area	10	
Shop	5	
Showroom	5	
Sick room	---	non-simultaneous
Skating rink		
rink area	3	
spectator area	1.5	
Snack bar	1.5	
Society room	1.5	
Spa	5	include areas for weight training, aerobics, massage, sauna/steam bath and whirlpools

Squash court	2 per court	
Staff office	10	
Storage area	30	
Staff canteen	1.5	
Staff lounge	3	
Stage, front/ back		
schools/ colleges/ tertiary institutions	3	
theatres/ cinemas/ concert halls	---	non-simultaneous
Storage/ store room	30	
Swimming pool		
condominium/ apartment	5	
hotel	---	
private club	---	
public sports complex	2.5	
public swimming complex	2.5	
serviced apartment	---	
Swimming pool deck		
condominium/apartment	10	
hotel	10	
private club	10	
public sports complex	5	
public swimming complex	5	
serviced apartment	10	
Supermarket	5	
Therapy centre	10	
Ticketing office	10	
Toilet	---	non-simultaneous
Trading floor	2	
Training area		
public sports complex	3	
public swimming complex	3	
stadium	3	
Treatment room	5	
Visitors lounge	3	
Waiting area	3	
Workshop		
institutional	5	
industrial	10	
Note: - All functional spaces shall be computed based on accessible floor area for the calculation of occupant load, unless specifically exempted under the “Remarks” column - The functional spaces stated above are non-exhaustive. Usage of other occupancy load factor is only allowed if permitted by SCDF		

Amendment History - Chapter 1 - General

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
1.1	25 Aug 2023	25 Aug 2023	Revised/Clarification	The Code of Practice for Fire Precautions in Buildings, hereinafter called “the Code” or “this Code”, serves to establish the minimum requirements for fire safety provisions in all buildings. It takes into account the function, design, management, operation, and maintenance of buildings to secure the life safety of occupants and property safety in the event of a fire.	25 Aug 2023
1.1.1	25 Aug 2023	1 Mar 2024	Revised/Clarification	Fire safety requirements for underground, surface, and elevated RTS including trainways, transit stations, train maintenance depots, on-line electric substations, and RTS facility buildings, shall comply with “Code of Practice for Fire Precautions in Rapid Transit Systems”.	1 Mar 2024
1.1.2	1 Mar 2021	1 Mar 2021	Clarification	Fire safety requirements for laboratories handling hazardous chemicals For laboratory storing and using chemicals/HazMat shall be in compliance with NFPA 45, except for the Maximum Allowable Quantity (MAQ) which shall comply with the figures released by SCDF.	1 Mar 2021
1.1.2 (dated 1 Sep 2021)	1 Sep 2021	1 Mar 2022	Revised/ Clarification	Fire safety requirements for laboratories handling hazardous chemicals Laboratories storing and using chemicals/HazMat shall comply with SS 641.	1 Sep 2021
1.1.3	1 Sep 2025	1 Mar 2026	Revised	1.1.3 Fire safety requirement for road tunnel Fire safety requirements for road tunnels shall be in compliance with NFPA 502.	1 Sep 2025
1.1.4	10 May 2019	Immediate	Relocated and Revised.	Fire Safety Report and Fire Safety Instruction Manual (Appendix 1 & 2) Fire Safety Report and/or Fire Safety Instruction Manual for building projects/fire safety provisions specified by SCDF shall be submitted when making building plan submission.	10 May 2019
1.1.4 (Amendment 1)	14 May 2019		replaced	14 May 2019	14 May 2019
1.1.4(Dated 1 Dec 2020)	1 Dec 2020	1 Dec 2020	Clarification	Fire Safety Report and Fire Safety Instruction Manual (Appendix 1 & 2) Fire Safety Report and/or Fire Safety Instruction Manual for building projects/fire safety provisions specified by SCDF shall be submitted when making building plan submission	1 Dec 2020
1.1.5	1 Dec 2020	1 Dec 2020	Clarification	Nil	1 Dec 2020
1.1.6	1 Mar 2021	1 Mar 2021	Clarification	Nil	1 Mar 2021
1.1.7	1 Mar 2021	1 Mar 2021	Clarification	Nil	1 Mar 2021
1.1.8	1 Mar 2021	1 Mar 2021	Clarification	Nil	1 Mar 2021
1.2		01 Mar 2019	New		---
1.2.3	1 Dec 2020	1 Dec 2020	Clarification	Nil	1 Dec 2020
1.2.3 (25 Aug 2023)	25 Aug 2023	25 Aug 2023	Revised/Clarification	All fire protection systems when installed/ provided in a building, shall be maintained in accordance with applicable codes or standards specified in Table 1.2A. The QP shall list down the maintenance details in the Fire Safety Instruction Manual and handover to the building owner for compliance at the completion of the building project. For the purpose of this Code, “fire protection system” has the same meaning as in the Fire Safety Act (Cap. 109A).	25 Aug 2023
1.4.1		01 Mar 2019	New		---
1.4.100	2 Mar 2020	2 Mar 2020	Clarification	Supervisory care facility “Supervisory care facility” is a building or part thereof, used for the housing, on a 24-hr basis, of mental health patients who may be capable of self-preservation but require supervision and are receiving therapy, training or other health-related care and for whom there may be security measures not under their control.	2 Mar 2020
1.4.111	1 Mar 2022	1 Sep 2022	New	Nil	1 Mar 2022
1.4.112	2 Mar 2020	2 Mar 2020	Clarification	Nil	2 Mar 2020
1.4.113	2 Mar 2020	2 Mar 2020	Clarification	Nil	2 Mar 2020
1.4.14		01 Mar 2019	New		---
1.4.18	1 Dec 2020	1 June 2021	Revised/ Clarification	Nil	1 Dec 2020
1.4.25		01 Mar 2019	New		---
1.4.28		01 Mar 2019	New		---
1.4.3	2 Mar 2020	2 Mar 2020	Clarification	Ambulatory healthcare centre “Ambulatory healthcare centre” is a building, or part thereof, used for providing them incapable of taking action for self-preservation or safety under emergency conditions without assistance from others, such as haemodialysis units or surgical treatment	2 Mar 2020
1.4.30	2 Mar 2020	2 Mar 2020	Clarification	Custodian-care facility “Custodian-care facility” is a building or part thereof, without stay in accommodation, used by persons who, because of age, or physical or mental disabilities, are unable to care for their self-preservation and safety. Such buildings shall include nurseries for children under 6 years of age, senior day care centres and institutions for the mentally disabled.	2 Mar 2020
1.4.47		01 Mar 2019	New		---

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
1.4.49	1 Mar 2022	1 Mar 2022	Clarification	External exit staircase “External exit staircase” refers to an exit staircase located outside a building, open to the external space, and that: a. b. space.	1 Mar 2022
1.4.63	2 Mar 2020	2 Mar 2020	Clarification	Habitable floor “Habitable floor” refers to all floors in a building, including the roof level. The roof level can be taken as non-habitable if it is not used for any purpose/activity other than housing M&E and/or telecommunication plants/equipment, e.g. lift motors, fire pumps, generators, fire hose reel pumps, water supply pumps, water tanks, cooling towers, solar photovoltaic panels, supply/ exhaust fans with associated ductwork, air-con condensing units, telecommunication antenna, satellite dishes and public warning sirens, etc..	2 Mar 2020
1.4.63 (dated 1 Mar 2022)	1 Mar 2022	1 Mar 2022	Clarification	Habitable floor Habitable floor” refers to all floors in a building, including the roof level. The roof level can be taken as non-habitable if it is not used for any purpose/activity other than housing M&E plants/equipment, e.g. lift motors, fire pumps, generators, fire hose reel pumps, water supply pumps, water tanks, cooling towers, solar photovoltaic panels, supply/ exhaust fans with associated ductwork, air-con condensing units, telecommunication equipment, satellite dishes and public warning sirens, etc..	1 Mar 2022
1.4.64	15 Sep 2020	15 Sep 2020	Clarification	Habitable height “Habitable height” refers to the height measured from the lowest level of fire engine accessway or fire engine access road (applicable to buildings under Purpose Group II) to the finished floor level of the highest habitable floor.	15 Sep 2020
1.4.68	2 Mar 2020	2 Mar 2020	Clarification	Hospital “Hospital” is a building used for medical and surgical care and shall include healthcare hospitals for psychiatric care, children's hospitals, etc..	2 Mar 2020
1.4.74	10 May 2019	Immediate	Clarifications	Nursing home, convalescent home, home for the aged & hospice These refer to a building, or part thereof, used for the housing and nursing care of persons on a 24hr basis who, because of mental or physical incapacity, may be unable to care for their own needs and safety without assistance of other persons.	10 May 2019
1.4.74 (dated 2 Mar 2020)	2 Mar 2020	2 Mar 2020	Clarification	Nursing home, convalescent home, home for the aged & hospice These refer to a building, or part thereof, used for the housing and nursing care of persons on a 24hr basis who, because of physical incapacity, may be unable to care for their own needs and safety without assistance of other persons.	2 Mar 2020
1.4.75	25 Aug 2023	25 Aug 2023	Revised/Clarification	“Occupant load” of a building, or part thereof, refers to the total number of persons that can occupy such a building, or part thereof, at any one time. The “occupant load” shall be determined via a. the floor area(s) available for occupation based on the appropriate areas per person as stated in Table 1.4B or b. by the number of fixed seatings, if applicable, for assembly occupancies.	25 Aug 2023
Table 1.2A	1 Dec 2020	1 Dec 2020	Clarification	Existing Table 1.2A	1 Dec 2020
Table 1.4.B	2 Dec 2019	Immediate	Clarification	Occupant load factor for “reading room” is missing.	2 Dec 2019
Table 1.4A	2 Mar 2020	2 Mar 2020	Clarification	Existing Table 1.4A	2 Mar 2020
Table 1.4B	3 Mar 2025	3 Sep 2025	Relaxation/ Revised		3 Sep 2025
Table 1.4B (dated 1 Sep 2022)	1 Mar 2023	1 Mar 2023	Revised/Clarifications	Existing Table 1.4B	1 Sep 2022
Table 1.4B (dated 15 Sep 2020)	15 Mar 2021	15 Mar 2021	Revised	Existing Table 1.4B	15 Sep 2020
Table 1.4B (dated 2 Mar 2020)	2 Mar 2020	2 Mar 2020	Clarification	Existing Table 1.4B	2 Mar 2020
Table 1.4B (dated 25 Aug 2023)	1 Mar 2024	1 Mar 2024	Revised/Clarifications		25 Aug 2023
Table 1.4B(dated 30 July 2020)	30 July 2020	1 Feb 2021	Revised	Occupant load factor for dormitory - 3m²/person (bed room area only)	30 July 2020

CLAUSE 2.1 GENERAL

The provisions of this chapter shall serve to express the intentions for determining the design, construction, protection, location, arrangement and maintenance of exit facilities to provide safe means of escape for occupants from all buildings hereafter erected, altered or changed in occupancy. Areas which are designated as means of escape, such as exit staircase, fire lift lobby, smoke-free lobby, exit passageway, escape corridor shall not be turned into other usage.

Rationale

The reason for preventing areas designated as means of escape from being converted to other usages is to ensure the safe egress of occupants.

Explanation and Illustrations

PG I buildings not exceeding 3 storeys

1. Proposals for detached, semi-detached, terraced houses and linked- houses which do not exceed 3 storeys or levels, including basement or attic are not required to be submitted to the SCDF for approval as provided for under the Fire Safety (Exemption) Order 1994.

2. The above exemption, however, does not mean that the QPs (Architects) need not comply with the relevant fire safety requirements in the Fire Code. The QPs are to self-regulate and to ensure that:

a. the buildings are designed with proper means of escape;

b. walls, floors are constructed of non-combustible materials; and

c. the separating walls between units are properly constructed to prevent fire spread etc..

3. Similarly, owners when carrying out internal renovation to their houses should also observe and comply with fire safety requirements in the Fire Code, for example, avoid introducing combustible partitions.

4. Townhouses which are treated as under PG I for the purpose of complying with the fire safety requirements that are applicable to detached, semi-detached, terraced and linked houses, are not covered by the Fire Safety (Exemption) Order 1994, hence, submission of plans to the SCDF is required.

5. It is important to note that any reference made to detached, semi-detached, terraced or linked houses and townhouses in the current Fire Code refers to such houses which are meant for single family occupation only.

PG II to VIII Buildings

6. The provision of fire escape in buildings under PG II to VIII comprises 3 distinct parts:

a. The part within the functional room spaces to the exit staircase/area of refuge.

It is critical that occupants from their respective areas of occupancy are able to get out within a prescribed distance, should a fire break out. The prescribed distances (given in *Table 2.2A*) shall be measured from the most remote point in that room space to its entrance (on first storey), or to the nearest exit staircase door, serving that storey or to door of area of refuge.

Occupants in room spaces, provided with two or more exit doors, should ensure that all these doors are readily opened for escape in emergency situations.

b. The exit staircase

Once the occupants have entered the exit staircase, they shall be protected (from exposure to fire risk and obstacle) throughout their descent down the staircase to the final exit at ground level.

c. The exit discharge

Occupants exiting from the exit staircases shall be able to discharge into the open external space at the ground level. From this point on they should no longer be in any danger from the fire or smoke in the building. Where an exit opens or discharges into an internal courtyard, a safe passageway must be readily available to lead the occupants out from this internal courtyard to safety at the building exterior.

Note :

In the case of PG II building, there is another critical consideration on the part “outside the residential unit”.

Areas which are designated as means of escape, such as exit staircase, fire lift lobby, smoke-stop lobby, exit passageway, escape corridors shall not be turned into other usage. The general statement is intended to remind QP, building owner, MCST, FSM on the sole use of the designated lobby as there were cases of designated lobby being converted to commercial areas.

CLAUSE 2.2 DETERMINATIONS OF EXIT REQUIREMENTS

2.2.1 General

Rationale

The exit provisions allow occupants to leave the fire area safely in the shortest possible time to a safe area.

Explanation and Illustrations

(No illustration)

DETERMINING NUMBER AND ADEQUACY OF EXIT FACILITIES

It is very essential that the building designers establish the number, sizes and capacity of exit facilities, especially that of exit doorways and exit staircases, to ensure their adequacy in facilitating the evacuation of all the occupants from that building during an emergency.

To determine the number and adequacy of exit doorways and staircases from a building or storey of a building, the following 3 steps must be taken:

a. Determine the occupant load, OL, on each storey of the building. This means computing the total number of persons that could be 'accommodated' in all spaces on a storey of the building. This is done on a storey by storey basis.

b. Determine the number of 'unit of width' of exit required facilitating escape for the above OL from each storey of that building. Cl.2.2.5 shall be referred for the explanation and application of the 'unit of width' for exit computation.

c. Determine the number of and the minimum widths of the exit doors and exit staircases required facilitating escape for that OL on each storey of that building.

The determination of exit requirements for a building shall be based upon the type of use or occupancy of the building, the occupant load, the floor area, the travel distance to an exit and the capacity of exits as provided in *Table 2.2A* and herein. Every storey of a building shall be provided with exit facilities for its occupant load. Vertical exits provided from any storey above ground level may serve simultaneously all storeys above the ground level. Vertical exits provided from any storey below ground level may serve all storeys below ground level, subject to the provisions of Cl.2.3.5 which prohibit basement staircases being continuous with exit staircases serving the upper storeys, unless otherwise allowed by the SCDF.

2.2.2 Mixed occupancy

Explanation and Illustrations

MIXED OCCUPANCY - OFFICES, FACTORIES & WAREHOUSES

1. TRAVEL DISTANCE REQUIREMENT:-

For a storey of mixed occupancy building consisting of offices, factories and warehouses, the exit capacity of staircases may be based on the total of the occupancies computed separately for each usage type as per *Table 1.4B*. However the position of the exit staircases shall be so located that the maximum permissible travel distance from any remote point to the staircase shall be based on that of the factory, having the stricter requirements in *Table 2.2A*. That is, equal to 30m for two-way non-sprinkler-protected buildings and 60m for two-way sprinkler protected buildings, and not the 45m and 75m distances allowable for office developments. Hence:

Travel distance (in *Figure 2.2.2-1*) to the nearest exit staircase shall not exceed 30m or 60m (if sprinkler-protected).

The Direct distance to the nearest exit staircase, if there are no predetermined walls, shall not exceed 20m (2/3 x 30m) or 40m (2/3 x 60m, if sprinkler-protected).

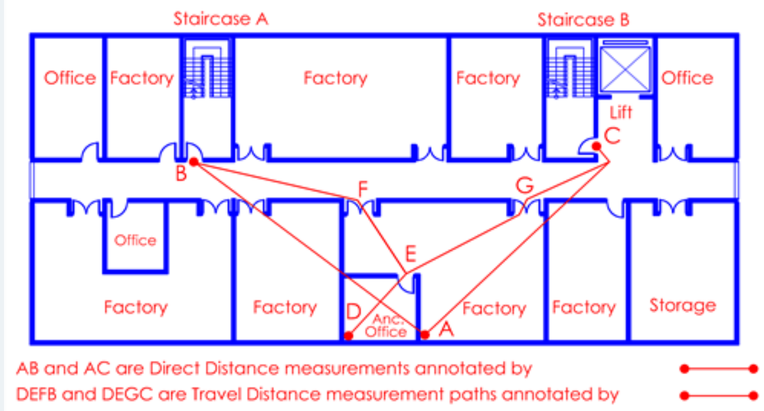


Figure 2.2.2 – 1: Example of a mixed development with factory, office & storage

The exit provisions in a mixed development may be assessed and provided separately if the differing purpose types are clearly defined and compartmentalized. For example, the escape distances for the offices' area which is clearly located in one part of the building as shown in *Figure 2.2.2 – 2*, may be based on the office configurations given in *Table 2.2A*. The remaining part of the building with the industrial usage is then based on the factory configurations.

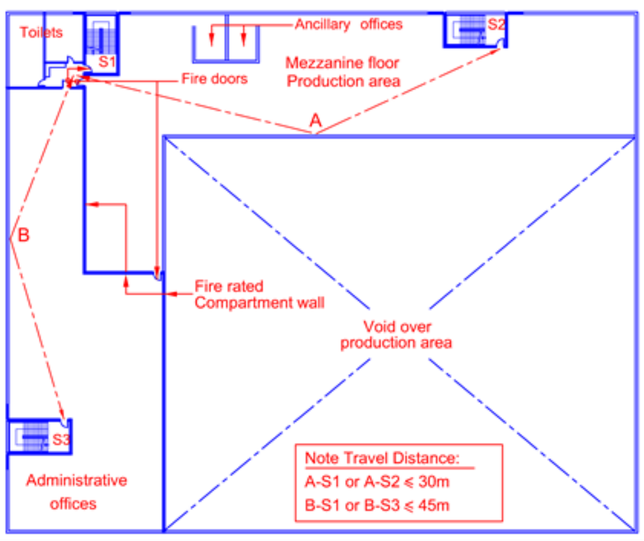


Figure 2.2.2 – 2 : Example of separate travel distance application

2. EXIT REQUIREMENT:-

Buildings with mixed occupancies the exit capacity of its exit staircases shall be based on the type of occupancy or usage having the strictest exit requirements given in *Table 2.2A*.

For example;

A storey of a building comprises dormitory, production and offices separated by usage with compartment walls, but shares common facilities like the staircases.

Then the exit capacity of its staircases shall be based on:

Dormitory occupancy which the number of persons per unit of exit width (500mm) of staircase is 45 persons.

Instead of:

Factory / Office / Warehouse occupancies which the number of persons per unit of exit width (500mm) of staircase is 60 persons.

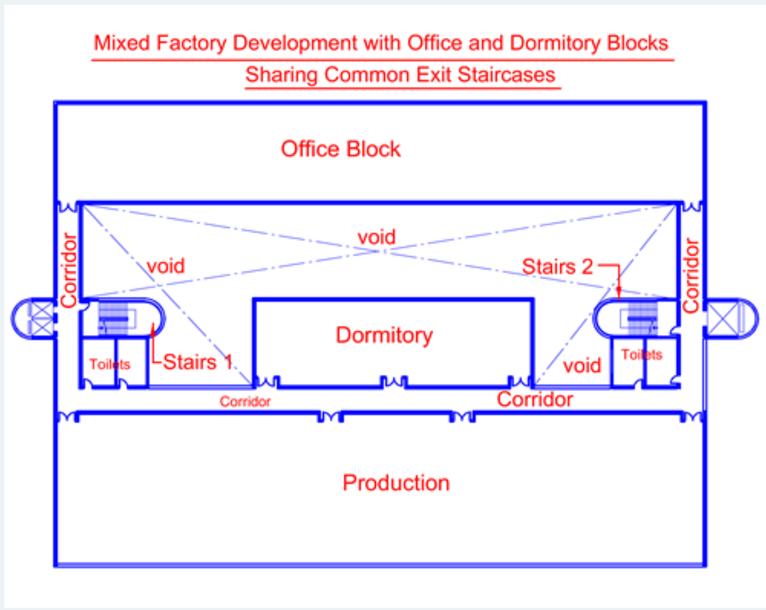


Figure 2.2.2 - 3 : Mixed factory development with office & dormitory blocks sharing common exit staircases

The maximum permissible occupant load (OL) for the entire storey of the building in *Figure 2.2.2 - 3*, for example, shall be based on the capacity of the two exit staircases of 2m width each, assumed serving a dormitory building. i.e.

OL = 4 units x 45 persons x 2 staircases
= 360 persons (maximum per storey)

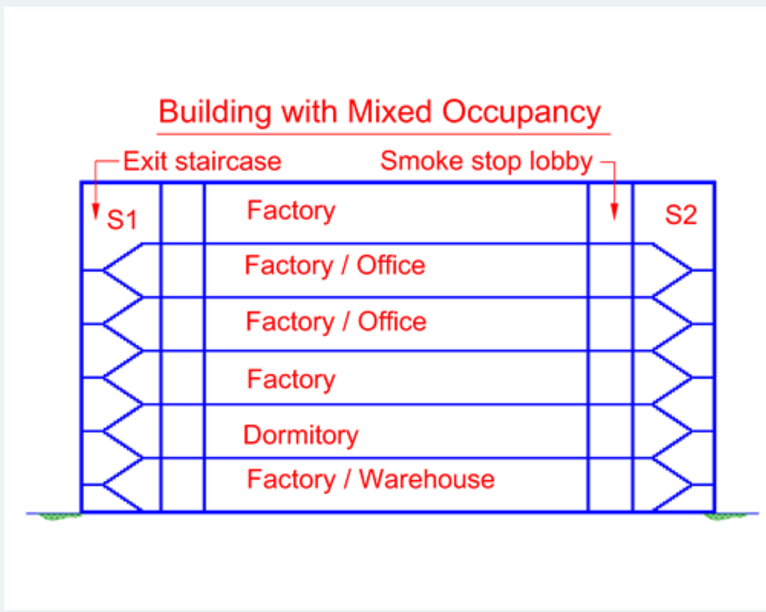


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Figure 2.2.2 - 4 : Building with mixed occupancy

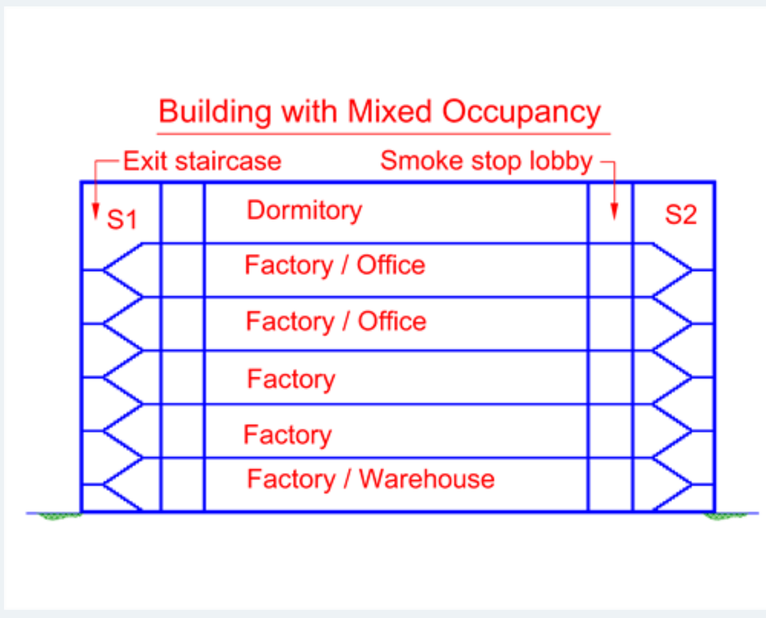

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Figure 2.2.2 - 5 : Building with mixed occupancy

This capacity of staircase exit width shall be applicable for all levels or storeys of the building with such shared staircase arrangement. This is regardless of the dormitory being located on the second storey or the top most storey of a multi-storey building. The only exemption is when the space with the more stringent requirement per unit of exit width, e.g. the dormitory, is located on only the ground level storey with direct escape to the external space.

(1) Travel distance requirement:

For a storey of mixed occupancy building consisting of offices, shops and place of public resort, the exit capacity of staircases may be based on the total of the occupancies computed separately for each usage type as per *Table 1.4B* . However the position of the exit staircases shall be so located that the maximum permissible travel distance from any remote point to the staircase shall be based on that of the shop, having the stricter requirements in *Table 2.2A*. That is, maximum 45m two-way escape travel distance for non-sprinkler-protected buildings and 60m two-way escape travel distance for sprinkler protected buildings shall be applicable and not the 45m and 75m distances allowable for office developments. Hence:

Travel distance (in *Figure 2.2.2 - 1*) to the nearest exit staircase shall not exceed 30m or 60m (if sprinkler-protected).

The direct distance to the nearest exit staircase, if there are no predetermined walls, shall not exceed 30m (2/3 x 45m) or 40m (2/3 x 60m, if sprinkler-protected).

MIXED OCCUPANCY - OFFICES, SHOPS & PLACES OF PUBLIC RESORT

1. TRAVEL DISTANCE REQUIREMENT:

For a storey of mixed occupancy building consisting of offices, shops and place of public resort, the exit capacity of staircases may be based on the total of the occupancies computed separately for each usage type as per *Table 1.4B* . However the position of the exit staircases shall be so located that the maximum permissible travel distance from any remote point to the staircase shall be based on that of the shop, having the stricter requirements in *Table 2.2A*. That is, maximum 45m two-way escape travel distance for non-sprinkler-protected buildings and 60m two-way escape travel distance for sprinkler-protected buildings shall be applicable and not the 45m and 75m distances allowable for office developments. Hence:

Travel distance (in Diagram 2.2.2-1) to the nearest exit staircase shall not exceed 30m or 60m (if sprinkler-protected).

The direct distance to the nearest exit staircase, if there are no predetermined walls, shall not exceed 30m (2/3 x 45m) or 40m (2/3 x 60m, if sprinkler-protected).

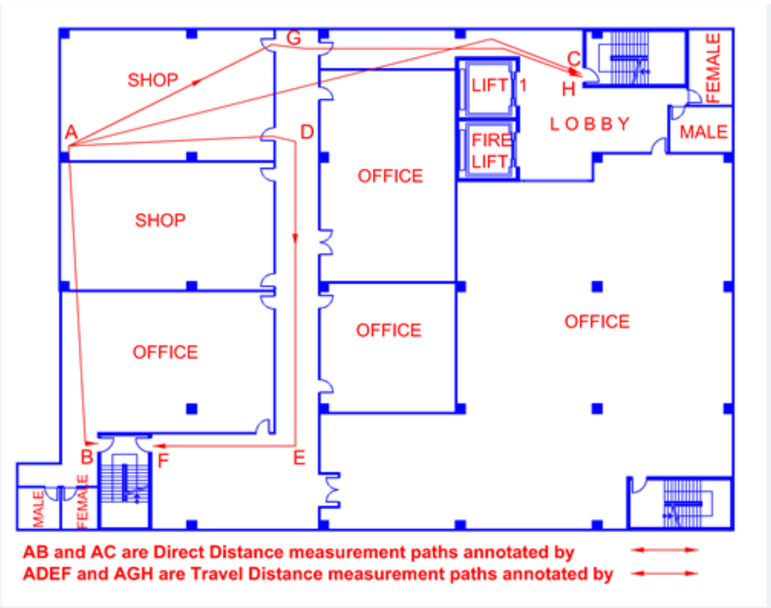

Figure 2.2.2 - 6

The exit provisions in a mixed development may be assessed and provided separately if the differing purpose types are clearly defined and compartmentalised.

For example, the escape distances for the offices' area, which is clearly located in one part of the building as shown in *Figure 2.2.2 - 6*, may be based on the office configurations given in *Table 2.2A* . The remaining part of the building with the shopping usage is then based on the shop configurations.

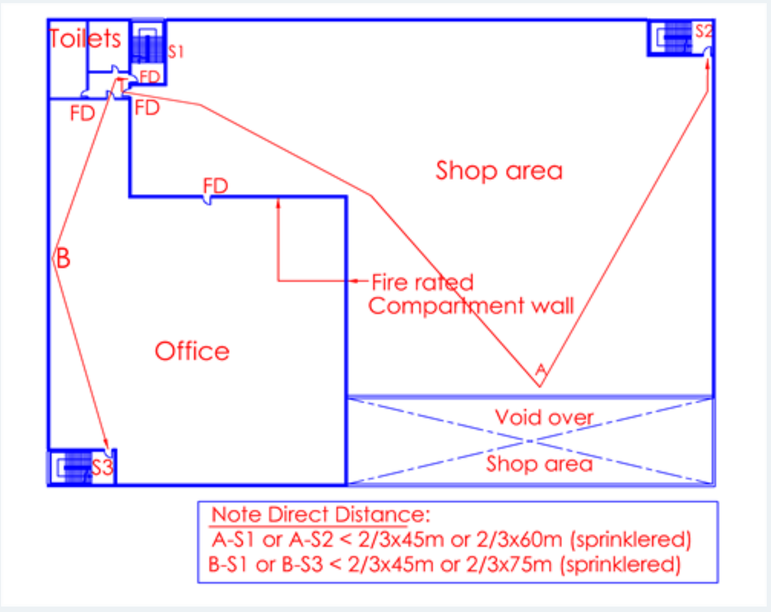

Figure 2.2.2 - 7 Example of separate travel distance application

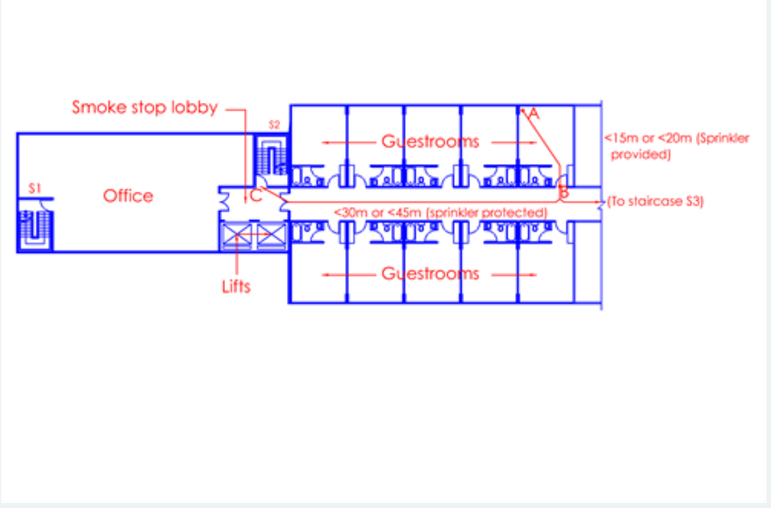

Figure 2.2.2 - 8

2. EXIT REQUIREMENT:

Buildings with mixed occupancies the exit capacity of its exit staircases shall be based on the type of occupancy or usage having the strictest exit requirements given in *Table 2.2A*.

For example, see *Figure 2.2.2 - 3*

A storey of a building comprises office and hotel residential occupancy separated by compartment walls, but shares common facilities like the staircases and lifts.

Then the exit capacity of its shared staircase (staircase S2) shall be based on the most stringent type of mixed occupancies, i.e. hotel residential floors.

Office Occupancy (Staircase S1)
No. of persons per unit of exit width (500mm) of staircase = 60 persons.

Hotel Residential Occupancy (Staircase S2 & S3)
No. of persons per unit of exit width (500mm) of staircase = 45 persons.

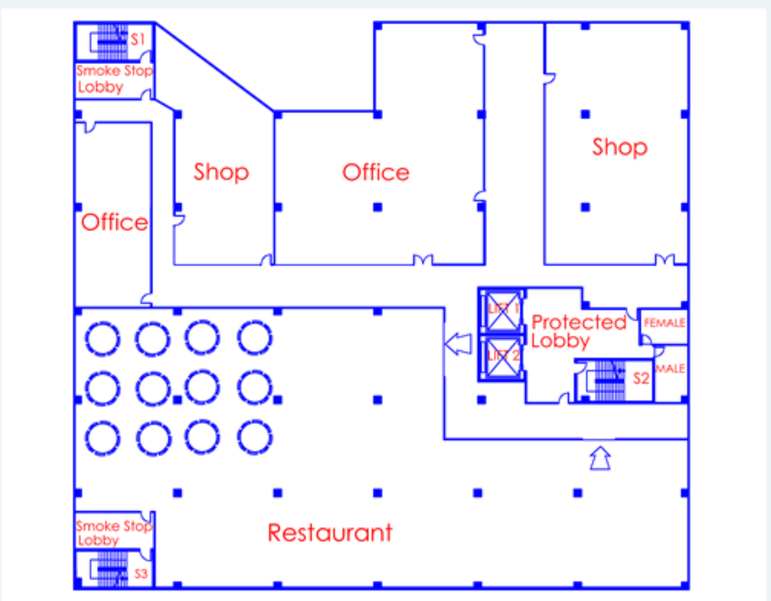

Figure 2.2.2 - 9 : Mixed development with office, shop & restaurant sharing common exit staircases

In the case of restaurant, the maximum permissible occupant load can be based on the capacity of the three staircases. As Staircase S3 is for the exclusive use of restaurant, owing to its

location, this staircase is inaccessible to occupants from offices and shops. Therefore, Staircase S3 shall not be computed as a common exit staircase rather computed as exit staircase for restaurant only. That is:

Exit capacity of common staircases = 4 units x 60 persons x 2 staircases

(Staircases S1 & S2 of 2m width each) = 480 persons

Hence, each common exit staircase can accommodate 240 persons (½ of 480 persons)

It is acceptable to allow ½ the occupant load of restaurant to use Staircase S3 and the other ½ to use the common exit staircases S1 & S2. Therefore, the maximum permissible occupant load for shops and offices shall include ½ the occupant load of restaurant, subject to not exceeding a total of 480 persons.

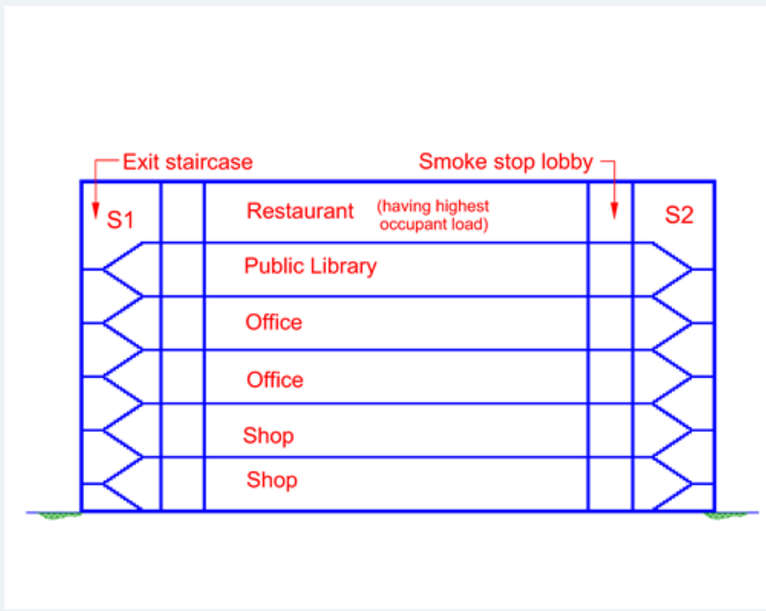

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Figure 2.2.2 - 10 : Situation where the exit capacities of entire staircase on all storeys are accounted similarly

The strictest capacity of staircase exit width (applicable to restaurant) shall be applicable to all levels or storeys of the building with such shared staircase arrangement. This is regardless of the restaurant being located on the second storey or the top most storey of a multi-storey building.

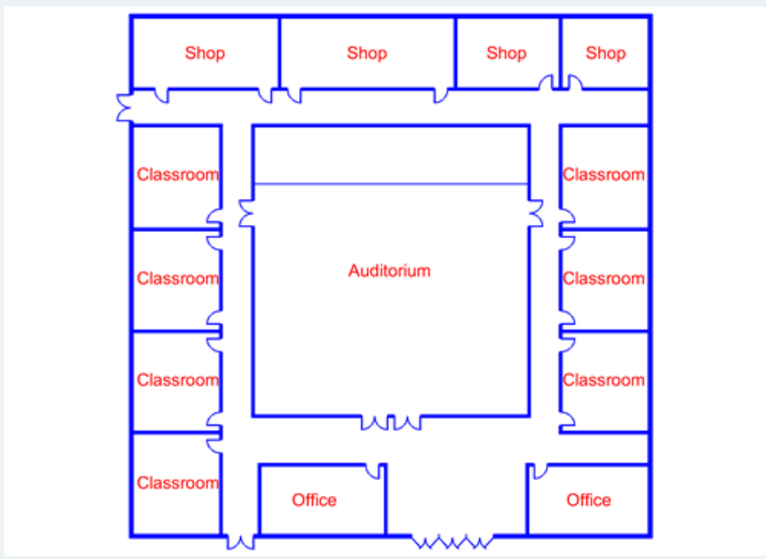


Figure 2.2.2 - 11 : Mixed occupancy building

Auditorium space shares the internal corridor as the classrooms. Such space cannot be qualified as non-simultaneous occupancy within the same storey.

Where different parts of a building or storey of a building are designed for different types of occupancies or used for different purposes at the same time, the exit requirements of the entire building or storey of the building shall be determined on the basis of that type of occupancy or usage having the strictest exit requirements or the exit requirements for each building section shall be determined separately.

2.2.3 Multiple occupancy or use

Explanation and Illustrations

A multi-purpose hall is an example of a space with multiple occupancy or use. It may have the various uses as listed below. Its exit provisions shall be based on the usage with the greatest occupant load. In this case it should cater to that of the dance hall, being the most stringent basing on an area of $1m^2$ per person.

Examples of usage of multipurpose hall:

a. Sports gym

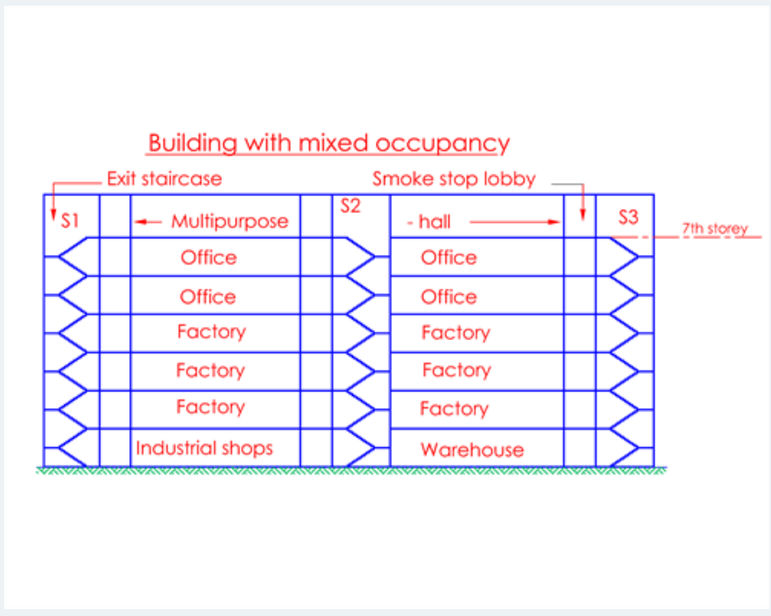
b. Dinner/buffet functions

c. Exhibitions/seminars

d. Church assembly

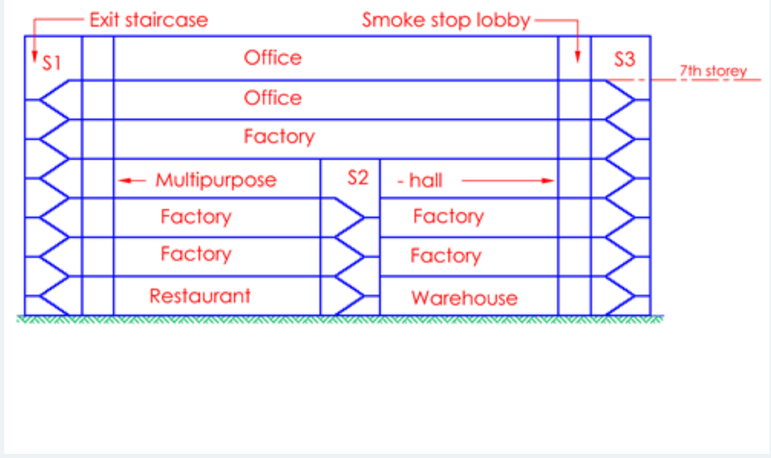
e. Lecture hall/classroom

f. Dance hall



Section

Figure 2.2.3 – 1 : Example of building with a multiple usage storey



Section

Figure 2.2.3 – 2 : Example of building with a multiple usage storey

In *Diagram 2.2.3-1*, the multi-purpose hall located on the 7th storey would have the highest occupant load. Hence, adequate number of exit staircases required to accommodate the evacuation of its occupant load shall be provided to the building. The total exit capacity of its exit staircases shall be determined based on its usage with the highest density of people. The exit staircases shall be carried right down to the ground level without any reduction in its width, regardless of the lower storeys having lesser number of occupants.

On the other hand, if the multi-purpose hall is located on an intermediate storey, then the exit requirements or provisions from that storey shall only be applicable to all the storeys below it. As for those storeys above that storey with the multipurpose hall, their exit capacities need only cater to what is the strictest above each respective storey.

Where a building or storey of a building or a part of a building is used for multiple purposes involving different activities at different times, that purpose or use involving the greatest number of occupants shall form the basis for determining the exit requirements.

2.2.4 Non-simultaneous occupancy

Explanation and Illustrations

Communal roof deck which is accessible to all residents shall be treated separately for the calculation of occupant load. For buildings under PG II, the occupancy load calculation is based on gross floor area of 15m2 per person, calculated on habitable areas. Spaces outside the residential units, such as lobbies, corridors would be excluded from calculation. Similarly, within the residential units, areas such as toilets, store room, kitchen and household shelter would be excluded from calculation. Living room, balconies and bedroom should be treated as habitable areas.

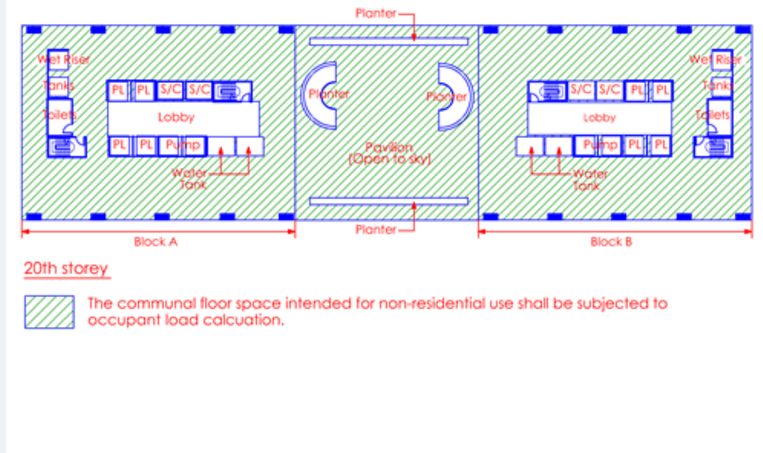


Figure 2.2.4 - 1 : Example of non-simultaneous areas

Staff canteens, if provided, is to be treated as simultaneous occupancies. This is due to the nature of its usage, whereby public or staff from other levels of the building would be patronising it through its operating hours. Pantries on the other hand, provided in the various levels of offices or production areas, catering to specific group of staff, may be treated as non-simultaneous areas. Hence, in applying the above clause, building owners has to be certain such rooms or spaces are not accessible to the public.

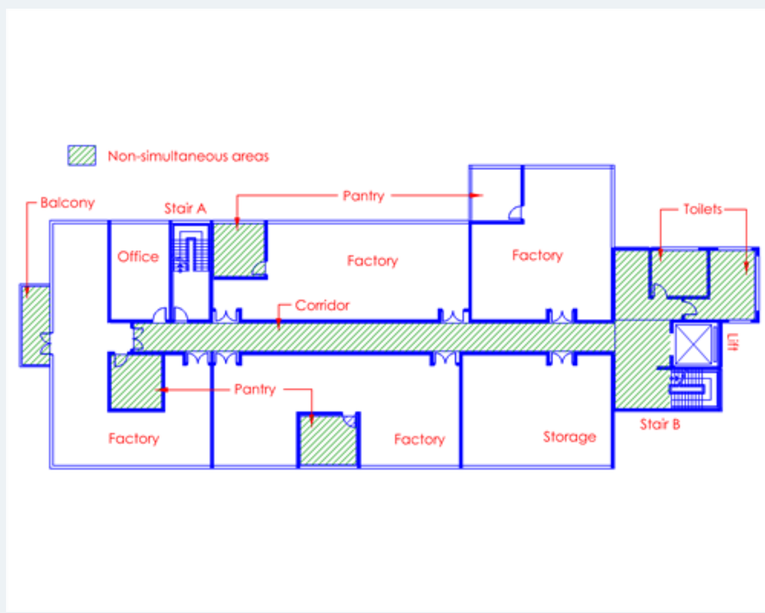


Figure 2.2.4 - 2 : Example of non-simultaneous areas (exaggerated)

The floor areas of toilets, locker rooms, lobbies, and corridors that are not occupied at the same time as other rooms or spaces by building occupants, can be omitted from the occupant load calculations of that storey of the building in which the storey is located.

2.2.5 Capacity of exits and exit facilities

Rationale

Adhering to the design parameters will prevent overcrowding and will ensure the corridors, exit staircases and doors are adequate in size to receive all the occupants on that floor during evacuation.

Explanation and Illustrations

To prevent overcrowding one has to ensure that the corridor and the exit staircases serving a storey of a building are adequate in size to receive all the occupants on that floor at the time of evacuation.

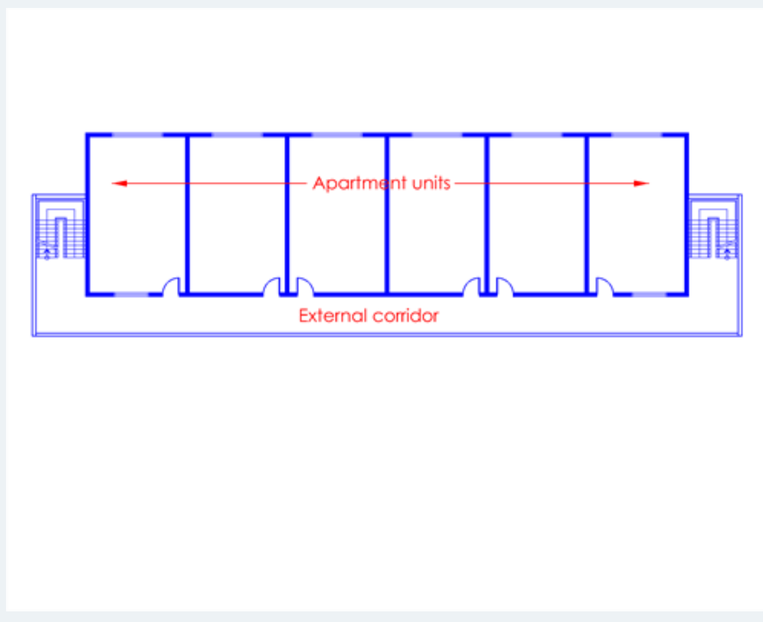


Figure 2.2.5 - 1 : Typical floor plan of standard slab design

The capacity of exit doors to the industrial units, corridor, exit doors to staircases and exit staircases are measured in units of width of one half of a metre i.e.:

Exit door/corridor/staircase clear width	Number of unit width
1m	2
1.5m	3

2m	4

Where a fraction of 250mm or more are added to one or more full units, half of a unit of width shall be credited, for example:

Exit door/corridor/staircase clear width	Number of unit width
1000 to 1249mm	2
1250 to 1499mm	2.5
1500 to 1749mm	3
1750 to 1999mm	3.5
2000mm (maximum)	4 (maximum number per exit)

The number of persons per unit of width shall be determined by the type of occupancy and type of exit as listed under *Table 2.2A* of the current Fire Code.

Example 1 : High hazard building

1 unit width = 500mm = 30 and 40 persons per unit width through staircase and doorway respectively.

Therefore: 1m doorway facilitates escape for 80 occupants from a high hazard factory, while 1m of its stairway permits escape for only 60 of its occupants.

The high hazard building has very much more stringent requirements than other buildings. It is due to the nature of its contents. In an emergency situation, because of the highly volatile or explosive nature of the contents, its occupants have very little reaction time to evacuate to a safer area. Hence, exits must be designed such that they are more readily available for escape purposes.

Where a room or space is required to be provided with two exits, each exit shall be of sufficient width to accommodate not less than one half the total occupant load.

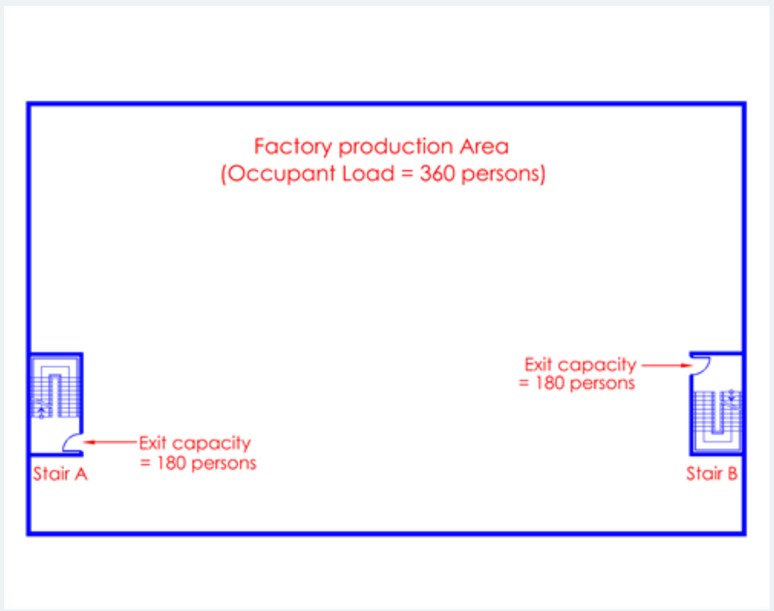


Figure 2.2.5 – 2 : Acceptable distribution of exit capacity

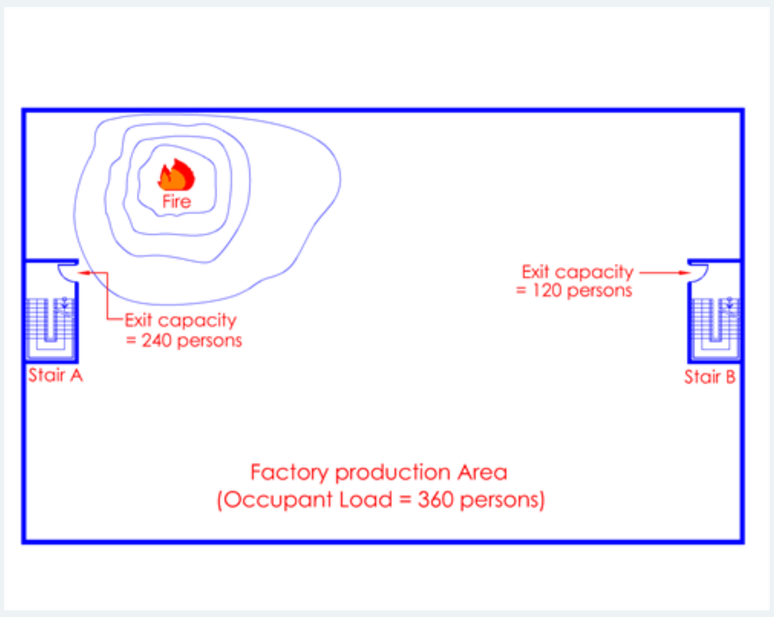


Figure 2.2.5 - 3 : Not Acceptable distribution of exit capacity

The above sub-clause is to address the problem, which may arise if staircases are not proportionately sized and distributed. For example, a fire near Stair A in *Diagram 2.2.5 –3*, which is designed to facilitate escape for 240 persons, can render it inaccessible. This would mean that, the other exit, stair B, which is only designed for 120 persons' escape, would hence need to facilitate escape for the full OL of 360 persons from that storey.

This scenario would render stair B to be drastically inadequate to facilitate all the occupants' timely escape, before the fire and smoke engulf the entire floor space. This is because it would require three times as long to evacuate the occupants from that storey using only stair B.

Imagine the consequences, for a scenario where the entire staircase A with the larger exit capacity is totally damaged or not usable in a high-rise building fire.

a. The capacity of exits, exit staircases, exit passageways, corridors, exit doors and other exit facilities shall be measured in units of half a metre's width. The number of persons per unit of width shall be determined by the type of occupancy and type of exit as listed under *Table 2.2A* In the determination of each exit width, fractions of a unit width less than 250mm shall not be factored in the measurement. Where 250mm or more are added to one or more full units, half of a unit of width shall be factored in.

b. Where a room or space is required to be provided with two exits, each exit shall be of sufficient width to accommodate not less than half the total occupant load.

2.2.6 Determination of travel distance

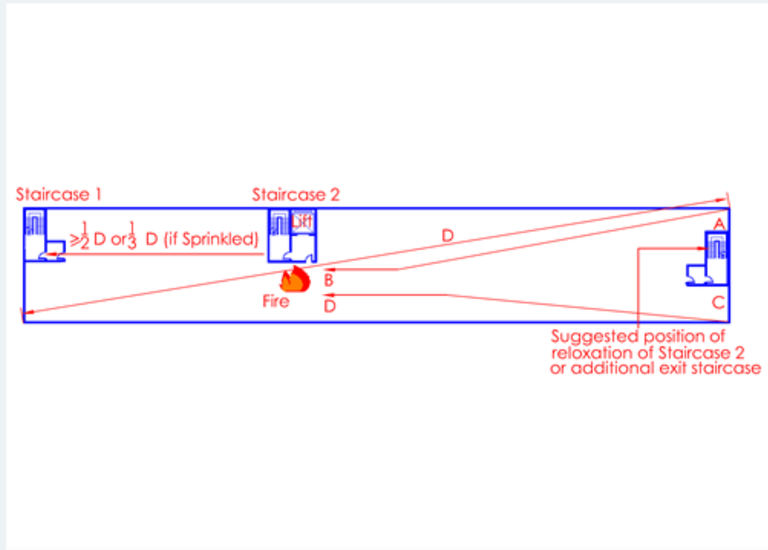
The maximum travel distance for the respective types of occupancies shall be not greater than as laid down in *Table 2.2A* and read in conjunction with all of the following:

a. In the case of a floor area designed with minimum two exits, the maximum travel distance as given in *Table 2.2A* shall be applicable. The maximum travel distance starting from the most remote point in any occupied space to the nearest exit, shall not exceed the limits specified in *Table 2.2A*.

Rationale

The travel distance serves to limit the distance a person is required to travel from the occupied space to an exit staircase door, which every designer should observe. On the other hands, it must also be stated that conforming to the permissible travel distance alone does not necessarily guarantee building occupant life safety during an emergency.

Explanation and Illustrations



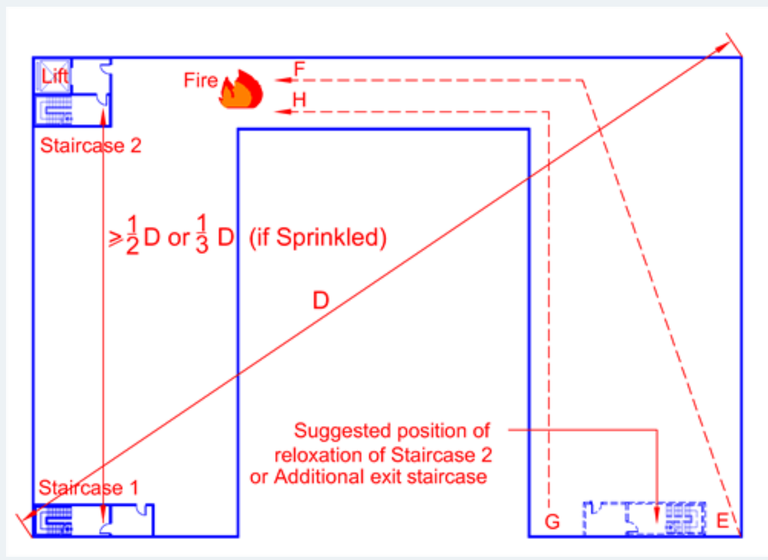


Figure 2.2.6a. : Not acceptable separation of exit staircases

In the above figures, the exit staircases are not remotely located from each other to reduce the possibility that more than one staircase can be blocked off by fire or other emergency condition. The escape routes AB, CD, EF, and GH are all considered as one-way direct travel as there is no alternative escape route. Occupants escaping in a fire emergency are unable to reach the nearest staircase as the escape routes are blocked by fire. The distribution of the staircases does not meet the intents of Cl.2.3.12 of current Fire Code, which require that "such exits shall be remotely located from each other and shall be arranged and constructed to minimise the possibility that more than one can be blocked by any fire or other emergency condition".

In the above figures, direct travel distances, which are highlighted, will be considered as one-way direct travel instead of two-way direct distance travel. To overcome the problems of one-way direct travel, relocation or addition of an exit staircase would be necessary, subject to meeting the direct travel distance requirements.

b. In a large floor area without sub-division of rooms, corridors and so forth, the travel distance can adopt the "direct distance" concept as a guide and shall not exceed two-third of the maximum travel distance permitted under *Table 2.2A*. Where the large floor area is undergoing sub-division of rooms, corridors, etc., the maximum travel distance shall be in accordance with *Table 2.2A*.

Rationale

The two-third direct distance method is intended to guide designer for planning of large open floor layout for facilitating flexibility for future inclusions and changes in layout. This guide serves to minimise problem of complying with travel distance during subsequent A/A works.

Explanation and Illustrations

Similarly, if the details of the internal layout are furnished on the building plan submissions, hence the actual travel distances permissible under the *Table 2.2A* would be taken into account.

However, in most situations during the planning and building plan submission stages of a building, its designer is unable to confirm the layout of the storey spaces. It is therefore recommended that the direct distance measurements, which are two thirds of the allowable travel distances, be strictly applied to such 'open' plans.

Example

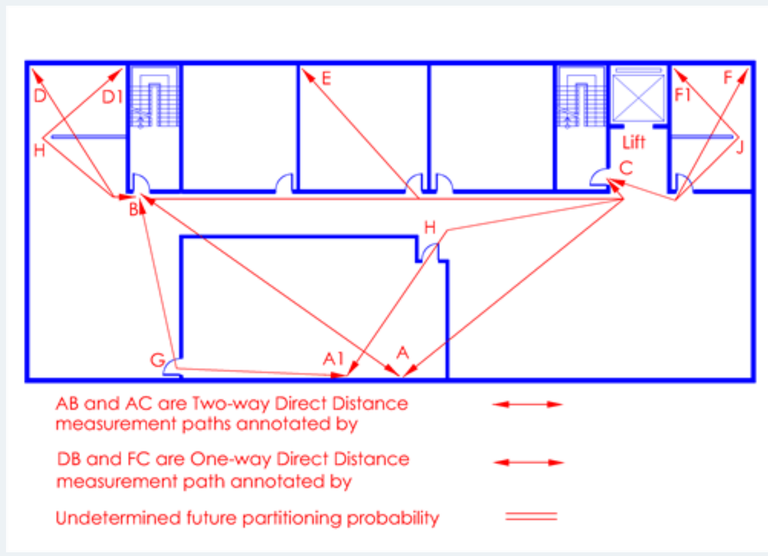


Figure 2.2.6b. - 1 : Typical single tenancy single office storey

The dotted walls in *Figure 2.2.6(b) - 1*, for example, may not be shown on plan and/or may be of differing configurations. In such indefinite situation, a straight line drawn from the most remote point A to B or C shall be taken as the two-way direct distance. If the maximum permissible two-way travel distance given in *Table 2.2A* for such usage is 60m (sprinkler-protected), then the direct distances (straight lines AB or AC) shall not exceed 40m, i.e. ⅔ x 60m. This shall also apply to the one-way distances BD and CF, as the actual one-way distances could possibly be D1HB and F1JC.

This application of the direct distance measurements, besides facilitating flexibility for future inclusions and changes in layout, ensures that escape distances for the occupants would not subsequently be excessive and life threatening in a fire emergency.

(Note: "travel distance" is to be taken as direct distance).

Maximum escape distance design parameters

Item	Sprinklered			Non-sprinklered		
	Shops	**Offices**	Places of public resort	Shops	Offices	Places of public resort
1-way Travel Distance (m)	25	30	25	15	15	15
1-way Direct Distance (m)	16.6	20	16.6	10	10	10
2-way Travel Distance (m)	60	75	60	45	45	45
2-way Direct Distance (m)	40	50	40	30	30	30

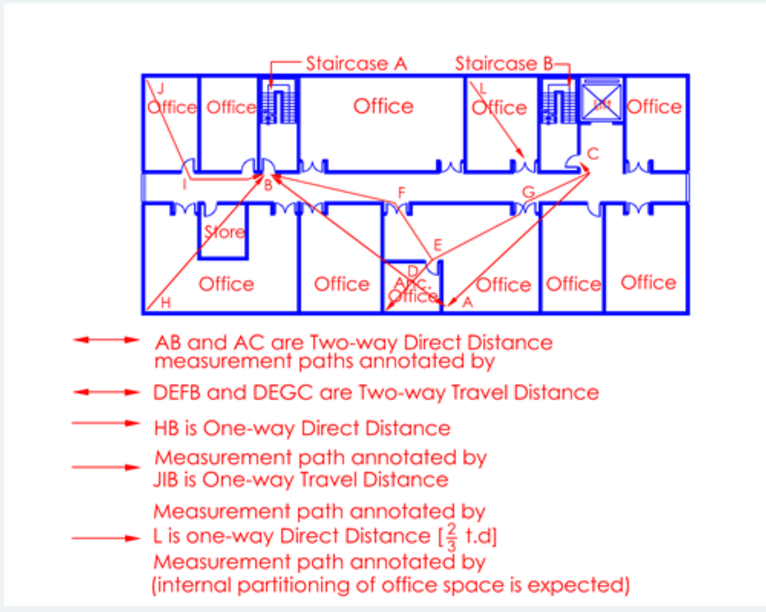


Figure 2.2.6b. - 2 : Typical storey plan of an office building

DIRECT DISTANCE = ⅔ TRAVEL DISTANCE

The actual path that an occupant needs to take from any part of a storey space to the nearest exit door to the external space or exit staircase, will be measured for escape travel distance compliance. This distance takes into account the internal partitions within that floor space and it shall comply with the relevant travel distances stipulated in *Table 2.2A*.

Thus, where details of the internal layout are furnished in the building plan submissions, for example *Figure 2.2.6 (a) & (b) – 1*, the full travel distances permissible under the *Table 2.2A* would be applied.

However, in most situations during the planning and building plan submission stages of a building, the designer is unable to confirm the internal layout of the storey spaces. It is recommended that the direct distance measurement, which is two thirds of the allowable travel distances, should be applied to such 'open' layout plans.

Example

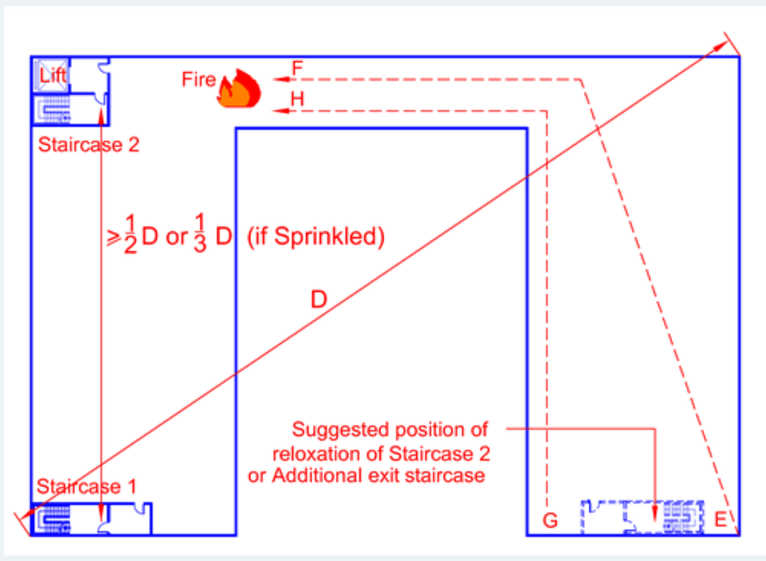


Figure 2.2.6b. - 3

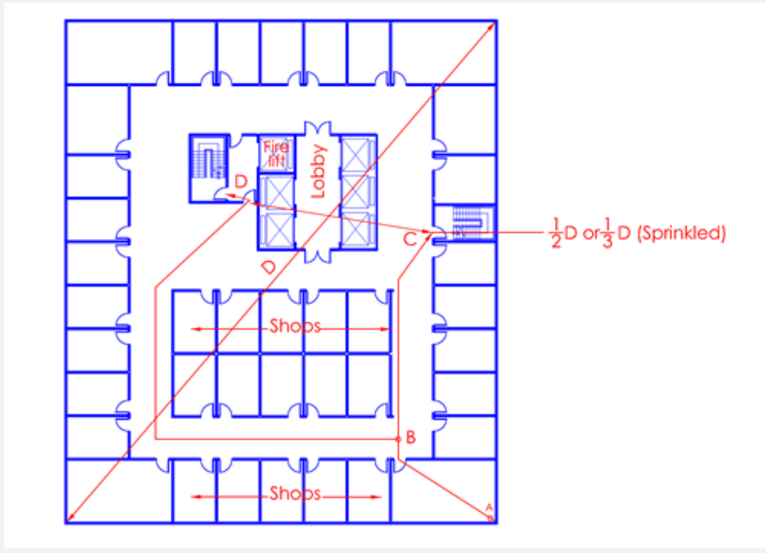


Figure 2.2.6b. - 4

A to B is considered as one-way travel distance and it shall be not more than 25m (sprinkler-protected). In computing two-way travel distance, the escape route from point A, B, C shall not exceed 60m (sprinkler-protected)

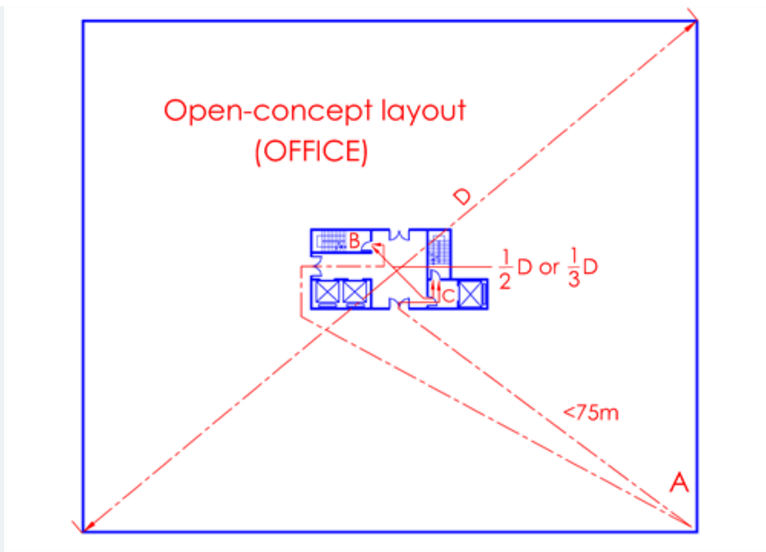


Figure 2.2.6b. - 5

Point A to C and Point A to B are considered two-way travel distance if the separation distance between exit doors of the two staircases is equal to or more than ½D or ⅓D (sprinkler-protected). If the storey space is to be subdivided for occupation by more than one occupier, a common corridor around the service core shall be created to meet the travel distance requirements.

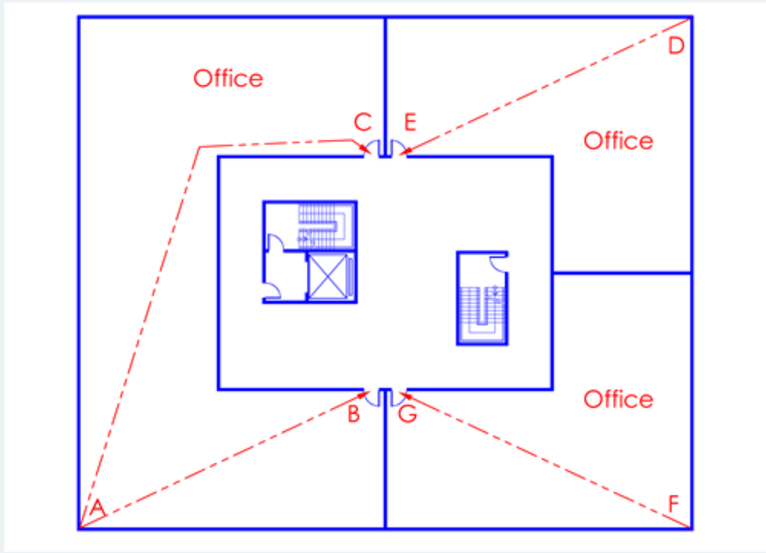


Figure 2.2.6b. - 6

Escape routes AB, AC are considered two-way direct travel. Escape routes DE, FG are considered one-way direct travel distances.

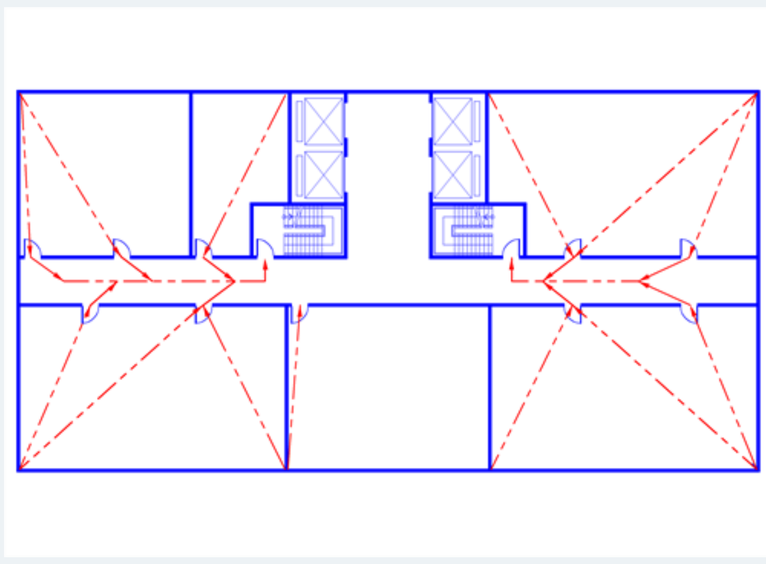


Figure 2.2.6b. - 7

The numerous one-way direct travel distances are illustrated by dashed lines.

The provision of fixed corridors and rooms in an open floor space would create numerous “common paths” from the rooms to the exit staircases as shown in the above figure. Common paths of travel are one-direction travel only without the choice of travelling in another separate direction toward an exit.

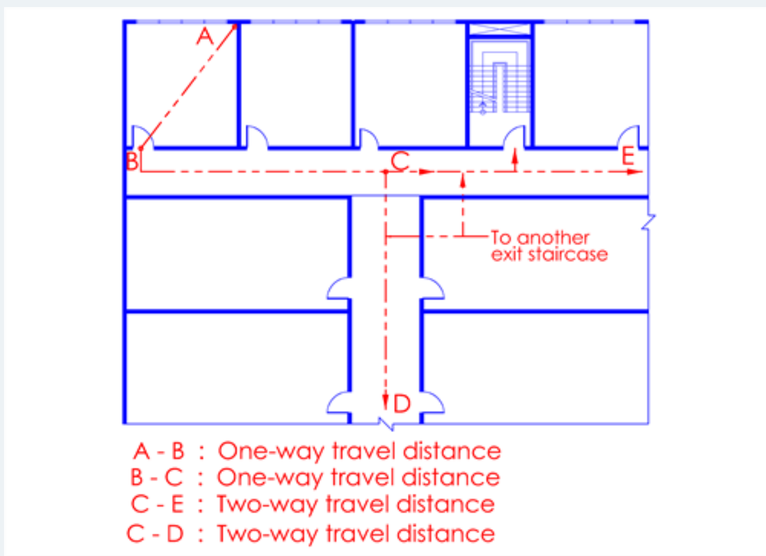


Figure 2.2.6b. - 8

In determining the types of travel distance, Point A, B or C is considered one-way travel distance or “common path”. At point C, where an occupant has the choice of more than one escape direction, would be considered as the starting point for 2-way travel distance. Hence, escape routes C E and C D are considered two-way travel distance.

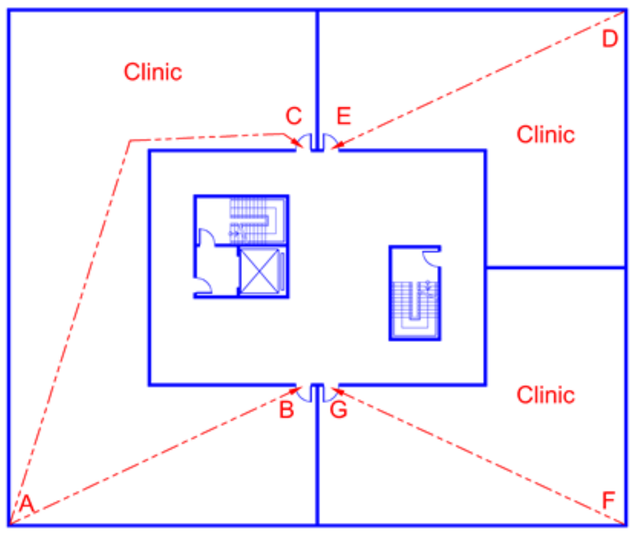
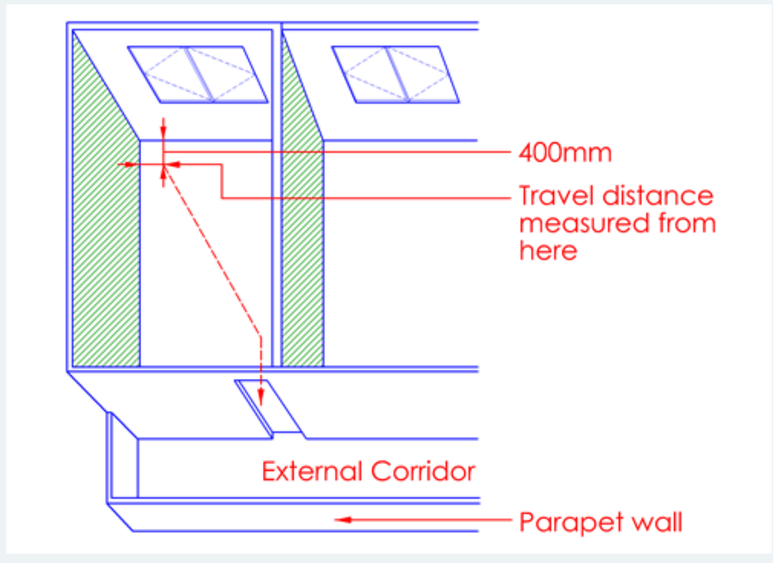


Figure 2.2.6b. - 9 : Example of 1-way direct & travel distances from subdision of storey spaces

Escape routes AB, AC are considered two-way direct travel. Escape routes DE, FG are considered one-way direct travel distances.

c. For the purpose of this clause, the most remote point from which the travel distance is measured shall be taken as being 400mm from the enclosure walls of the room or space.

Explanation and Illustrations



Axonometric Section

Figure 2.2.6c.

d. In the case of a residential apartment or maisonette, the travel distance shall be determined based on the provisions under *Cl.9.2.1a.(5)*.

e. Where area of refuge is provided in lieu of required exits, travel distance shall be measured to the exit door at the corridor leading to the area of refuge.

Explanation and Illustrations

Where an area is designated as 'area of refuge' (Building B in *Figure 2.2.6e.*, it must have adequate provision of exit facility and shall be adequate in size to hold the occupant load it receives from the floor area (Building A) it serves, allowing at least 0.3m² per person. Area of refuge acts as a temporary holding area allowing the occupants more time for evacuation. Hence, it shall be protected from the fire and smoke risk from building A via the provision of cross-ventilated bridges or external corridors.

Reference shall also be made to *Cl.1.4.9* and Cl.2.2.15 for more explanations and details on the area of refuge.

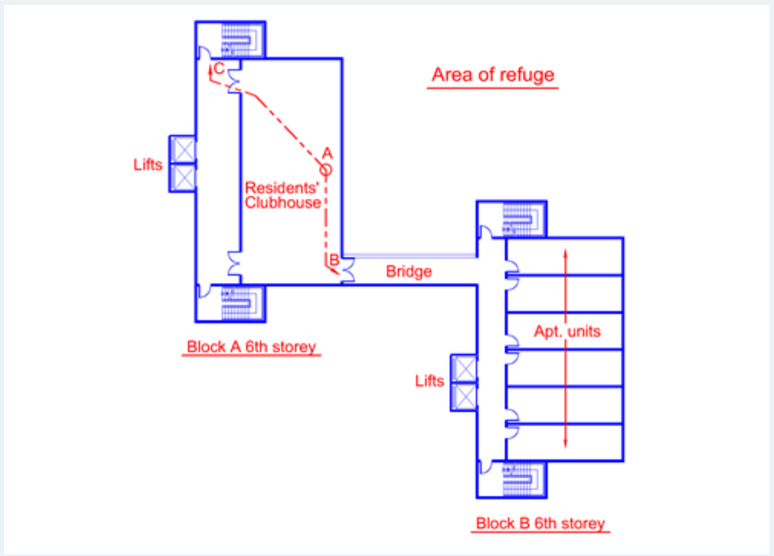


Figure 2.2.6e. Area of refuse located in other compartment of the same building connected through a linkway/bridge

Where an area is designated as 'area of refuge' (Building B in *Figure 2.2.6e. – 1 & 2*), it must be adequate in size to hold the occupant load it receive from the floor area (Building A) which it serves as area of refuge. Area of refuge acts as a temporary holding area allowing the occupants more time for evacuation. Hence, it shall be protected from the fire and smoke risk from Building A via the provision of cross-ventilated bridges or external corridors.

While some conditions for the area of refuge is given below, reference shall also be made to *Cl.1.4.9* and Cl.2.2.15 for more explanations and details on the area of refuge.

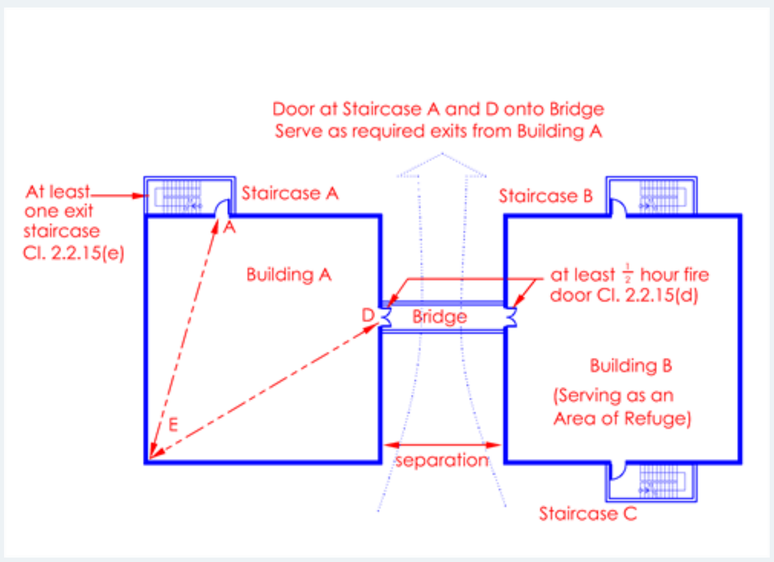


Figure 2.2.6e. - 2 : Area of refuge located in other building connected through a linkway/bridge

Lines EA and ED are taken as two-way direct distance measurements.

General conditions for area of refuge

a. Occupant Load for area of refuge to be based on 0.3m^2 per person.

b. Each connecting area shall have at least one protected staircase or exit facility of adequate width discharging at ground level.

c. Access door to area of refuge shall be kept accessible at all times

d. Door No 1, {in *Figure 2.2.6e. – 2*} leading to area of refuge can also be treated as a required exit from the area served by it, and hence travel distance can also be measured to this door.

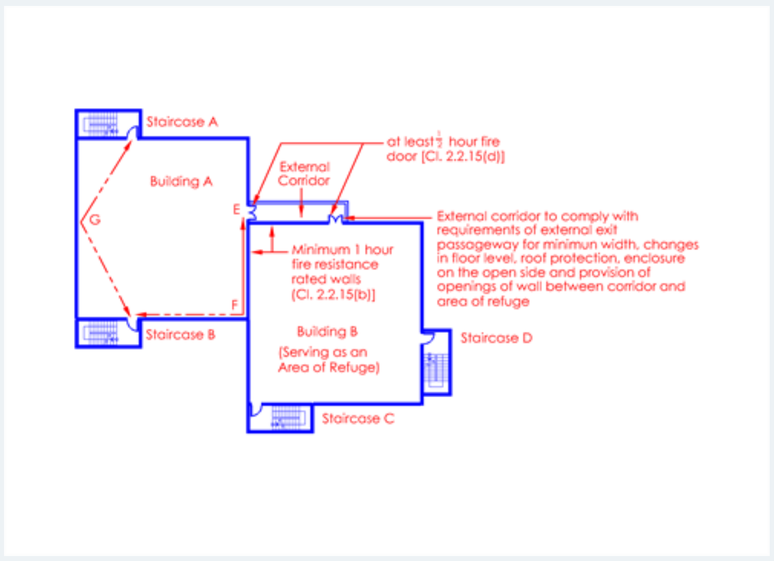


Figure 2.2.6e. - 3 : Area of refuge located in other building connected through an external corridor

General conditions for area of refuge

a. Area of Refuge shall be adequate in size to hold the occupant load it receives from Building A, in addition to its own occupant load calculated on the basis 0.3m^2 per person.

b. Each connecting area or floor served by an area of refuge shall have at least one protected staircase or exit facility of adequate width discharging at ground level.

c. Access door to area of refuge shall be kept accessible at all times.

d. Door D & E, {in *Figure 2.2.6e. – 2 & 3* respectively} leading to area of refuge can also be treated as a required exit from the area served by it, and hence travel distance can also be measured to these doors.

f. Where permitted under Cl.2.3.3 for exit staircases not required to be protected with fire-rated enclosures or to be entered without the provision of an exit door, the travel distance shall be measured to the exit doors at ground level or measured to a position where the exit door would be installed if otherwise required, respectively.

Explanation and Illustrations

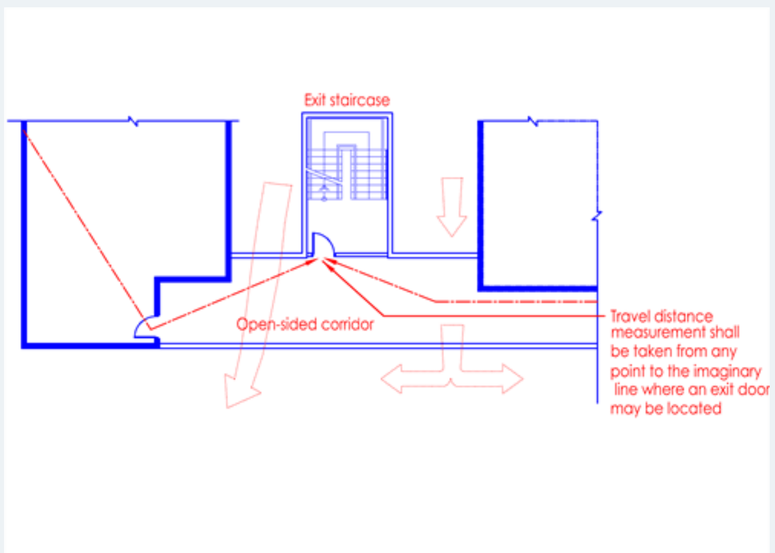


Figure 2.2.6f.

g. Ancillary office within other purpose groups

Where an ancillary office is housed within a space belong to other Purpose Groups, the travel distance requirement for the ancillary office is allowed to be based on PG IV, provided:

(1) the ancillary office is fire compartmented from spaces belonging to the other purpose groups; and

(2) the ancillary office occupants shall have access to exit(s) within the ancillary office compartment leading to direct discharge at ground level into an external space, exit staircase, or internal/ external exit passageway

Explanation and Illustrations

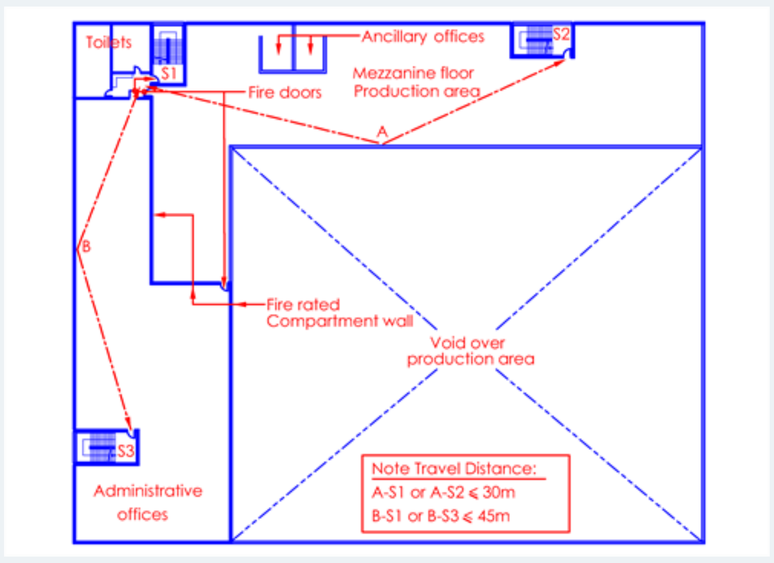


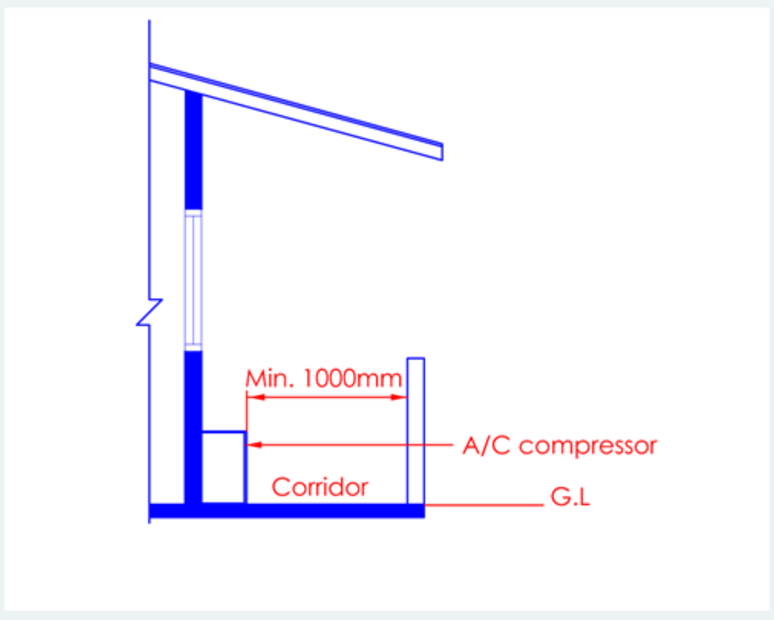
Figure 2.2.6g. : Example of separate travel distance application

The fire risk in office space is lower than factory space. If there is fire separation between office and factory spaces as shown above, the travel distance requirement for the ancillary office is allowed to be based on office use under PG IV.

2.2.7 Minimum width of exit access door, exit door or other exit facilities

a. No exit, exit staircase or other exit facilities shall be narrower than the minimum width requirement as specified under *Table 2.2A*. The minimum clear width of an exit door/ exit access opening shall be not less than 850mm.

Explanation and Illustrations



Section

Figure 2.2.7a. - 1

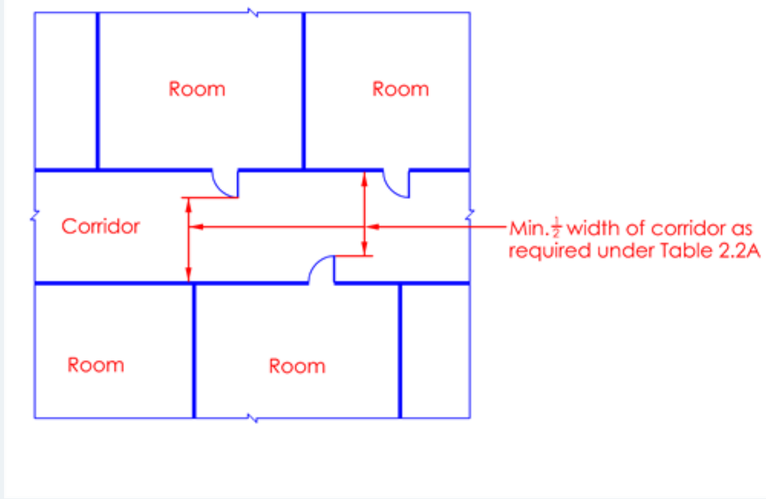


Figure 2.2.7a. - 2

Other exit facilities refer to passageways, defined corridors, etc.

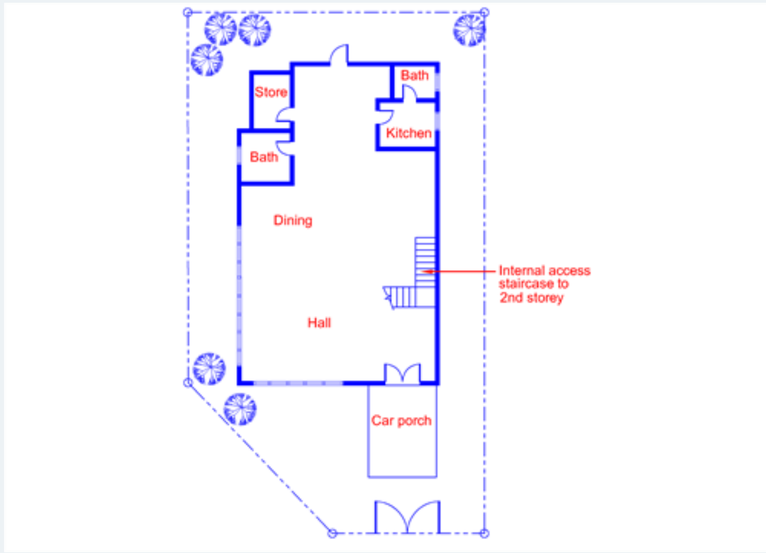


Figure 2.2.7a. - 3

In the case of PG I dwelling unit, the minimum width of corridor and access staircase is 900mm. This relaxation is not applicable to all other purpose group buildings.

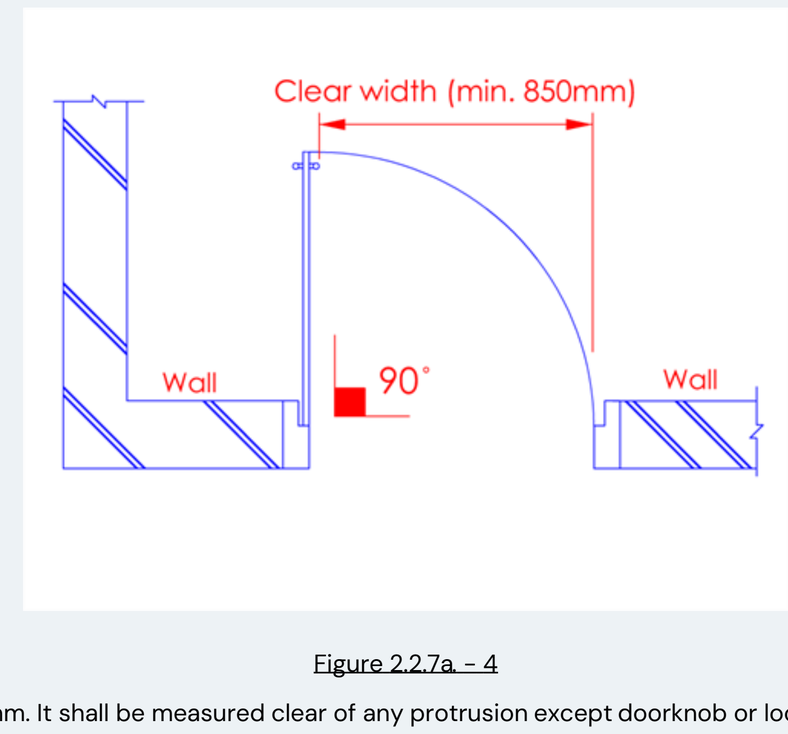


Figure 2.2.7a. - 4

Clear width of exit door opening shall not be less than 850mm. It shall be measured clear of any protrusion except doorknob or lockset, subject to complying with exit requirements. 850mm is equivalent to 1½ units of width only, for the purpose of determining the exit capacity.

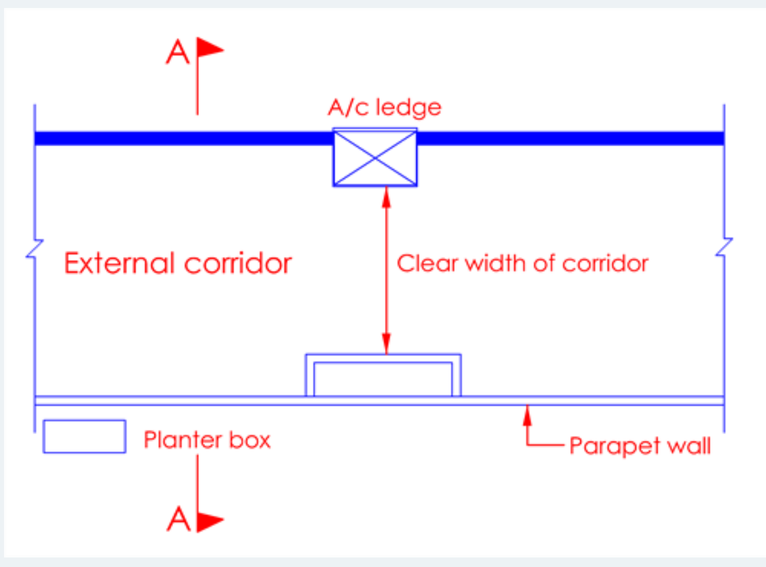
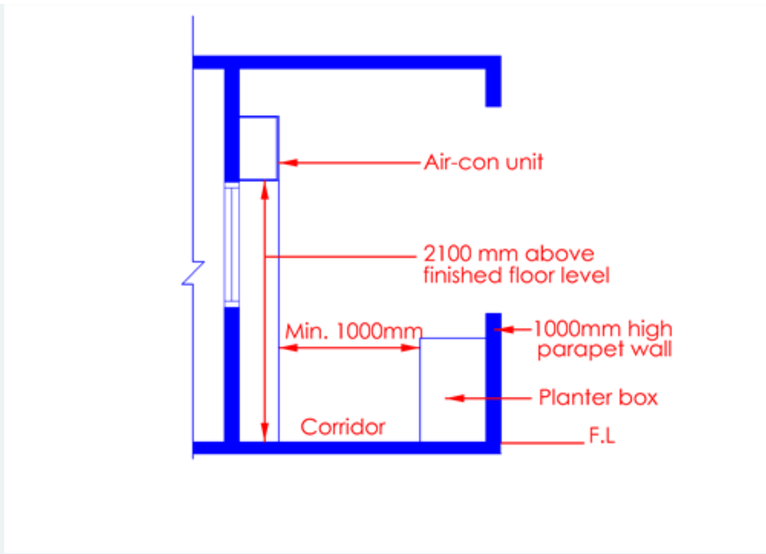


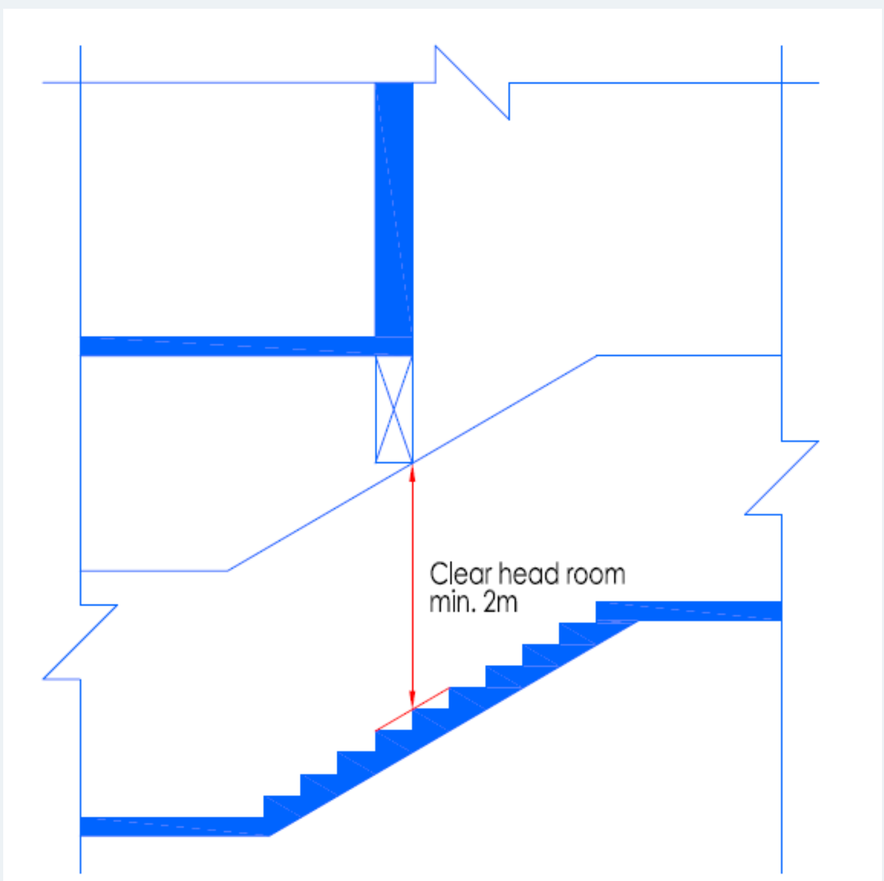
Figure 2.2.7a. - 5

Clear width of corridor leading to an exit shall not be less than 1200m.



Section A-A

Figure 2.2.7a. - 6.



Section

Figure 2.2.7a. - 7

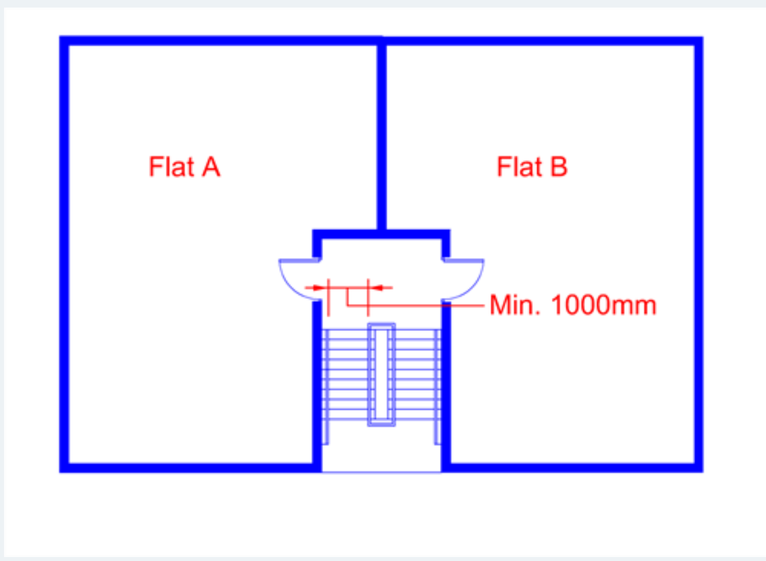


Figure 2.2.7a. - 8

Clear width of exit staircase shall not be less than 1000mm. Please refer to *Cl.2.2.9a.* for details on measuring of width.

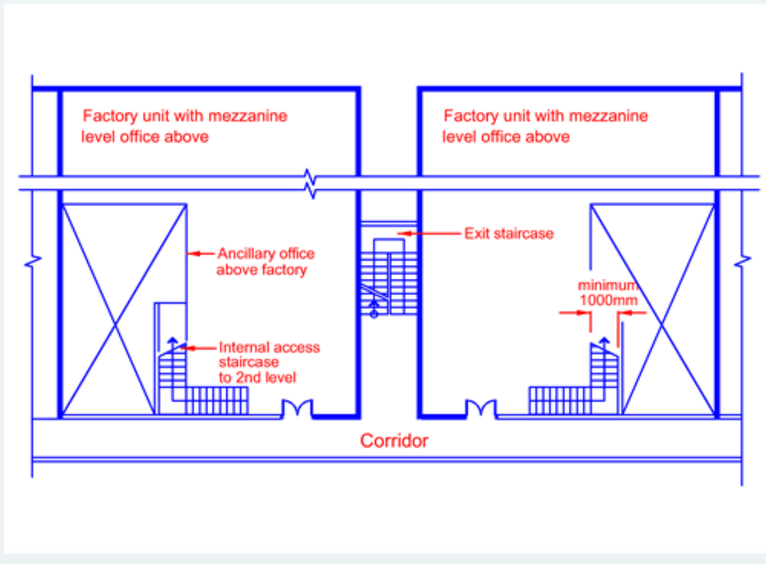


Figure 2.2.7a. - 9

Clear width of internal access staircase in maisonnette unit can be less than 1m but not less than 900mm. This relaxation is only permitted for PG I residential building.

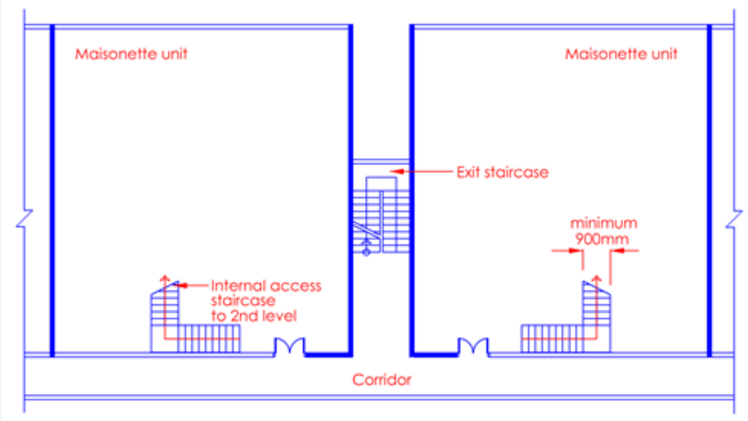


Figure 2.2.7a. - 10

Clear width of internal access staircase in factory unit with mezzanine level office shall not be less than 1000mm. The one-way travel distance from the most remote point of the ancillary office on mezzanine level to the exit door on the main storey level of factory shall not exceed the permissible limits of *Table 2.2A*.

b. Exit access doors serving a room with an occupant load of not more than two persons shall not be less than 610mm in clear width.

c. A single leaf swing door along the means of egress shall not exceed 1.25m in clear width.

Rationale

The purpose of controlling the width of single leaf door is to discourage the use of bigger, heavier leaf doors. This is because there is risk of door sagging and thus require more effort to open the door. To overcome it, 2-leaf doors should be used in larger openings instead of single leaf swing door.

2.2.8 Maximum width of exit staircases

Rationale

The purpose of limiting the maximum effective exit capacity of an exit staircase is to prevent concentration of evacuees at any point of the exit. The consequence of permitting exit staircase without capacity limits could be disastrous if that staircase were rendered unusable in an emergency situation. Dividing staircase into segments not wider than 2m enables better crowd control and orderly evacuation in times of emergency.

Explanation and Illustrations

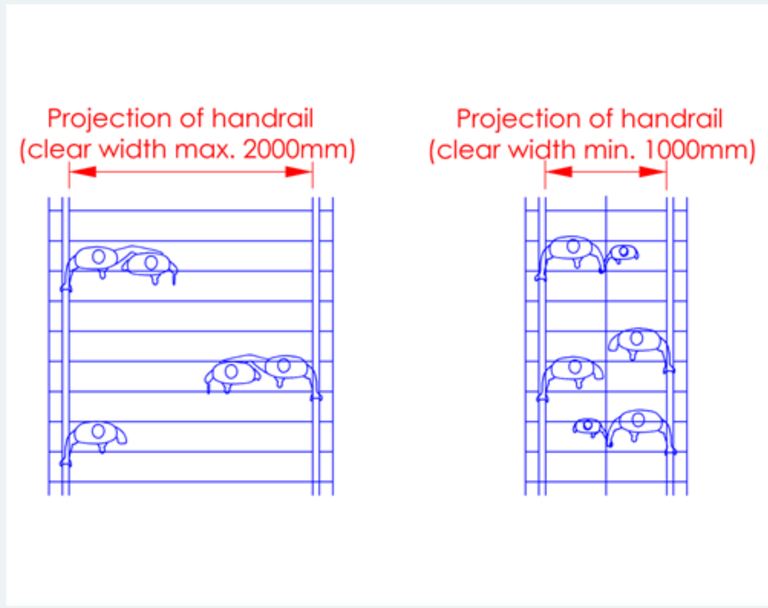
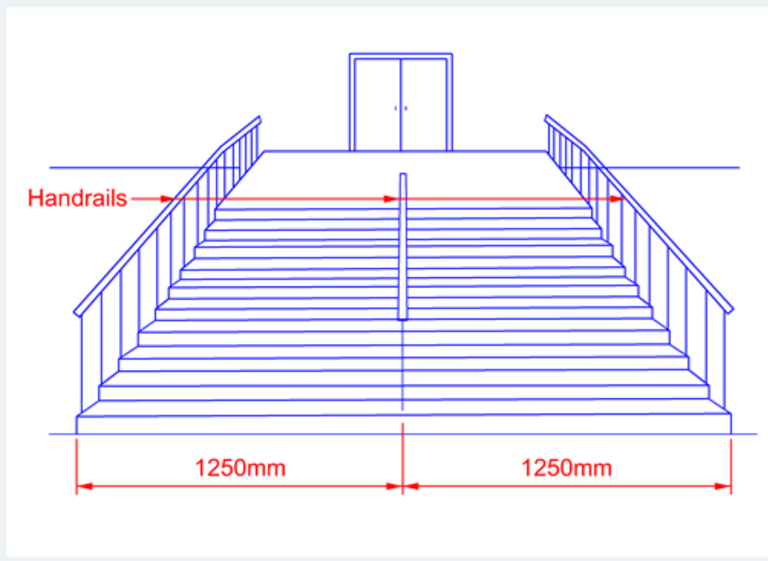


Figure 2.2.8 - 1

The above sub clause does not preclude the design of staircases wider then 2000mm. It is intended to limit the number of occupants to be allocated to a single exit staircase, and thereby, prevent the concentration of the occupant's escape at any one point of exit. The consequences, if higher capacity is to be permitted through an exit without capping would be disastrous, if that staircase is to be rendered unusable, in an emergency situation.

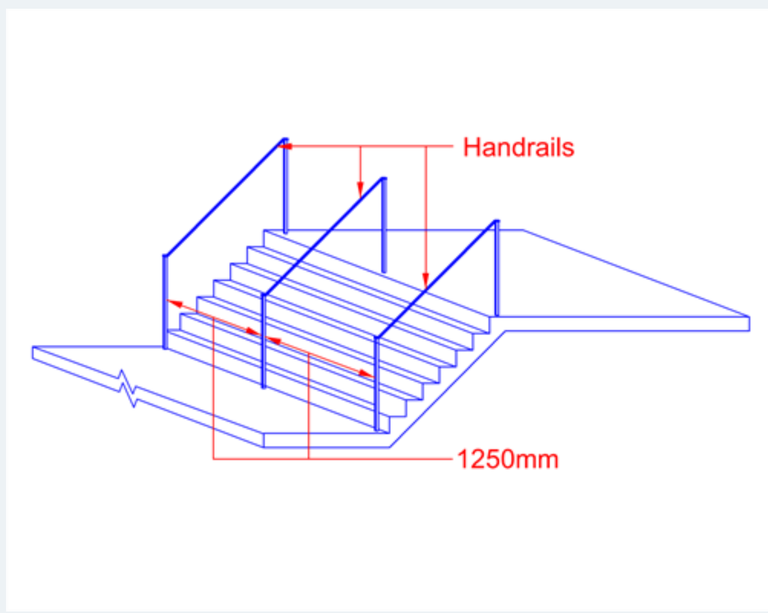
Hence, where a staircase is designed with a width greater than 2000mm, its total exit capacity shall be based on the capacity of only 4 units of exit width when determining the adequacy of exit provisions from that storey of building served by that staircase.

This staircase is also required to be sub-divided equally into 2 or more sections with handrails such that the spacing between the handrails are not less than 1000mm and not more than 2000mm.



Axonometric Section

Figure 2.2.8 - 2



Axonometric view

Figure 2.2.8 - 3

The width of staircase of 2500mm is being divided into 2 sections of 1250mm each by the introduction of an intermediate handrail. Although the staircase is 2500mm clear, it is still computed as 2000mm only. Dividing staircase wider than 2000mm enables better crowd control and orderly evacuation in times of emergency.

a. The maximum width of exit staircases shall be not more than 2m. Where staircases exceed 2m in width, handrails shall be used to divide the staircase into sections of width not less than 1m or more than 2m.

b. For the purpose of determining the exit capacity of a staircase that is wider than 2m that forms part of the required means of escape from any storey of the building, that part of its width in excess of 2m shall not be taken into account.

2.2.9 Measurement of width

Rationale

The allowance of 80mm projection of handrail is considered acceptable as the projection would normally occur at the waist-height of a person. Therefore, it is unlikely to affect the egress within a protected staircase.

The measurement of width referred to under Cl.2.2.7 and Cl.2.2.8 shall be the clear width, including the width of plinth to balustrade or parapet wall:

a. For an exit staircase

The clear width shall be measured between:

(1) the finished surfaces of the walls, if the staircase is enclosed on both sides by walls only, or

Explanation and Illustrations

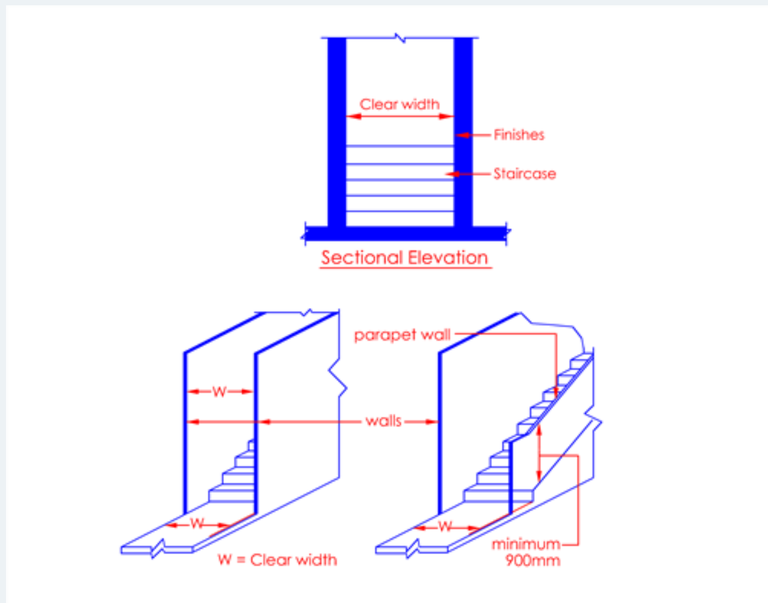


Figure 2.2.9a.(1)

(2) the finished surface of the wall and the inner side of the balustrade, if the staircase has a wall on one side and a balustrade on the other side, or

Explanation and Illustrations

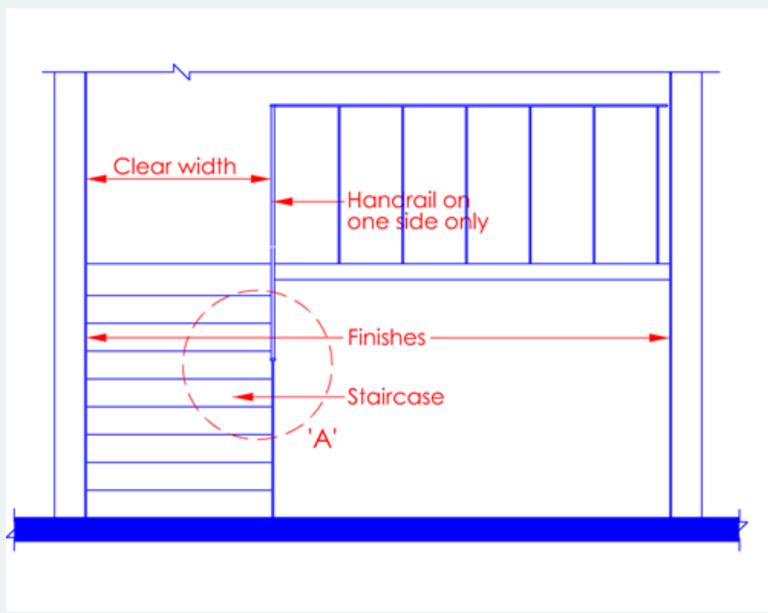
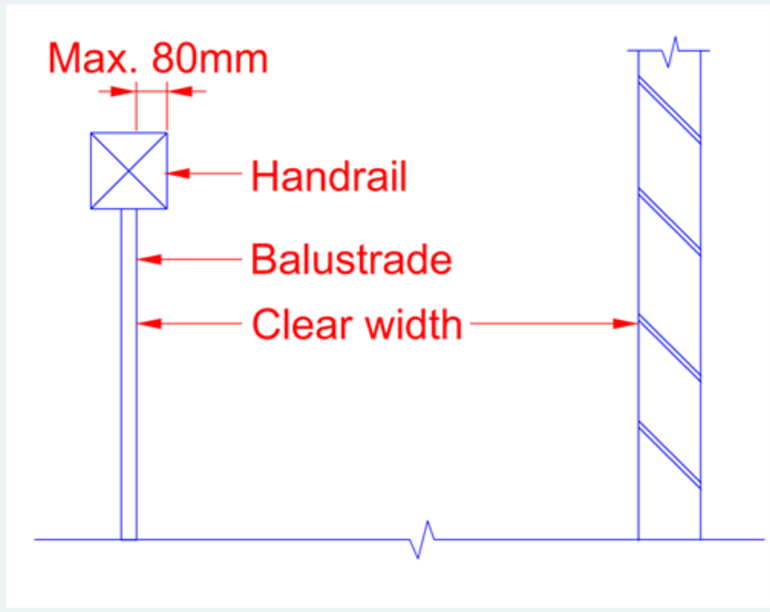


Figure 2.2.9a.(2) – 1



Section

Figure 2.2.9a.(2) – 2

(3) the inner sides of the balustrades if the staircase has balustrades on both sides.

Note: The projection of handrail into the clear width of a staircase shall not exceed 80mm on each side of the staircase. If the projection exceeds 80mm, the clear width of the staircase shall be measured from the inner sides of the handrails.

Explanation and Illustrations

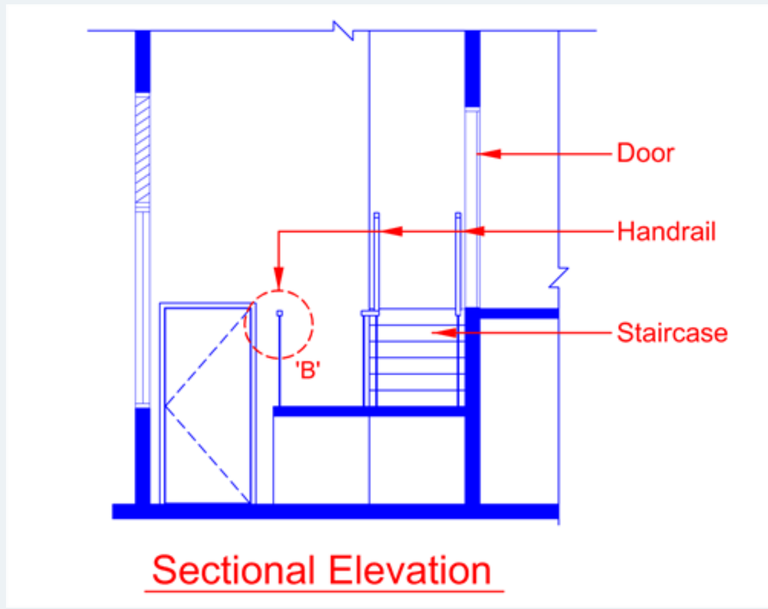
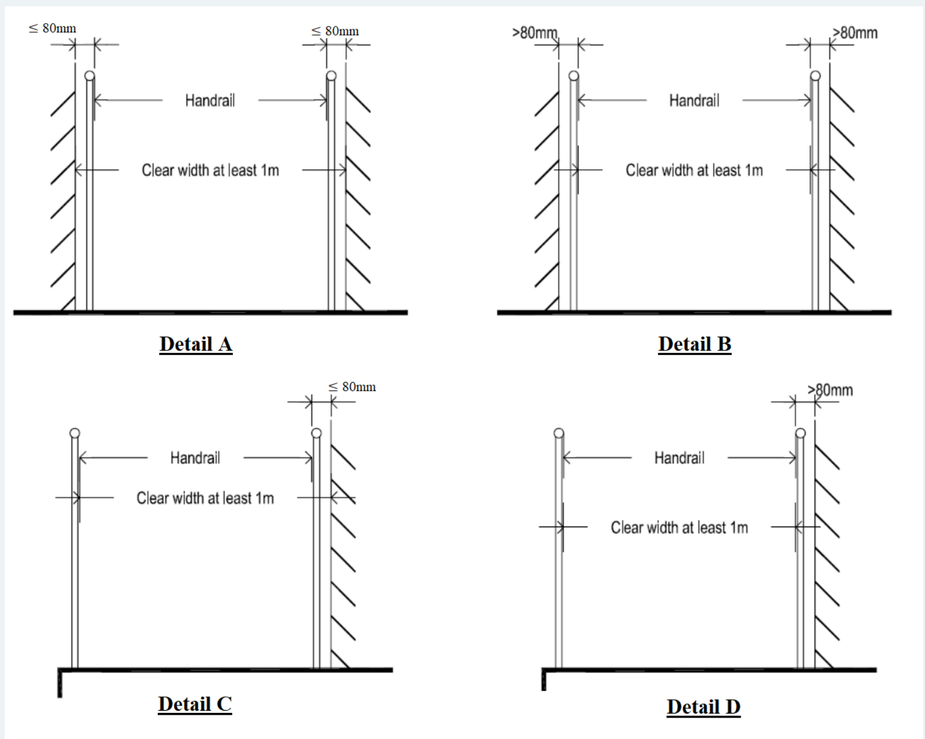


Figure 2.2.9a.(3) – 1



Section

Figure 2.2.9a.(3) – 2

If the projection of handrail exceeds 80mm, the clear width shall be measured between the inner sides of the handrails.

b. For an exit door

(1) In the case of an exit door having a single leaf door, the opening shall be measured between the edge of the door jamb and the surface of the door when opened at an angle of 90°. See *Diagram 2.2.9b.*.

(2) In the case of a 2 leaf exit door fitted with an approved automatic flush bolt, the clear openings shall be measured between the surface of one leaf to the other door leaf when opened at an angle of 90°.

(3) If one of the door leaves is bolted to the door frame and/ or floor by a manually operated bolt, this door leaf shall not be considered for the purpose of determining the exit capacity of the door. The opening of the other door leaf shall have a clear width of not less than 850mm, measured between the edge of the bolted door leaf and the surface of the other door leaf, when opened at an angle of 90°.

(4) Door hardware and handrails which do not protrude more than 80mm into the clear width of exit opening can be disregarded.

Explanation and Illustrations

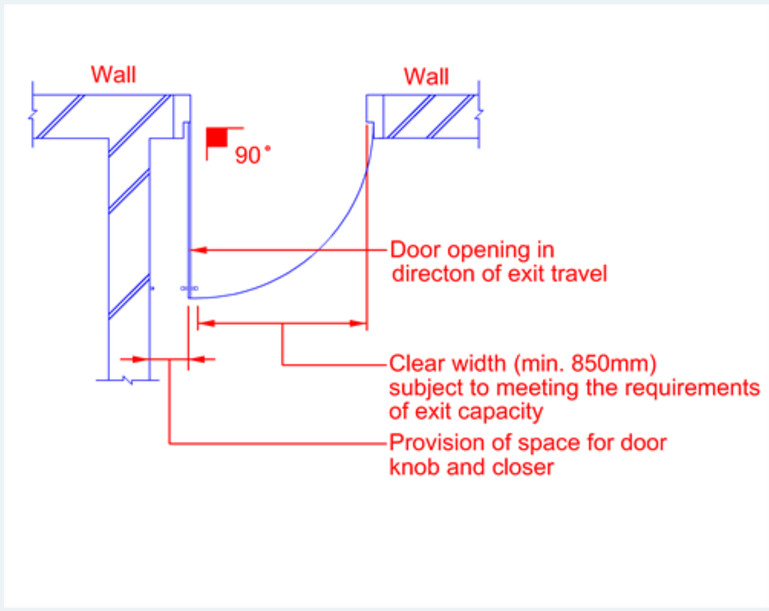


Figure 2.2.9b. - 1: Single leaf door

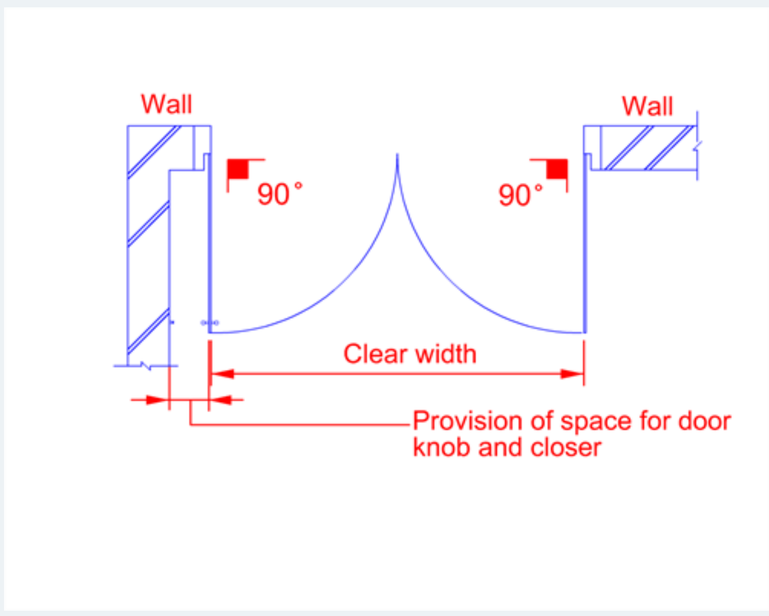


Figure 2.2.9b. - 2 : 2-leaf door

The terminology “2-leaf” is generally known as “multi-leaf” a common term in the building industry. It may comprise of leaf door panels of different sizes. The smaller leaf door may be bolted onto the floor and opened only to facilitate shifting of bulky items. The smaller leaf door if intended to be kept in closed position and not use as escape, it need not be provided with door closer.

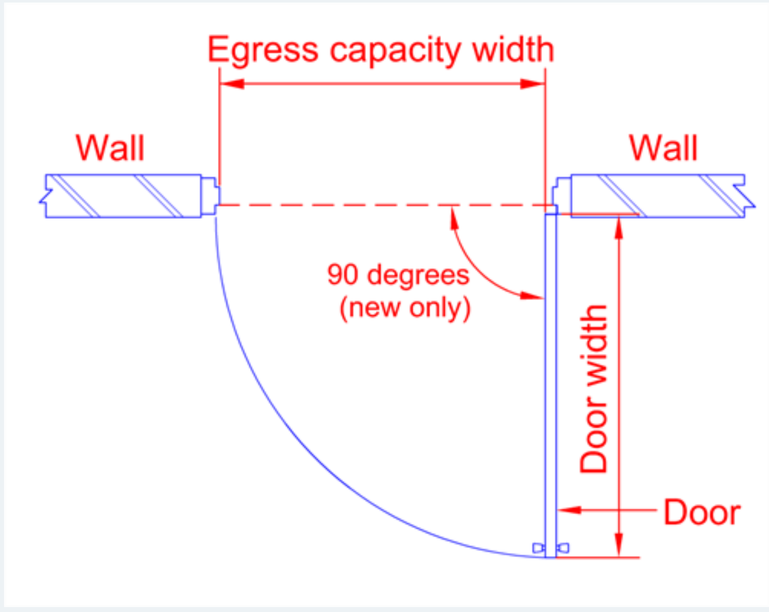


Figure 2.2.9b. - 3 : Minimum clear width

Determining the egress width of swinging doors for purposes of calculating capacity, only the clear width of the doorway when the door is open 90 degrees shall be measured. In determining the egress width for other types of doors for purposes of calculating capacity, only the clear width of the doorway when the door is in the full open position shall be measured. Clear width of doorways shall be measured between the face of the door and door frame.

2.2.10 Number of exits from rooms and spaces

There shall be at least two door openings remote from each other which lead to exits from every room or enclosed space in which the total occupant load exceeds the maximum permissible occupant load for one door as listed in the table below:

TABLE 2.2.10 – PERMISSIBLE OCCUPANT LOAD FOR ONE DOOR

Type of Occupancy	**Max. Occupant Load**
High hazard	25
Patient accommodation area	50
Classrooms	50
Godowns, stores, and factories not of high hazard type	50
Assembly	50

Note:

(a) The number and minimum width of exits for rooms and spaces with occupancy of more than 50 persons shall comply with provisions in Table 9.7.3a. for assembly occupancy
(b) For residential occupancy, see Cl.9.2
(c) For healthcare occupancy, see Cl.9.3.2
(d) For office/shop/factory/warehouse occupancy, see Cl.9.4, Cl. 9.5, Cl.9.6, and Cl. 9.8
(e) For hotels, see Cl.9.7.2
(f) For assembly occupancy, see Cl.9.7.3

2.2.11 Number of exit staircases or exits per storey

Rationale

Where possible, occupants should not be denied of alternate egress to an exit staircase. By having minimum two exit staircases, it provides an alternative for occupants to access either. This clause also addresses exit provision for non-habitable roofs and incorporates fixed ladder and access hatches requirements.

Explanation and Illustrations

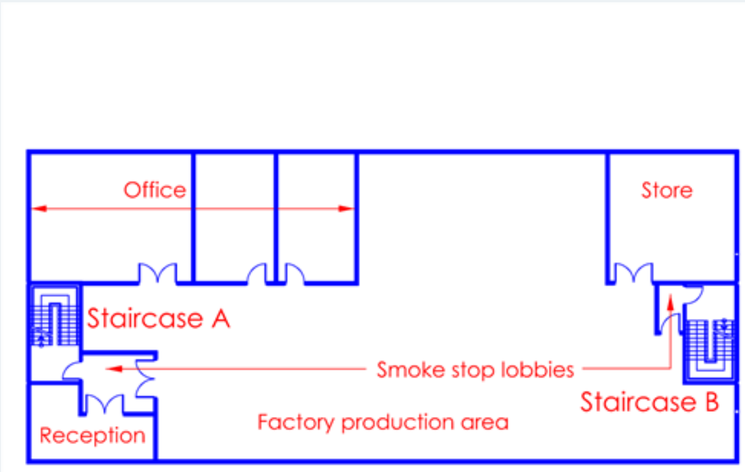


Figure 2.2.11

Minimum requirement – 2 exit staircases per storey

Single exit is permissible if the storey of the building can satisfy the conditions stipulated in Cl.2.2.10 and Cl.2.6.

Single staircase provision is permitted for residential buildings under *Cl.9.2.1a.(3)*, *Cl.9.2.1a.(4)* and commercial/industrial buildings under *Cl.9.4.1a.*, *9.5.1a.*, *9.6.1a* or, *9.8.1a.*.

There shall be at least two independent exit staircases or other exits from every storey of a building, unless otherwise permitted under other subsequent provisions of the Code.

Exception

a. For non-habitable roof that is able to comply with one-way travel distance, at least one exit staircase shall be provided. The travel distances for roof areas which are open-to-sky shall be based on the requirements for sprinkler-protected buildings.

b. For non-habitable roof that is unable to comply with one-way travel distance to the exit staircase, an additional cat/ ship ladder adequately separated in accordance with Cl.2.3.12 and leading to the circulation area of the floor below shall be provided. All access hatches, if provided, shall be readily accessible from the roof. Access hatch opening shall have a minimum clear width of 1m in diameter. The travel distances for roof areas which are open-to-sky shall be based on the requirements for sprinkler-protected buildings.

c. Roof of the protruding structures above the non-habitable roof, namely exit staircase shafts and lift motor rooms.

d. For green roofs which are accessible for maintenance purposes only, the means of access shall comply with *Cl.10.2.1b.(1)(a)*.

2.2.12 Location of exits & access to exits

All exits and access facilities shall be required to comply with all of the following:

a. Exits and access facilities shall be clearly visible or their locations shall be clearly indicated and shall be kept readily accessible and unobstructed at all times.

b. Every occupant within a building or storey of a building shall have direct access to the required exit or exits without the need to pass through another room(s) or other tenanted space(s). Where direct access to the required exit or exits of the storey is not possible, occupants shall only be allowed to pass through a maximum of one other room or space belonging to the same tenant with the following conditions being complied with:

(1) the exit access door separating the rooms or spaces which the egress route passes through shall only be fitted with electromechanical device designed in accordance with *Cl.2.3.9k.(2)*;

(2) the doorway of the exit access door shall not be blocked/obstructed and be kept clear at all times.

(3) warning signs of wording “Exit Access Door - Keep Clear” shall be placed prominently on both sides of the exit access door, and

(4) the egress paths through the exit access door shall be suitably demarcated.

Explanation and Illustrations

Where any storey of a building is occupied by more than one tenant, it is imperative that each occupant from any of the tenancies shall have direct accessibility to alternate exit staircases without having to enter other tenancies. This could be facilitated via common or neutral spaces like corridors or lobbies that are accessible to all occupants on that storey.

Examples of correct method of determining access travel routes to the required exits:

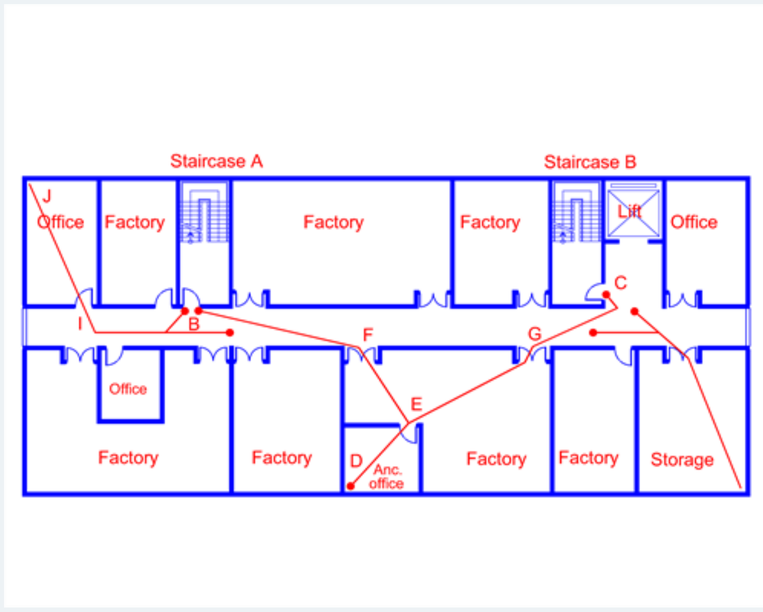


Figure 2.2.12b. – 1 : Multiple tenancy – each with access to the two exit staircases

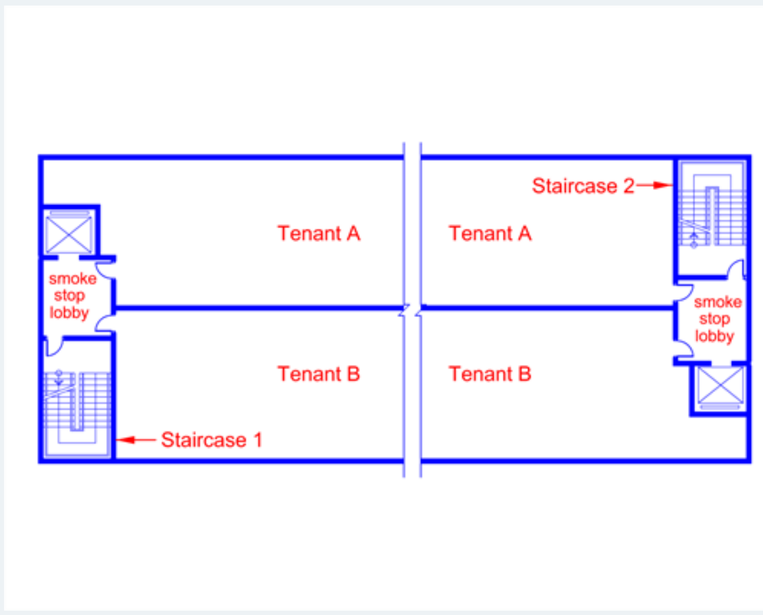


Figure 2.2.12b. – 2 : Two tenancies, both with access to two smoke-stop lobbies

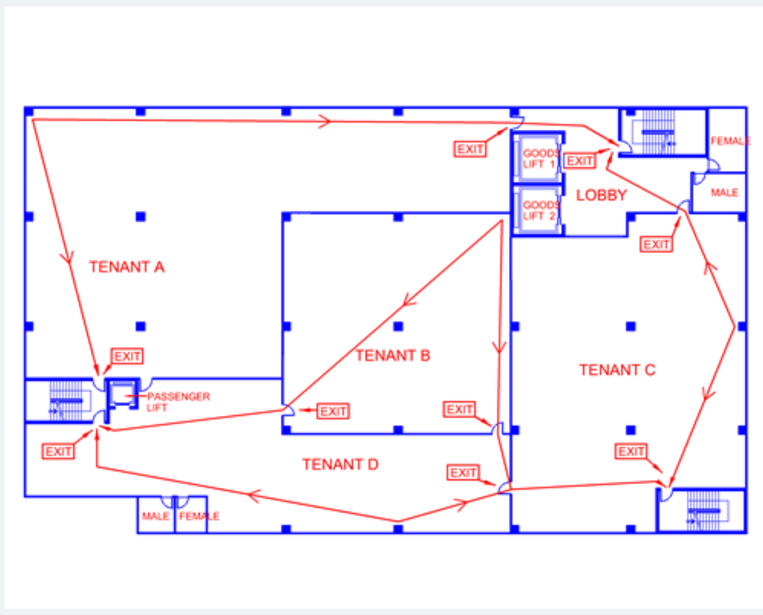


Figure 2.2.12b. – 3 : Example of incorrect method of locating exits

The above figure shows an incorrect method of determining access travel routes as the paths have to traverse through other tenancies. Though tenants A and C may have adequate exits, tenants B and D will not be able to meet required exit provisions and hence it would not be allowed.

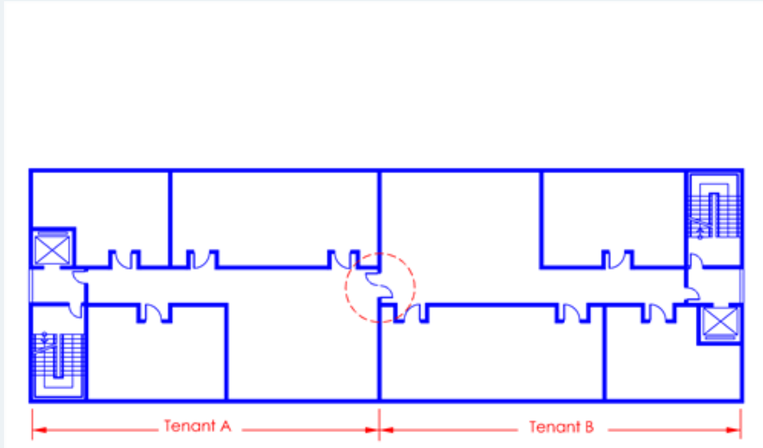


Figure 2.2.12b. – 4 : Another example of a layout that is NOT acceptable

This arrangement of exits for the separate tenancies is not acceptable because the central door, circled in *Figure 2.2.12b. – 4*, would be kept locked for security reasons and to prevent or avoid any intrusion from one another. This would render the occupants from that storey with insufficient number of exits for escape in an emergency.

c. When more than one exit is required from any room or space or a storey of a building, each exit shall be placed as remote as possible from the other as permitted under *Cl.2.3.12a., b., c.* or *d.*.

Rationale

To reduce the possibility of more than one exit staircase being rendered unusable simultaneously by fire or other emergency situations, the exit staircases are to be remotely located from each other.

Explanation and Illustrations

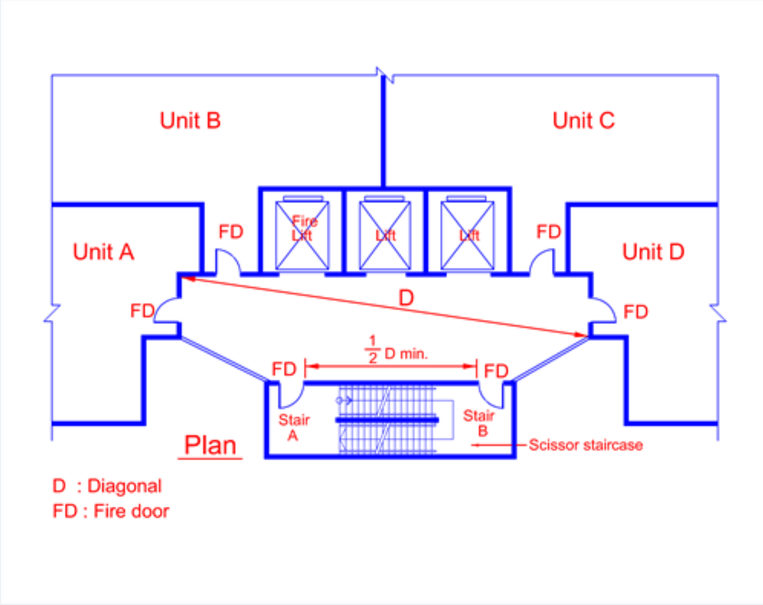


Figure 2.2.12c. - 1 : Acceptable locations of exits

The distance between the sides of the two exit doors to the scissor staircases A and B shall be equal to or more than one half the length of the maximum overall diagonal dimension (D) of the lobby, or 7m, whichever is greater. Please refer to Cl.2.3.4 as these are conditions for compliance of scissor staircase.

Permanently fixed ventilation openings in the external walls to the lobby shall not be less than 15% of the lobby floor area and located not more than 9m from any part of the lobby (see *Cl.2.2.13b.(7)(a)* & *(b)*).

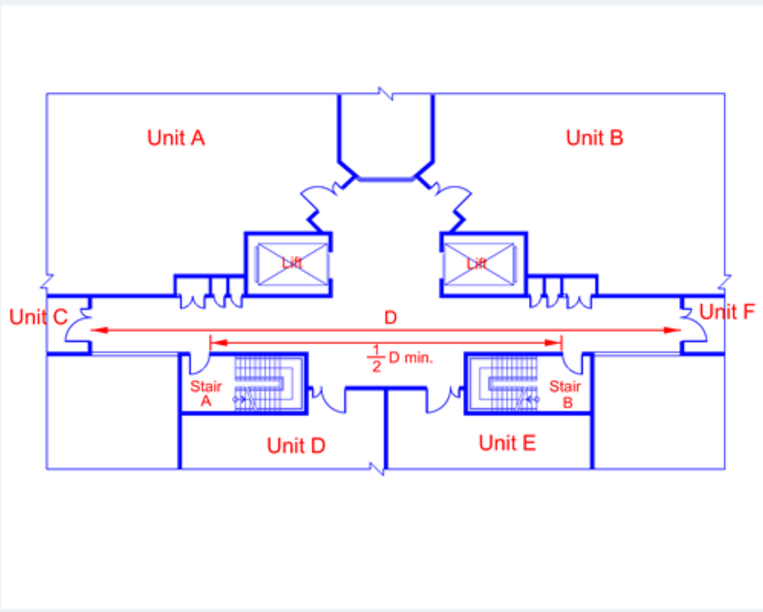


Figure 2.2.12c. - 2 : Acceptable locations of exits

This method of measurement for unit exit door is only applicable to residential buildings.

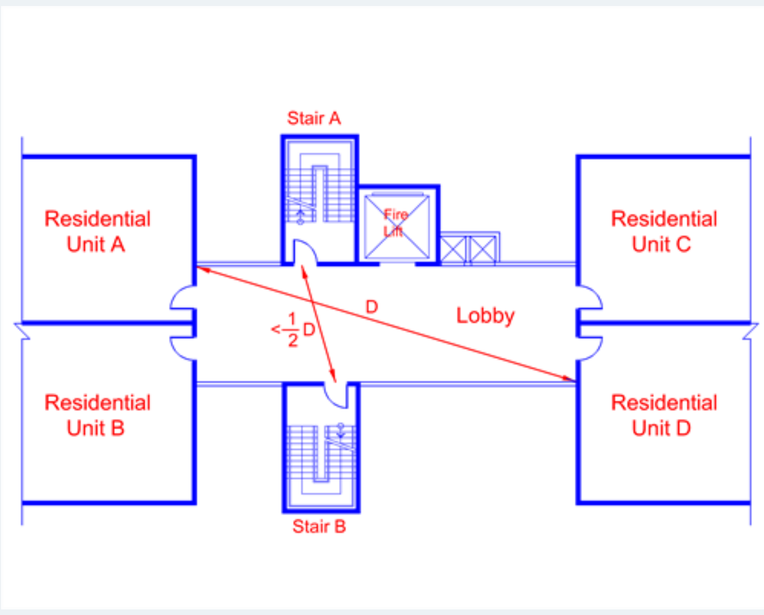


Figure 2.2.12c. - 3 : Not acceptable locations of exits

The distance between the sides of two exit doors to the staircases A and B is less than one half the length of the maximum overall diagonal dimension (D) of the lobby.

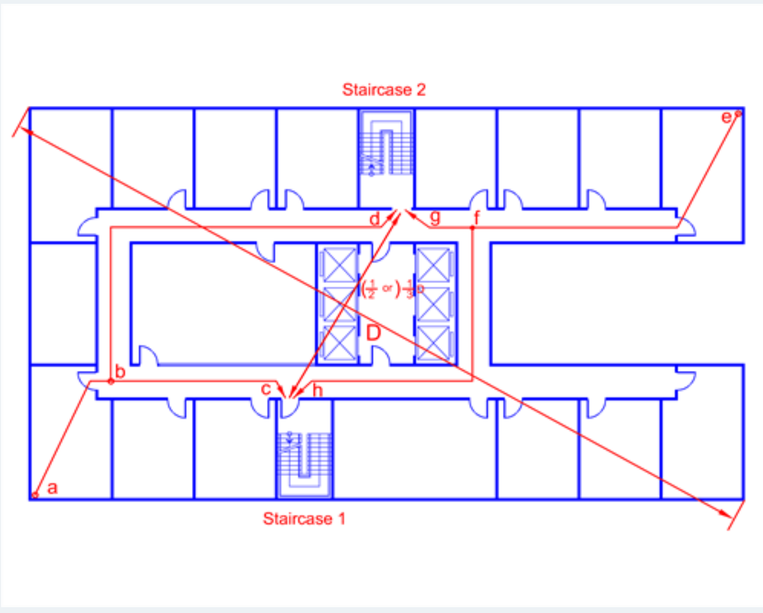


Figure 2.2.12c. - 4

Distance between exit door to staircase 1 & 2 shall be at least ½ (or ⅓, if sprinkler-protected) the longest diagonal of the building indicated as (D) in the above figure.

One-way travel distance exists where a space is arranged so that occupants within that space are able to travel in only one direction to reach any of the exits or to reach the point at which the occupants have the choice of two-way travel to remote exits.

For example, the portions of the escape routes from points a to b and e to f are one-way travel, which shall not exceed 15m or 25m (sprinkler-protected). The option to travel in another escape

route occurs at points b and f, which provide two-way travel distances to the exit staircases 1 & 2 respectively. One-way travel distances are indicated by the dashed lines. See further illustrations under *Cl.2.3.12b., c.* or *d.*

2.2.13 Smoke-free approach to exit staircase

Rationale

The smoke-free approach is intended to act as a buffer space to minimise smoke entry into the exit staircase when used by evacuees and firefighters during a fire emergency.

Entry at every storey level (including 1st storey) to an exit staircase serving more than four storeys above ground level shall be through any one of the following:

a. An external exit passageway or external corridor

The openings for natural ventilation to the corridor shall be located such that they face and are open to any of the following:

(1) an external space complying with Cl.2.3.11, or

(2) a street, service road or other public space which is open to the sky, or

(3) an air well which opens vertically to the sky and has a minimum width of 6m and a superficial plan area of not less than 93m², except that for external corridors, it shall comply with the requirements of Cl.2.3.10.

Explanation and Illustrations

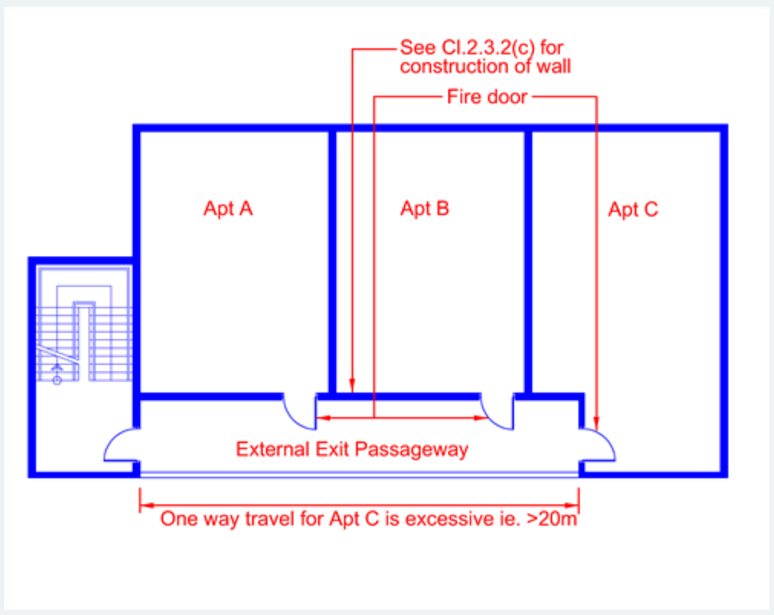
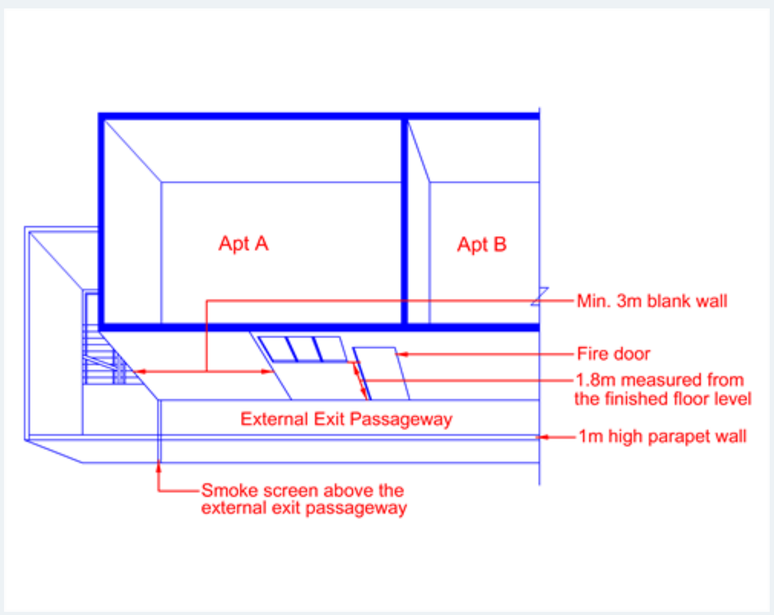
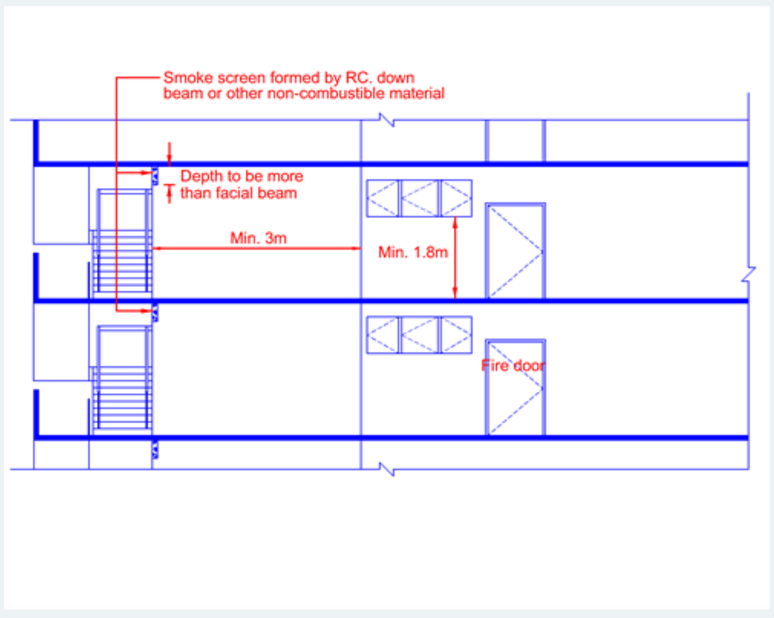


Figure 2.2.13a. - 1



Axonometric Section

Figure 2.2.13a. - 2



Section

Figure 2.2.13a. - 3

External exit passageway is a protected area, which is an extension of the vertical exit staircase. It is used to overcome excessive travel distances as shown in the above figure.

The provision of smoke screen above the passageway before the staircase is to prevent smoke from entering the stairwell at ceiling level.

Main differences between external corridor, smoke-stop lobby and external exit passageway

#	External corridor	Smoke-Stop Lobby	External exit passageway

Entrance door	No fire rating	At least ½-hr fire rating	At least ½-hr fire rating
Usage	As smoke-free approach	As smoke-free approach	As extension of the vertical exit (to overcome travel distance deficiency)
Corridor/lobby – air well ventilation	Min 1.2m high opening Max 3m roof over 1m Air well - Min 6m wide / area 93m²	Opening 15% of lobby area Max 9m from opening Air well - min 6m wide / area 93m²	Min 1.2m high opening Max 3m roofed over 1m Comply with Table 1.2.1A if facing air well
Cross ventilation	Min 1.2m high opening Max 3m roof over	Opening 50% of opposing wall superficial area Max 12m from opening No obstruction	Min 1.2m high opening Max 3m roof over 1m Comply with Table 1.4.2
Vent openings btw unit & corridor/smoke-stop lobby	Above 1100mm from finished floor level of corridor	No opening allowed	Above 1800mm from finished floor level of passageway
Risers	No fire rating for shaft door	Fire rated shaft and doors	No services allowed
Exposed M&E services (Cl 3.9.6)	Service allowed only if enclosed with fire rated enclosure	No services allowed unless enclosed in 1hr rated enclosure	No services allowed

It is important that exit staircases are kept free of any smoke at all times, especially in times of a fire emergency, as it is the main essential means for evacuating occupants from the building. To facilitate this smoke free environment, a buffer zone that can quickly dispel any smoke entering it from occupied spaces to the external space is created before entry into the staircases. Hence the passage or route through these areas (or buffer zone) which is relatively free of smoke for safe escape for the occupants and leading to the exit staircases is referred here as the smoke free approach.

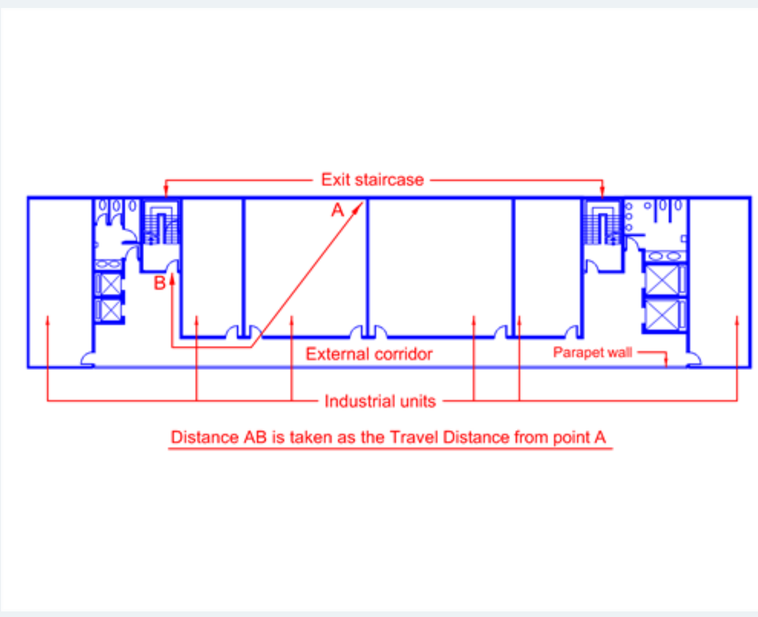


Figure 2.2.13a. - 4

Travel Distance measurement, as shown by line AB in *Diagram 2.2.13 (a)(iii)-4*, in the external corridor situation is taken from any remote point within the occupied area to the exit door of the exit staircase.

External Exit passageway, as shown in *Diagrams 2.2.13 (a) – 2* below, is a protected area, which is an extension of the vertical exit staircase. It is used to overcome excessive travel distances.

A smoke screen may be provided above the passageway before the entry into the exit staircase to prevent smoke at the ceiling level from entering the stairwell.

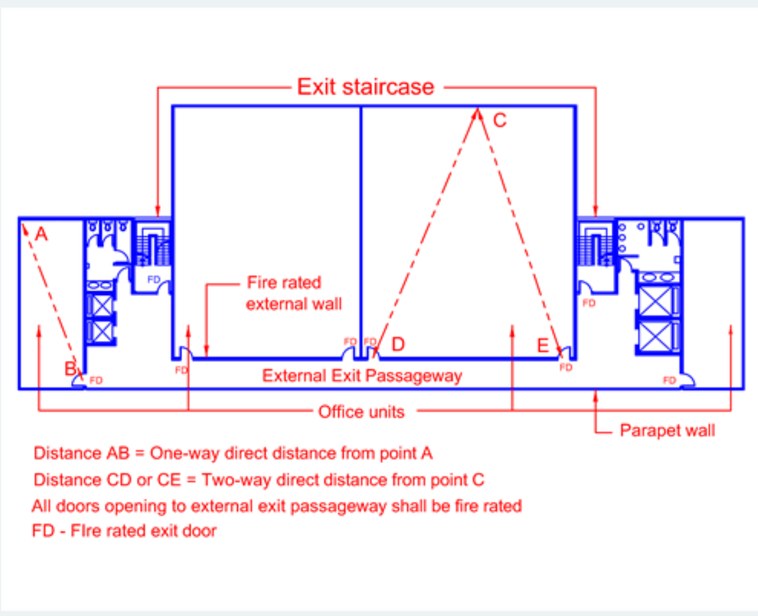


Figure 2.2.13a. - 5 : Approach to exit staircase through external exit passageway

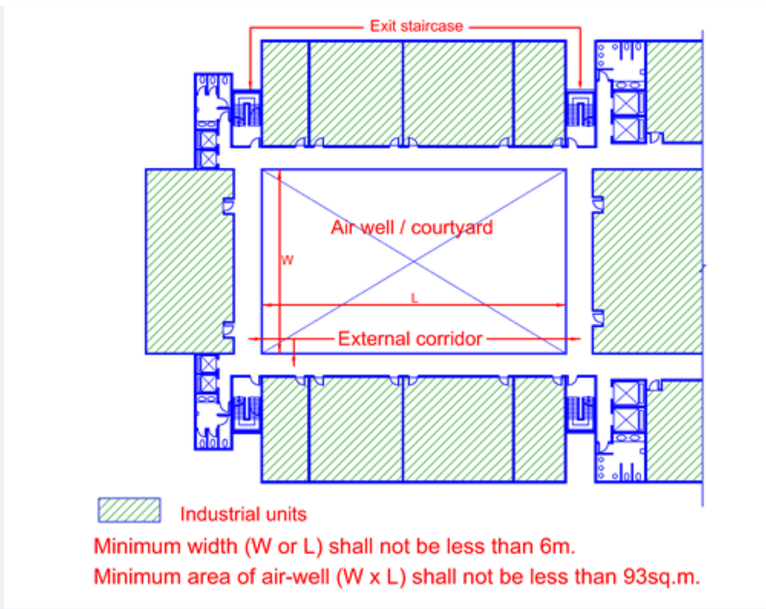


Figure 2.2.13a. - 6

The height of parapet walls of corridors alongside an air-well shall not exceed 1000mm measured from its finished floor level. It shall be noted here that the ventilation openings for exit staircases in the above design layout shall not open into the air-well.

b. Smoke-free/ fire lift lobby

(1) A smoke-free lobby shall be separated from the adjoining areas of the building by a wall having 1-hr fire resistance.

(2) The exit access door shall have ½-hr fire resistance fitted with automatic self-closing device conforming to the requirements of *Cl.3.9.2.*

(3) The design of a smoke-free lobby shall be such as not to impede movement of occupants through the escape route.

(4) The floor area of a smoke-free lobby shall be at least 3m² and with minimum clear width of 1.2m. If a smoke-free lobby also serves as a fire lift lobby, the floor area shall be not smaller than 6m² and with minimum clear width of 2m.

(5) The floor shall be graded from the lift door towards the lobby door with a fall not exceeding 1 in 200.

(6) A smoke-free lobby, including fire lift lobby, which acts as buffer space for entry into the exit staircase and use by firefighters during emergency, shall be maintained as common property.

Explanation and Illustrations

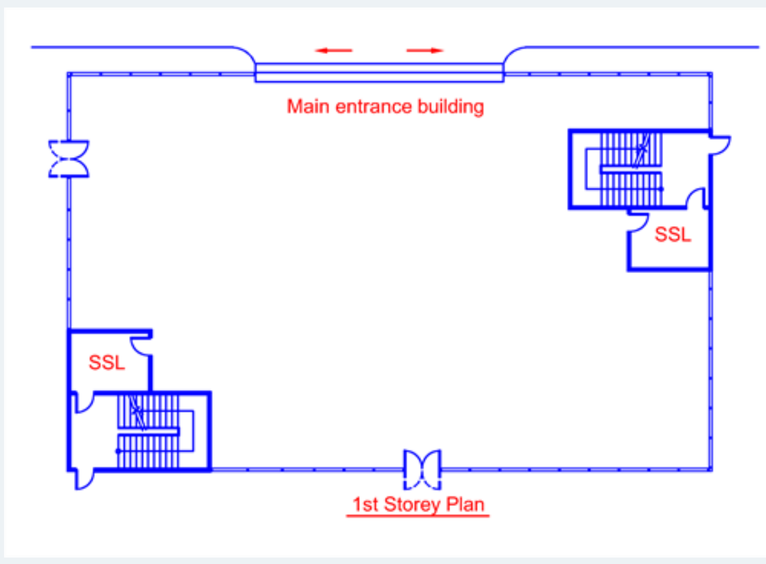


Figure 2.2.13b.

Note : A smoke-free approach (i.e. smoke-stop lobby) is to be provided for entry into the exit staircases, even at 1st storey.

(7) A smoke-free lobby shall be ventilated through any of the following:

Rationale

Access routes to exits shall be kept smoke-free by a smoke-stop lobby, either naturally or mechanically ventilated, in order to provide a reliable means of escape for occupants and access for firefighters.

(a) Permanent fixed ventilation openings which are located in the external wall of the lobby and have a total area of not less than 15% of the floor area of the lobby.

Each opening shall not be less than 1m^2 and shall abut an external space or air well, each having a minimum clear area of 93m^2 and minimum width of 6m and without obstruction vertically throughout the airspace for ventilation. No part of the lobby floor area shall be more than 9m away from the air well or external space.

Rationale

The minimum width of 6m and a superficial plan area of not less than 93m² of an air well have been validated through fire engineering study to provide effective smoke ventilation for a smoke-stop lobby.

Explanation and Illustrations

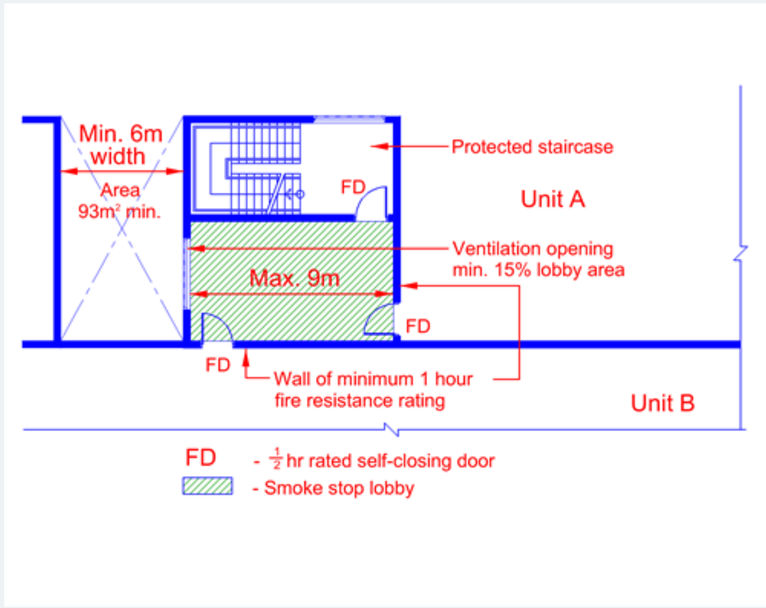


Figure 2.2.13b.(7)(a) - 1

To ensure that every part of the lobby is well ventilated, the distance between the external openings and any part of the lobby should not exceed 9m. In order that the smoke stop lobby can remain an effective buffer to the protected staircase, the former must be a common space, i.e. it should not be part of the apartment unit.

For effective natural ventilation, the smoke-stop lobby shall be within 9m of its ventilation openings. To ensure the integrity of smoke-stop lobby as dedicated buffers protecting exit staircase from smoke infiltration, it must be located in natural spaces. This arrangement would prevent any misuse by tenants, as the case may be if the lobby is to be located within a privately owned space.

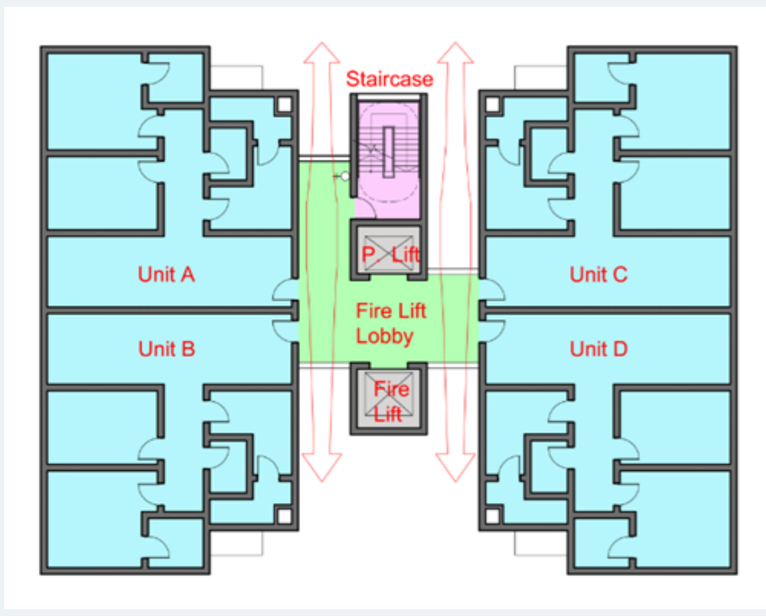


Figure 2.2.13b.(7)(a) - 2

For high-rise residential blocks with single exit staircase, the approach to the exit staircase is through a cross-ventilated lobby. See *Cl.9.2.1a.(4)(e) & (f)* for details the provision of openings to the lobby. To comply with the provision of single exit staircase, designer has to make reference to *Cl.9.2.1a.(4)* of the Fire Code.

(b) Mechanical ventilation, except for PG II buildings, which complies with the requirements in Chapter 7.

Explanation and Illustrations

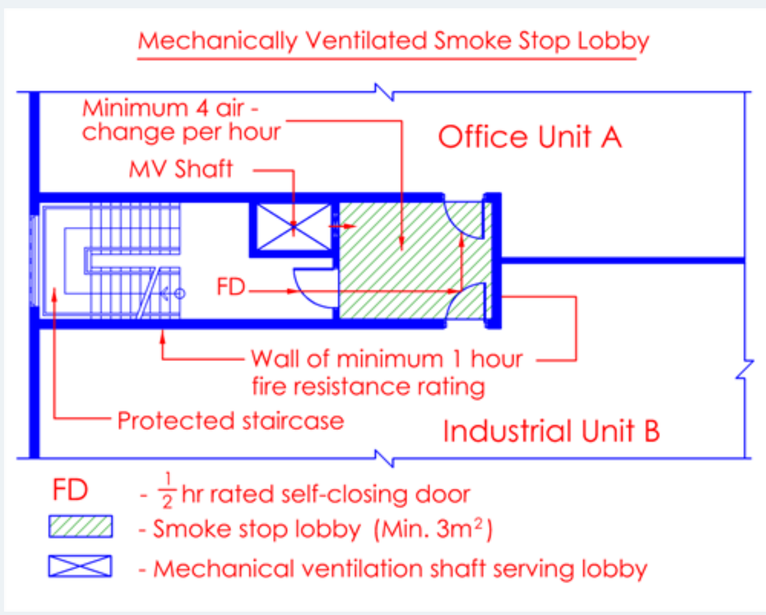


Figure 2.2.13b.(7)(b) : Smoke-stop lobby

(c) Cross-ventilated corridor/lobby which complies with all of the following:

(i) The corridor/lobby shall have fixed ventilation openings abutting an external space. The ventilation openings shall be located on opposite sides of the corridor/lobby at high level and shall not be less than 50% of the superficial area of the opposing external walls.

(ii) No part of the floor area of the corridor/lobby shall be at a distance of more than 12m from the ventilation openings.

(iii) The distance of 12m can be measured along the internal corridor via the intermediate ventilation opening to the external space, provided there is no unprotected openings in the walls along the path to the external space. The intermediate ventilation opening shall not be less than 2m in width and 1.2m in height and the width of the path to the external space shall not be less than 2m.

Note: For residential buildings of habitable height more than 24m with single exit staircase, the requirements for the cross-ventilated corridor/lobby stipulated in *Cl.9.2.1a.(4)(e)* shall be complied with

Explanation and Illustrations

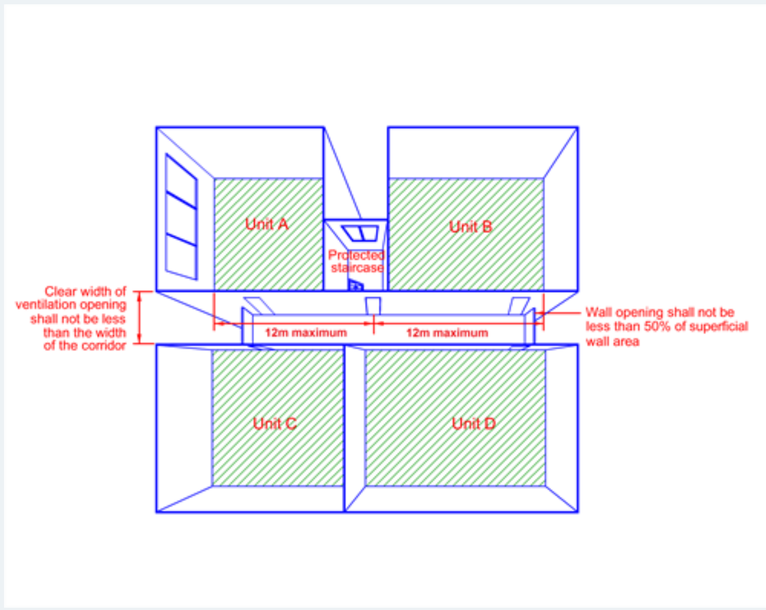


Figure 2.2.13b.(7)(c) - 1 : Acceptable layout

For the purpose of measuring the horizontal distance of max. 12m from any floor space of the corridor to the ventilation openings, the ventilation openings shall be assumed to be located at the edge of the building and not at the edge of the corridor.

It is important to note that the above requirements shall not be taken to equal other clauses that call for smoke-free approach and cross ventilated lobby approach under *Cl.9.2.1a.(4)(e) & (f)*.

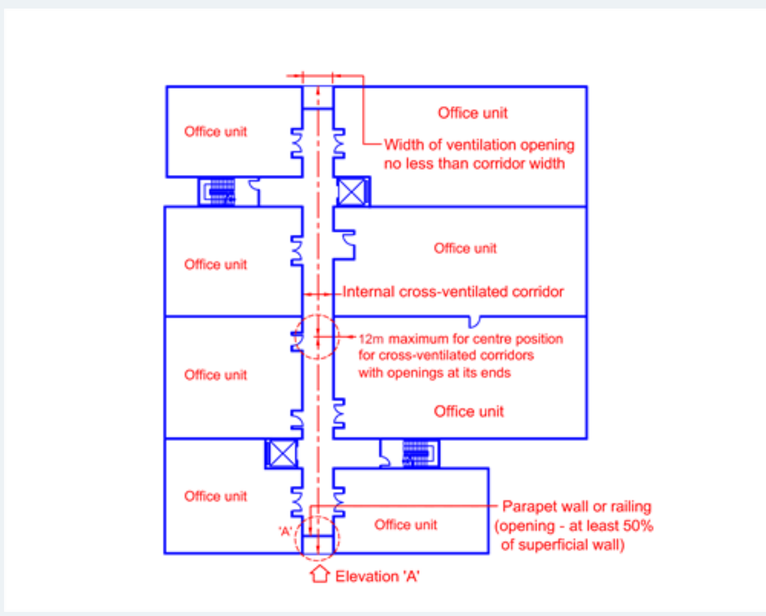


Figure 2.2.13b.(7)(c) - 2 : Acceptable layout

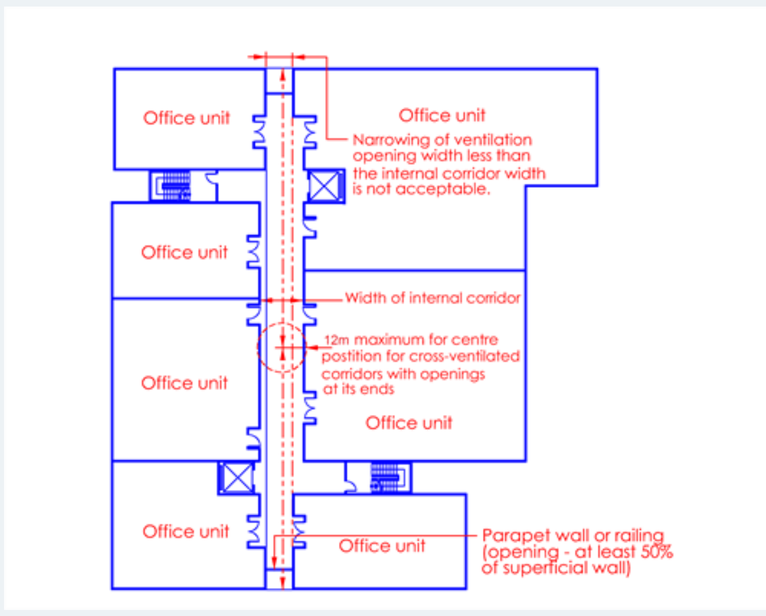


Figure 2.2.13b.(7)(c) - 3 : Not acceptable layout

The above provision of cross-ventilated corridor is not acceptable, as the ventilation opening on one side of the building is narrower than the width of the corridor. This could adversely affect the movement of air currents through the corridor, intended to draw out any smoke in the corridor area before it can affect the staircase.

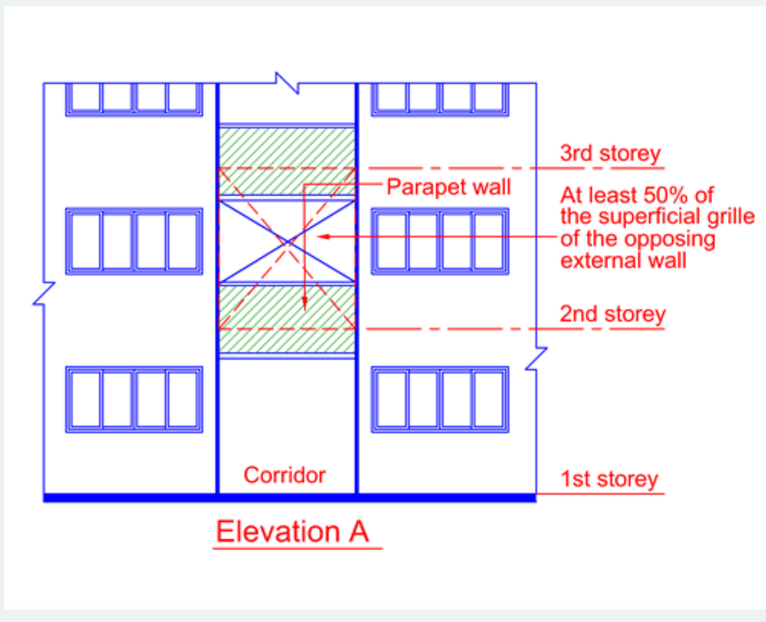


Figure 2.2.13b.(7)(c) - 4

c. Exception

(1) The omission of the smoke-free lobby required under *Cl.2.2.13b.* leading to the exit staircase of any building exceeding four storeys is allowed under any of the following situations, provided the door opening into the exit staircases shall have 1-hr fire resistance rating and fitted with an automatic self-closing device to comply with the requirements of Cl.3.9.2:

Explanation and Illustrations

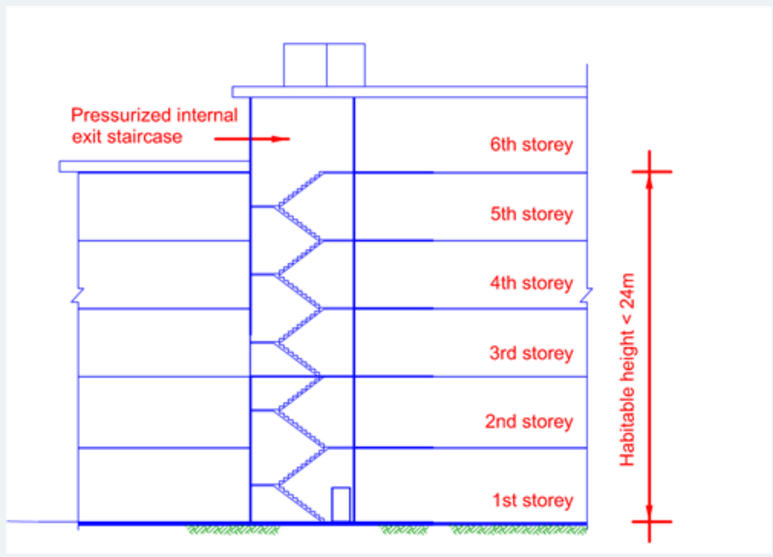


Figure 2.2.13c.(1) - 1

Any internal exit staircase with dedicated pressurisation system (without natural ventilation) and its height not exceeding 24m will be permitted without the provision of smoke-stop lobby. The door opening into the staircase is required to have minimum 1-hr fire resistance rating.

The above smoke-stop lobby exemption is not applicable to the exit staircase adjacent to a fire lift and buildings under PG III & VII.

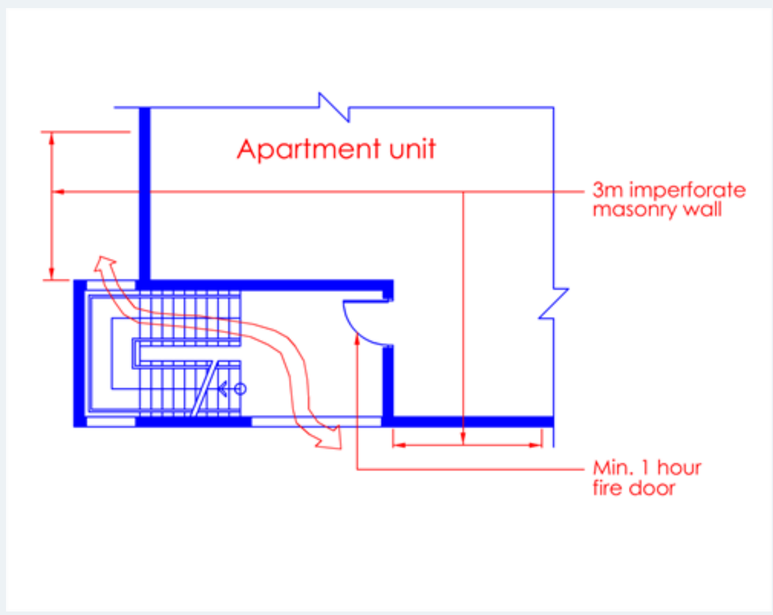


Figure 2.2.13c.(1) - 2

Smoke-stop lobby is exempted if an external exit staircase located along the perimeter wall of the building is required to be cross-ventilated having uninterrupted external openings of minimum 50% of the planal area of the staircase.

The above smoke-stop lobby exemption is not applicable to the exit staircase adjacent to a fire lift and buildings under PG III & VII.

(a) Where the internal exit staircase is provided with pressurisation up to a habitable height of 24m in compliance with the requirements of Chapter 7;

Rationale

The positive pressure in the pressurised staircase acts to force smoke away from the doorway of the exit staircase when the exit door is opened, thereby preventing smoke from entering the exit staircase.

(b) Where an external exit staircase is constructed to comply with *Cl.2.3.3b.*;

Rationale

Open sides of an external exit staircase allow for quick dispersal of any smoke infiltrated through the doorway when the door is opened. As such, a smoke-stop lobby before the external exit staircase is not necessary.

(c) In an open-sided car park floor where cross-ventilation is provided in accordance with *Cl.3.2.8a. & b.*, the fire door to the exit staircase can be ½-hr fire-rated.

(d) On M&E floor of headroom not exceeding 1.8m.

Rationale

The doorway before the exit staircase is unlikely to be smoke logged during a fire emergency. This is because the substantial ventilation openings along the perimeter of the car park allow for quick dispersal of smoke.

(2) The omission of a smoke-free lobby to exit staircases shall not be allowed under any of the following situations:

(a) Where the building exceeds four storeys and belongs to PG III or VII.

(b) Where the internal exit staircase, which is provided with pressurisation, exceeds the habitable height of 24m.

(c) Where the exit staircase is adjacent to a fire lift as required in Chapter 6.

Explanation and Illustrations

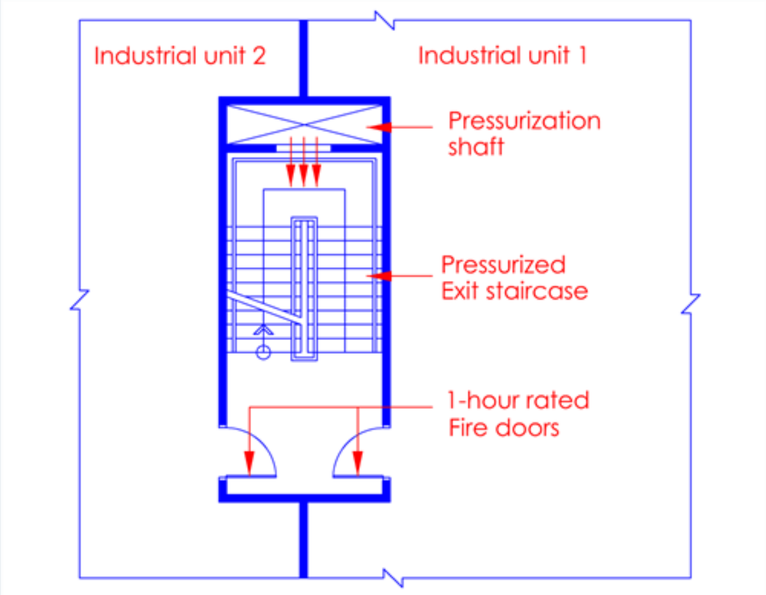


Figure 2.2.13c.(2) – 1

The positive pressure in the pressurised staircase *Figure 2.2.13c.(2) - 1* acts to force smoke away from the doorway of the staircase when that exit door is opened, thereby preventing smoke entry into the staircase. The above exemption shall apply to building of which the habitable height does not exceed 24m. This is to meet the requirements under *Cl.2.3.3d.(8)* and *Cl.7.2.1a.* which specifically require all internal staircases of building having a habitable height exceeding 24m to be pressurised. If the habitable height of the building exceeds 24m, the entry to the internal exit staircase shall be through smoke-stop lobby or external approach.

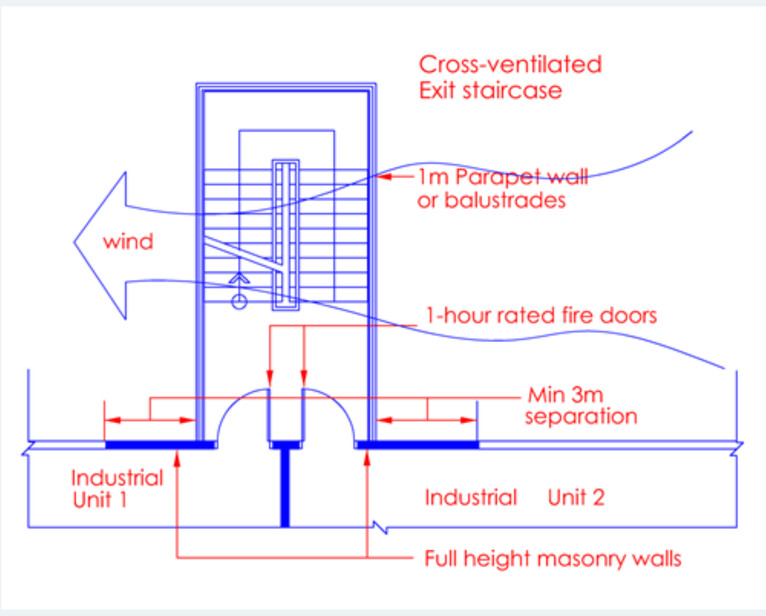


Figure 2.2.13c.(2) - 2

In the case of the cross-ventilated staircase (*Figure 2.2.13c.(2) - 2*), its open sides allow for quick dispersal of any smoke infiltrating the doorway when opened.

Hence, in both these situations, it is possible to achieve a relatively safe smoke free environment in the exit staircase for facilitating escape for its occupants. Another reason to note is that these premises warrant emergency plans and fire drills to familiarise its occupants on their procedural actions in fire emergencies.

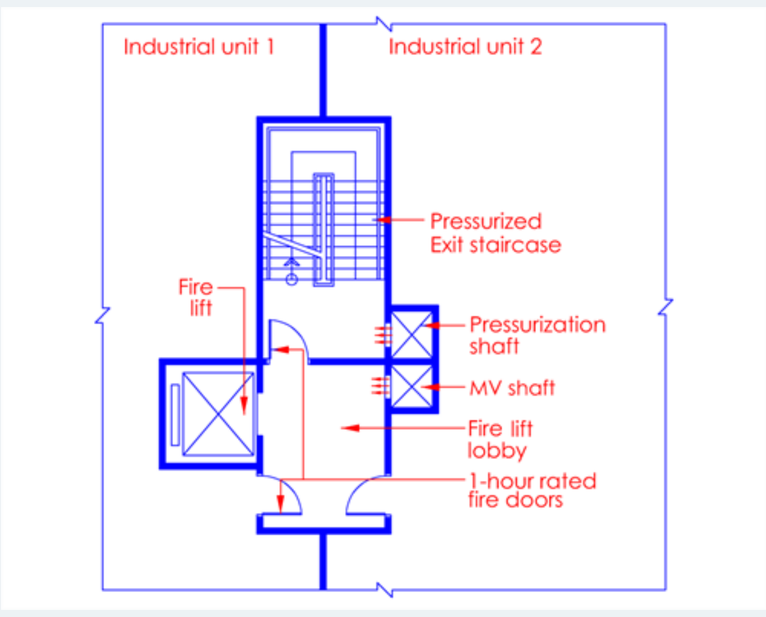


Figure 2.2.13c.(2) – 3

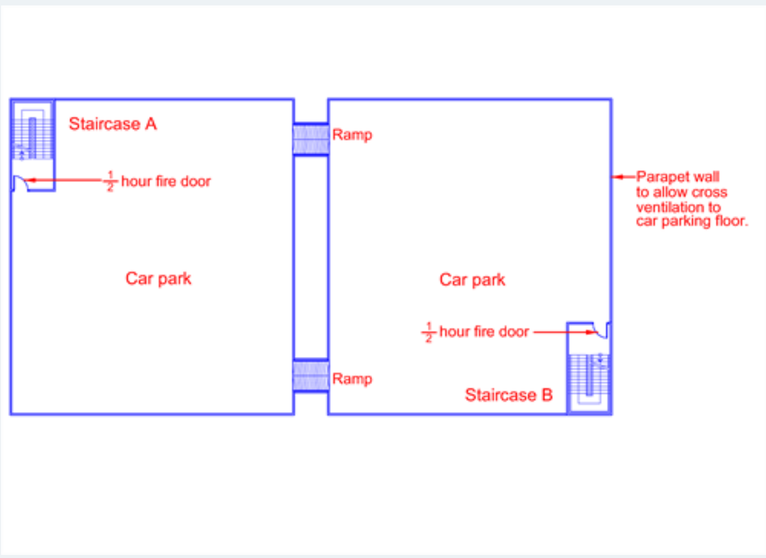
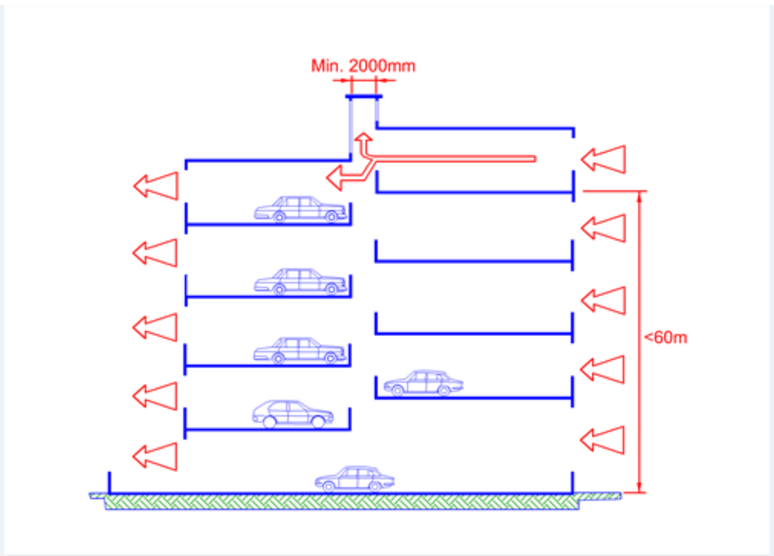


Figure 2.2.13c.(2) - 4 : Open-sided multi-storey car park



Section

Figure 2.2.13c.(2) - 5 : Open-sided multi-storey car park

The above requirement exempts the provision of smoke-stop lobby to exit staircases in cross-ventilated car park buildings. In *Figure 2.2.13c.(2) - 4*, the space before the exit staircases can satisfactorily achieve a smoke free environment. The doors to exit staircases shall be minimum ½-hr fire rated.

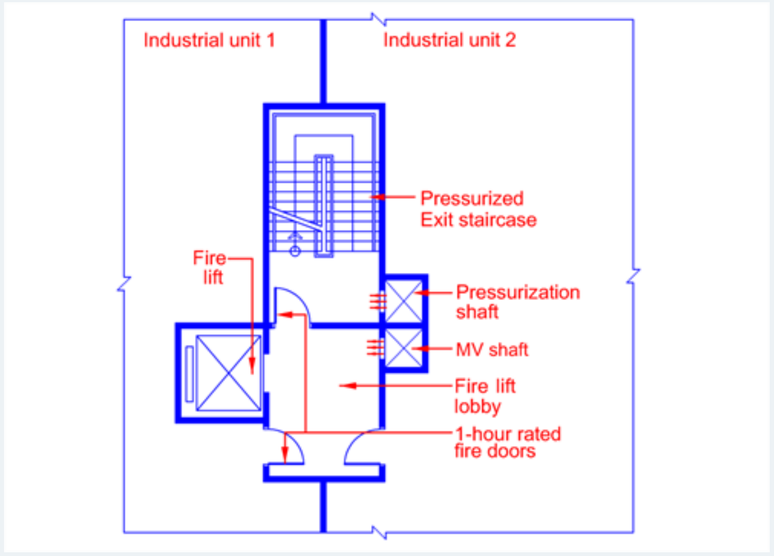


Figure 2.2.13c.(2) – 6 : Situation where no exemption is granted – internal staircase serving building exceeding 24m habitable height

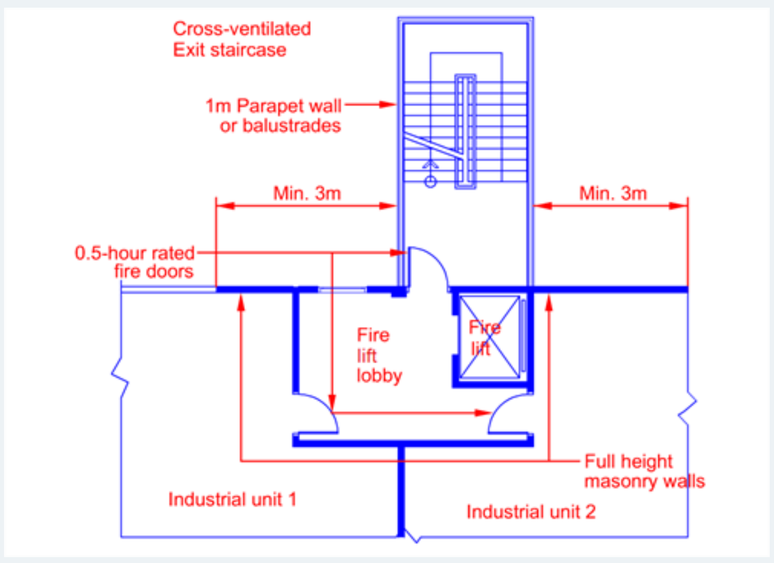


Figure 2.2.13c.(2) - 7 : Situation where no exemption is granted - when adjacent to a fire lift

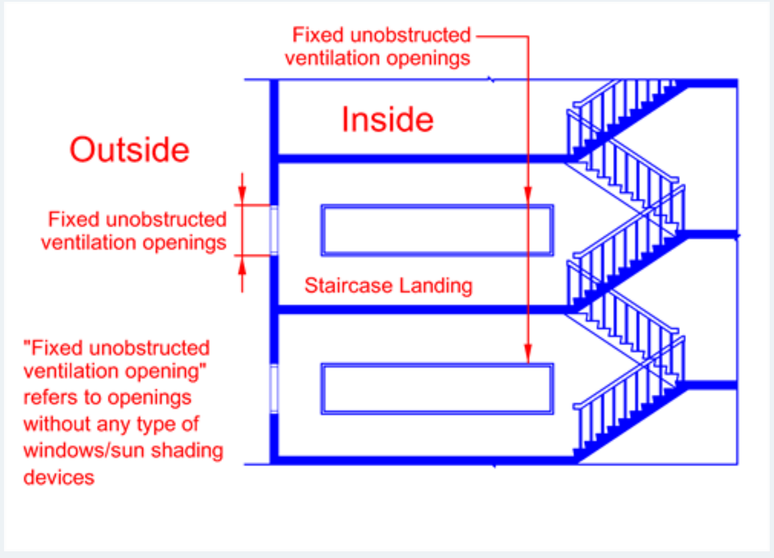
No exemption of the smoke-stop lobby will be granted for the exit staircase adjacent to a fire lift. The firefighters would require the lobby space as a 'staging' point in their fire fighting operations, prior to entering into the affected areas, in fire emergencies.

(Note: *CI 2.2.13c.(2)* is not applicable to buildings under PG VII)

Smoke-stop lobby is exempted for the arrangements shown in *Figures 2.2.13(c)(2) – 1 & 2* in buildings of PG II, IV, V, VI & VIII up to 60m high. The reasons for this relaxation being:

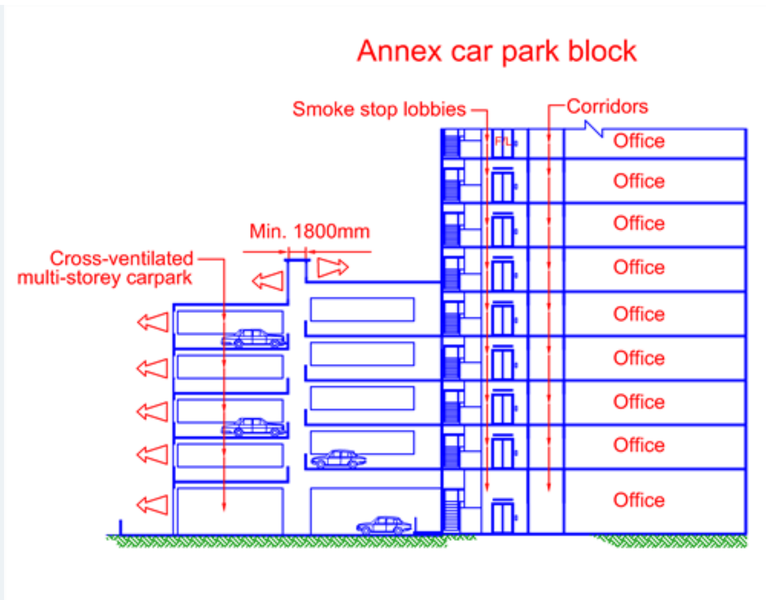
Any internal exit staircase without provision for natural ventilation and in habitable height not exceeding 60m will be provided with dedicated pressurization system. The door opening into the staircase is required to have minimum 1-hr fire resistance rating.

Partially enclosed staircase is required to be cross-ventilated having uninterrupted external openings of minimum 50% of the plan area of the staircase.



Section

Figure 2.2.13c.(2) - 8 : Fixed unobstructed ventilation openings



Section

Figure 2.2.13c.(2) - 9

Likewise a cross-ventilated car parking storey in *Figure 2.2.13c.(2) - 9* is exempted from the provision of smoke-stop lobby to exit staircase. However, the upper storeys above the car parking floors are not exempted from provision of *Cl 2.2.13c.(2).*

2.2.14 Smoke-free approach to exit staircase in basement

Rationale

Access to exits must be free of smoke and be available to building occupants at all times. Therefore, a reliable means of escape for occupants and access for firefighters shall be provided via smoke-free access route and staircases. For this reason, providing mechanical air pressuring systems to smoke-stop lobbies and exit staircases is needed to prevent smoke infiltration.

a. In a building comprising single basement storey, the entry to exit staircases need not be through smoke-free lobbies.

Explanation and Illustrations

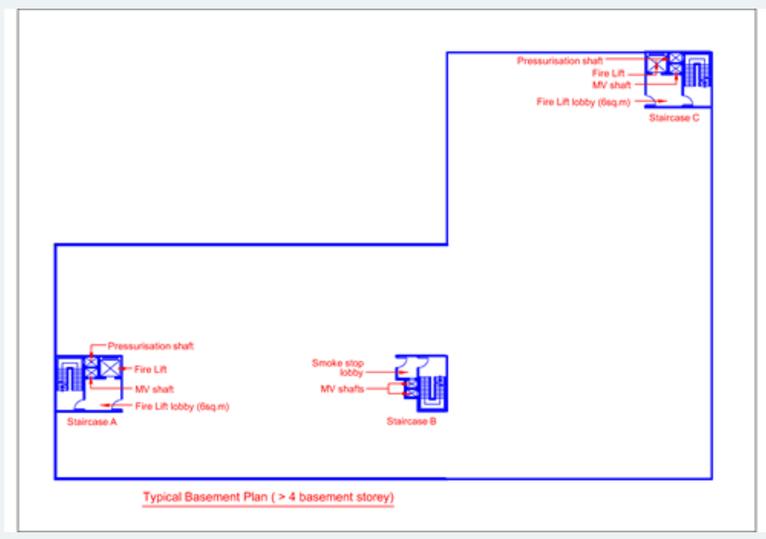


Figure 2.2.14a.

Smoke-stop lobby is required for all staircases, one of which shall be designated as a fire lift lobby. Owing to the depth of the basement, and to prevent heat and smoke from getting into the staircase, the provision of smoke-stop lobby is required. This is similar to the requirement of smoke-stop lobby to building exceeding 4 storeys above ground. Also refer to *Cl.6.6.4b.* for the provision of two fire lifts if basement depth exceeds 9m.

b. In a building comprising two, three or four basement storeys, entry at every basement storey level to at least one of the exit staircases serving the basement storeys shall be through a fire lift lobby even though the exit staircase is not required to be served by a fire lift. However, where the depth of the basement exceeds 9m below the average grade level and fire lifts are required in accordance with *Cl.6.6.4b.(3)*, the entries to the exit staircases with provision of fire lifts at every basement storey level shall be through fire lift lobbies.

Explanation and Illustrations

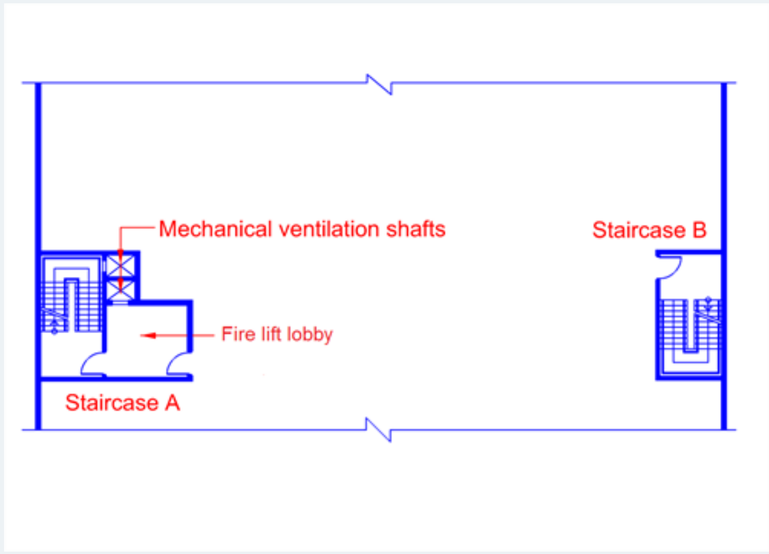


Figure 2.2.14b. - 1 : Plan of basement storey (<9m depth)

Smoke-stop lobby is required for at least one of the staircases. One of which shall be designated as a fire lift lobby.

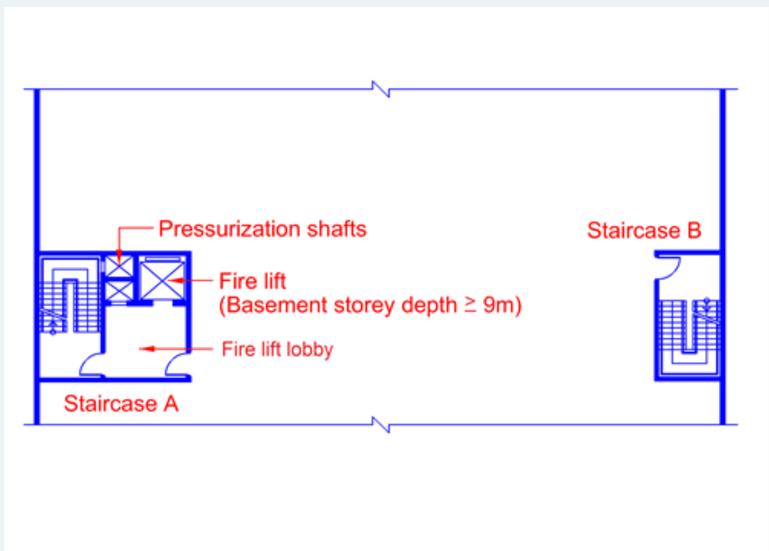


Figure 2.2.14b. - 2 : Plan of basement storey (=>9m depth)

At least one staircase requires smoke-stop lobby, which shall also be served as fire lift lobby. Also refer to *Cl.6.6.4a.* & *b.* which requires two fire lifts and exit staircases to be provided.

c. In a building comprising more than four basement storeys, the entry to exit staircases serving the basement storeys at every basement storey level shall be through smoke-free lobbies or designated fire lift lobbies in accordance with *Cl.6.6.4b.(3)*.

Explanation and Illustrations

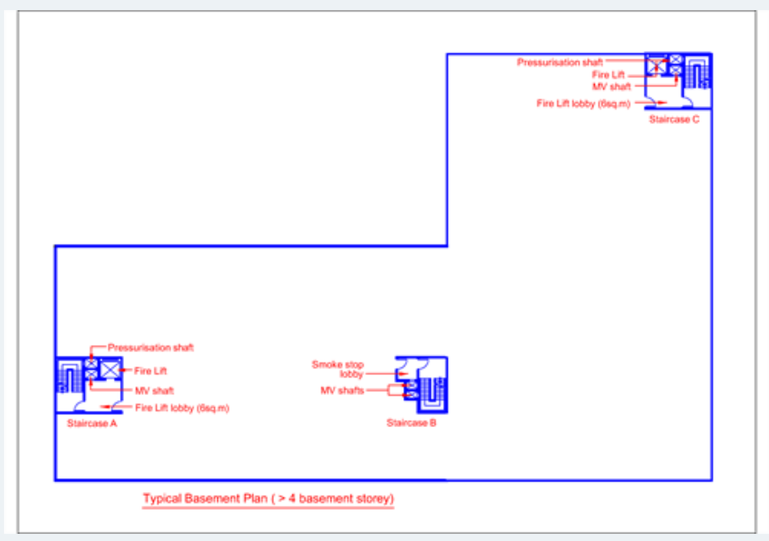


Figure 2.2.14a.

Smoke-stop lobby is required for all staircases, one of which shall be designated as a fire lift lobby. Owing to the depth of the basement, and to prevent heat and smoke from getting into the staircase, the provision of smoke-stop lobby is required. This is similar to the requirement of smoke-stop lobby to building exceeding 4 storeys above ground. Also refer to *Cl.6.6.4b.* for the provision of two fire lifts if basement depth exceeds 9m.

d. Smoke-free and fire lift lobbies in basement occupancies shall be required to comply with the relevant provisions under *Cl.2.2.13b.* and shall be mechanically ventilated to comply with the requirements in *Chapter 7*.

2.2.15 Area of refuge and exit reduction

Explanation and Illustrations

(No illustration)

An area of refuge is intended to provide only temporary point of safety to permit delayed egress travel from any level. Therefore, an area of refuge cannot be a room or space whose only access to the building spaces is through the space where the fire is located has been provided. Rather, the area of refuge must provide access to a public way via an exit such as an enclosed exit stair.

See Cl.1.4.9 and *Cl.2.2.6e.* for illustration.

When a floor area has access to area(s) of refuge in compliance with all of the following requirements in this Clause, the occupant load for which vertical exits are to be accounted for the floor area can be reduced to half when one area of refuge is provided and to one third when two or more areas of refuge are provided.

a. An area of refuge shall be adequate in size to hold the occupant load it receives from the floor area it serves as provision for required exit, in addition to its own occupant load calculated on the basis of 0.3m^2 per person except for healthcare occupancies when the occupant load shall comply with the provisions under *Cl.9.3.2b.(4).*

b. An area of refuge shall be provided with at least one staircase for use by the occupants to gain access to other exit staircases or the ground level directly to an external space.

c. An area of refuge shall be entered through an external corridor and the room or space or area of refuge shall be separated from the corridor by a wall with at least 1-hr fire resistance rating.

d. External corridors when used as entry into an area of refuge shall conform to the requirements for external exit passageway for minimum width, changes in floor level, roof protection,

enclosure on the open side and provision of opening of wall between the room or space and the exit passageway.

e. Exit doors between the room or space or area of refuge and the external corridor shall have fire resistance of at least ½-hr and be fitted with an automatic self-closing device to comply with the requirements of *Cl.3.9.2.*

f. Every fire compartment in which exit reduction is permitted in connection with area of refuge shall have in addition to exit through the area(s) of refuge at least one exit staircase complying with *Cl.2.3.3.*

CLAUSE 2.3 MEANS OF ESCAPE REQUIREMENTS

2.3.1 General

Explanation and Illustrations

STAIRCASE IDENTIFICATION

Staircase identification is required for all buildings (except PG 1) regardless of the height of the building.

Staircase identification is to facilitate firefighting operation. It also enables the user of the staircase to orientate his location or whereabouts. This would help to alleviate any fear of disorientation by a person using the staircase during a fire emergency.

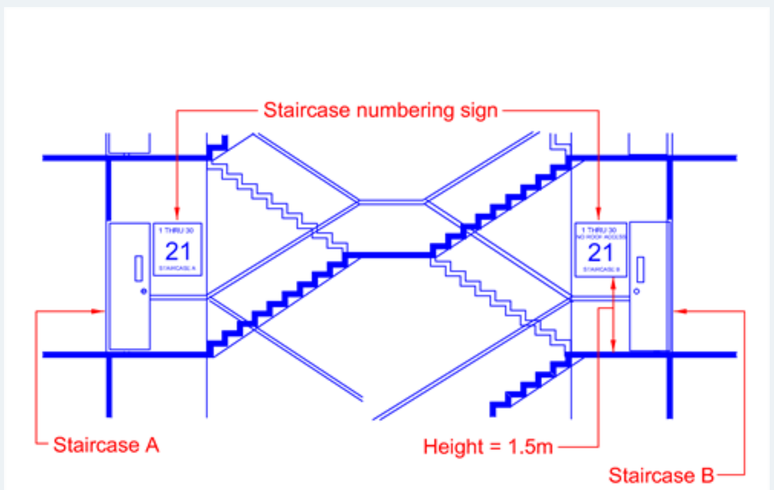
REQUIREMENT ON STAIRWAYNUMBERING SYSTEM

a. The numbering system is composed of square signs of at least 30cm x 30cm located, or painted, on the wall surface adjacent to the door on the stairway side.

b. A sign should be located at each level landing in the stairway. The bottom of the sign should be located not less than 1.5m above the floor of the staircase landing. The sign should be placed adjacent to the door and shall be visible with the door opened or closed.

c. The block-lettered sign may be of any colour that will contrast with the colour scheme of the stairway.

(1) The height of the large number(s) in the middle of the sign denoting the storey should be a minimum of 12.5cm.



Section

Figure 2.3.1 – 1: Location of sign in scissor exit staircases

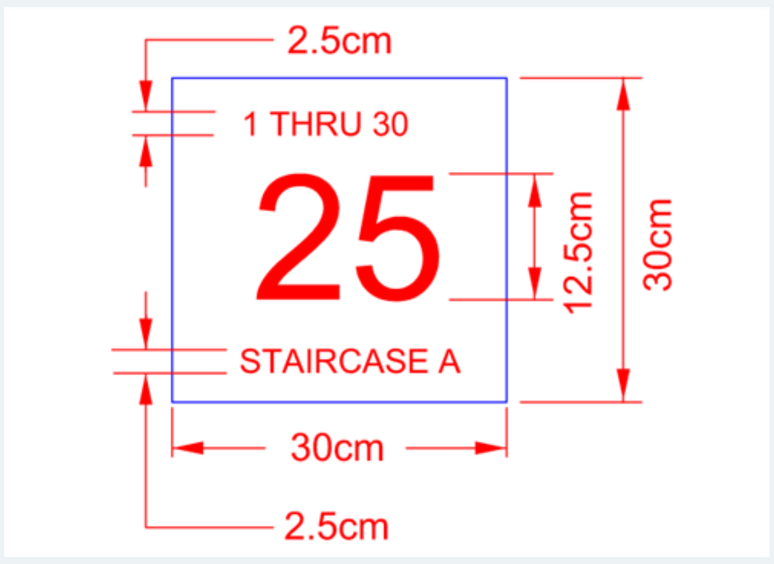


Figure 2.3.1 – 2 : Example 1

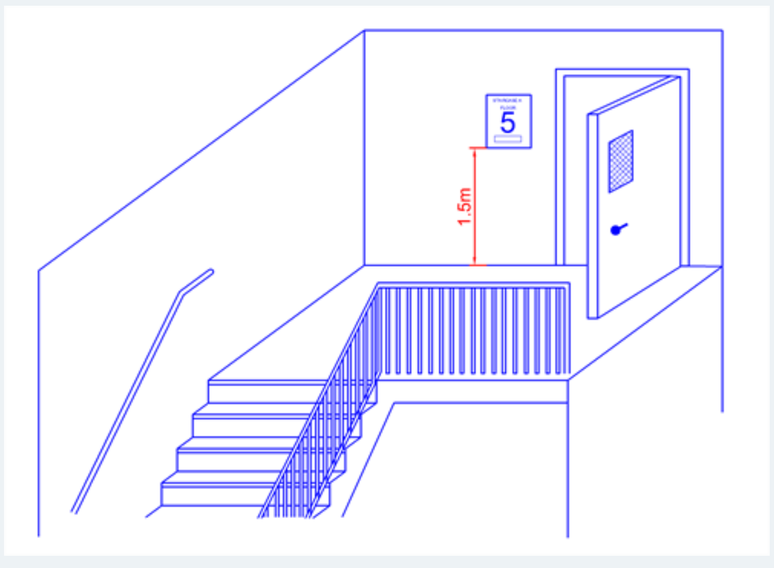
25th storey of a staircase that extends from the 1st storey to the 30th storey of a 30-storey building.

The stairway terminates at the roof.

This is the 'A' Staircase in the building.

(2) The number(s) and/or letter(s) at the top of the sign denoting the upper and lower terminations of the stairway should be a minimum of 2.5cm.

Identification of staircases in the building should be indicated in alphabetical and/or numeric order. The lettering height should be 2.5cm minimum, e.g., Staircase A, and located at the bottom of the sign.



Axonometric view

Figure 2.3.1 – 3

The intent of this provision is to provide vital egress information to the occupants of a building and to firefighters. To reduce information overload to occupants during emergency egress, a sign indicating the floor level and the direction to the exit discharge is permitted to be placed as a separate sign with another sign indicating the floor level, the terminus of the top and bottom of the stair enclosure, and the identification of the stair.

a. Means of escape shall be provided for all buildings by one or more of the facilities listed herein. Access and exit facilities not specifically covered in this Code shall not be used without the approval of the SCDF. Required exits shall be kept readily accessible, and doors shall be openable and unobstructed at all times during the occupancy of the building. Any future grille gate/door swing from units/service shaft into the common areas shall be indicated with dotted lines on building plans to show the egress requirements are met, despite the door swing.

b. Exit staircase signage

(1) Exit staircases serving all buildings (except PG I) shall be provided with a signage not smaller than 300 x 300mm and be within the stairwell at each storey landing.

(2) The signage shall contain the following information:

(a) the storey number, at least 125mm in height; and

(b) an identification of the staircase in alphabetical and/or numeric form, at least 25mm in height.

(3) The letters and numbers on the sign can be of any colour that provides contrast with the background colour.

(4) The signage shall be located such that it is visible when the door is in the open position and also visible to any person moving up or down the staircase.

Rationale

The signs facilitate awareness of one's location for building occupants and firefighters within the enclosed stairway. This would help to alleviate any fear of disorientation by a person using the exit staircase during a fire emergency.

c. Fire escape plan

(1) A fire escape plan shall be provided for all buildings except PG I and displayed in common lobbies or lift lobbies such that they are easily viewable by the building occupants and the general public passing through these common areas. The fire escape plan shall have legible lettering and the fire escape routes made clear to the viewer. It shall clearly show the layout of the floor in the correct orientation and highlight the escape routes (in relation to viewer's location), escape corridors and exit staircases using appropriate colours, directional signs and words. The information required on the plan are only for firefighting and evacuation purposes and shall include the locations of the following:

(a) Fire lifts;

(b) Evacuation lifts;

(c) PWD holding points;

(d) Hose reels;

(e) Fire extinguishers;

(f) Manual alarm call points; and

(g) Rising mains.

(2) For ensuring legibility of the fire escape plan for buildings with large floor areas, partial plan showing minimally 2 escape routes is acceptable. The plan shall show the egress paths to at least 2 remotely located exits/exit staircases, including the PWD holding points.

Rationale

The fire escape plan serves to orientate and guide the building occupants and public on the egress routes during an emergency.

These plans should be placed at common areas where the public and occupants of the building are most likely to frequent or use and can locate them easily. Such locations include common corridors, lobbies etc.

2.3.2 Exit passageways

a. Fire resistance

Exit passageways that serve as a means of escape or required exits from any building or storey of a building shall have the requisite fire resistance as specified under Cl.3.3.

b. Internal exit passageway

An internal exit passageway which serves as required exit of a building shall comply with the following requirements:

(1) it shall be enclosed with construction complying with the provisions of Cl.3.3;

(2) the enclosure walls shall have not more than two exit doors, excluding the final discharge door and exit staircase door, opening into the exit passageway;

(3) exit doors opening into an exit passageway shall have fire resistance rating as required for exit doors opening into exit staircases, be fitted with automatic self-closing device and comply with the requirements of Cl.3.9.2 for fire resisting doors;

(4) the minimum width and capacity of exit passageway shall comply with the requirements as provided in *Table 2.2A*;

(5) changes in level along an exit passageway requiring less than two risers shall be via a ramp complying with the provisions under Cl.2.3.8; and

(6) if the exit staircase which connects to the internal exit passageway is pressurised, the internal exit passageway shall also be pressurised to comply with the requirements in Chapter 7.

Explanation and Illustrations

The word exit used in the term exit passageway helps to distinguish the difference between an exit passageway and an ordinary passageway or corridor. An exit passageway is an exit; it provides a path of travel offering the same level of protection and safety that is required on an enclosed exit stair. An exit passageway is a versatile feature, because it can be used to extend an exit, or, as in done in many cases, it can be used to bring an exit closer to where the occupants are located.

External exit passageway is not common in building under PG II owing to the restrictive requirements of high level ventilation of 1.8m above the finished floor level of passageway and the provision of fire doors opening into the passageway.

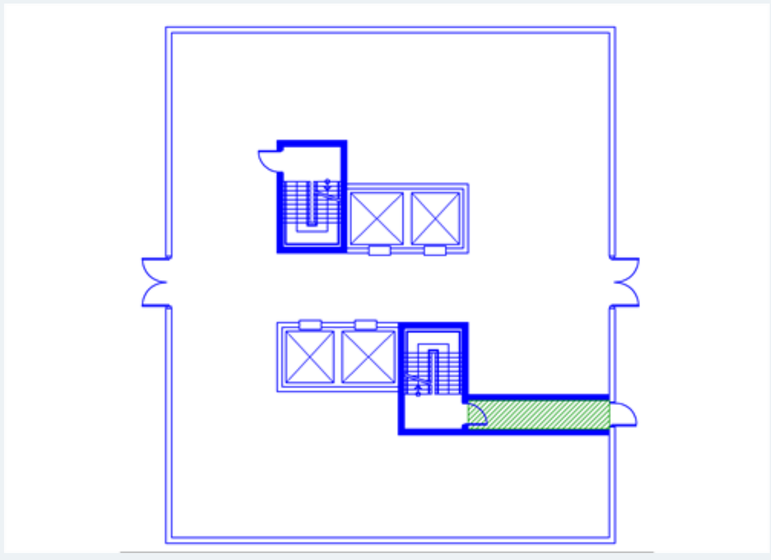


Figure 2.3.2b. -1 : Exit passageway used to connect exit staircase with exterior of building

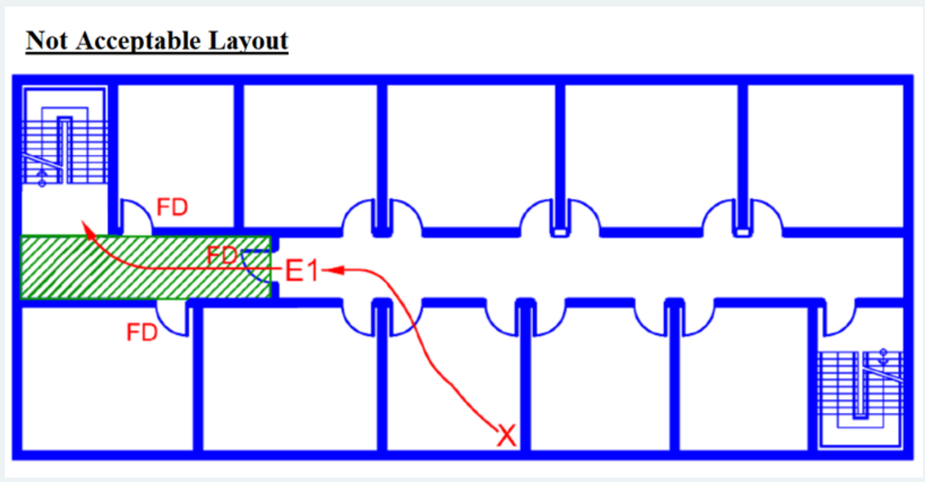


Figure 2.3.2b. - 2 : This layout is not acceptable as the nos of door openings within an internal exit passageway has go beyond 2.

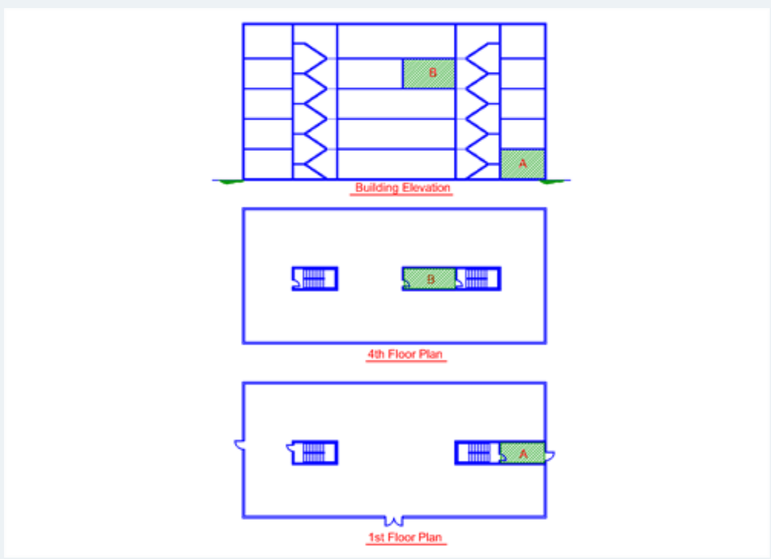


Figure 2.3.2b. - 3 : Exit passageway with fire-rated enclosures & fire-rated door

Exit passageway A on the first floor - the level of exit discharge – opens at one end to a five-storey exit stair enclosure and at the other end to a door to the outside. This exit passageway also serves as a horizontal continuation of, and discharge for, the stair enclosure. In serving as a discharge for the exit stair, the exit passageway must provide the same degree of protection required of the stair enclosure.

The exit passageway B, on the fourth floor, is used to provide the safety of an exit occupants travelling to the exit stair enclosure. This exit passageway might have been built to meet the travel distance limitation.

c. External exit passageway

An external exit passageway can be used as a required exit in lieu of an internal exit passageway. It shall comply with the following requirements:

(1) any ventilation openings on the external wall between the exit passageway and the rest of the floor space shall be of non-combustible construction, fixed at a level of at least 1.8m, measured from the finished floor level of the passageway to the sill level of the openings and such ventilation openings shall be located not less than 3m from any opening of an exit staircase;

(2) it is exempted from the limitations of a maximum of two exit doors opening into the exit passageway;

(3) it can be roofed over provided the depth of the roofed over portion does not exceed 3m to avoid smoke logging;

(4) it can be enclosed on the open side by only a parapet wall of not less than 1m and not more than 1.1m in height and the vertical height of the unobstructed and uninterrupted ventilation opening measured from the parapet wall up to the top edge of the opening or eaves of overhang shall be not less than 1.2m; and

(5) exit doors opening into an external exit passageway shall have fire resistance rating of at least ½-hr and shall be fitted with an automatic self- closing device.

Rationale

An exit passageway provides the same level of protection from the effects of fire and smoke as an exit staircase. It is an extension of an exit staircase. An exit passageway can be provided when the travel distance from the occupied space to the exit staircase exceeds the permissible travel distance.

d. Ventilation

(1) All internal exit passageways shall be naturally ventilated by fixed ventilation openings in an external wall, such ventilation openings being not less than 15% of the floor area of the exit passageway.

(2) Internal exit passageways that cannot be naturally ventilated shall be mechanically ventilated to comply with the requirements in Chapter 7.

Rationale

An internal exit passageway is an extension of an exit staircase and shall be adequately ventilated to prevent smoke-logged during a fire emergency. Where natural ventilation is not possible, mechanical ventilation shall be provided.

Explanation and Illustrations

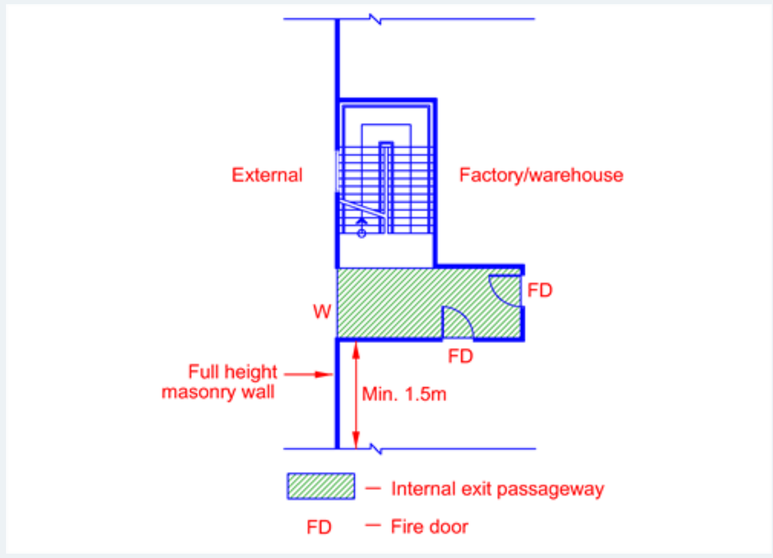


Figure 2.3.2d

Natural ventilation shall be provided to all internal exit passageway. Window openings (W) shall not be less than 15% of the floor area of internal exit passageway shown above. Where internal exit passageway cannot be naturally ventilated, mechanical ventilation shall be provided to comply with Chapter 7. The number of exit doors opening into the internal exit passageway shall not exceed two.

Note : It is uncommon to design means of escape using internal exit passageway for buildings under PG II.

2.3.3 Exit staircase

a. Internal exit staircase

(1) Staircase enclosure

An internal exit staircase which serves as the required exit of the building shall be enclosed with construction complying with the provisions of Cl.3.8. The enclosure walls of an internal exit staircase, excluding the final discharge, shall not have more than two exit doors opening into the exit staircase shaft at each storey.

Rationale

The number of door opening into an exit staircase shall be controlled so as to minimise the risk of the staircase integrity being breached. These fire doors shall be closed fully in order to act as an effective barrier against the spread of fire and smoke.

Explanation and Illustrations

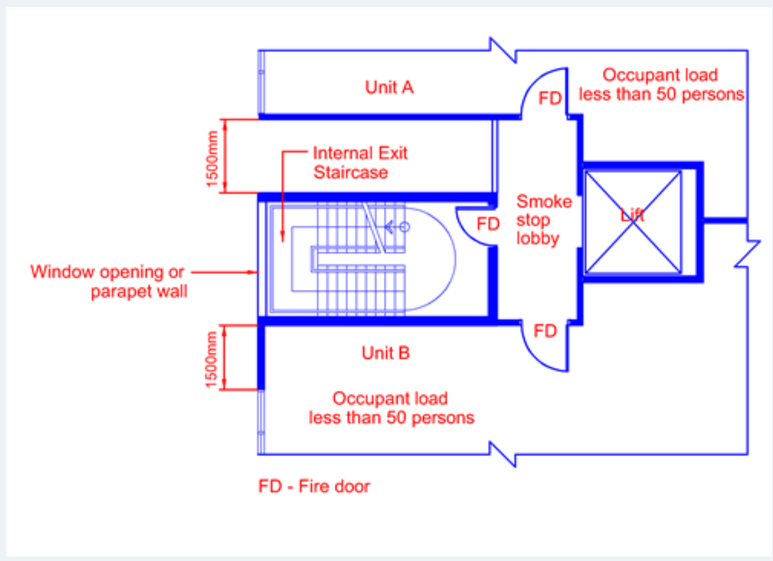


Figure 2.3.3a.(1)

This is a 5-storey building. Entry to exit staircase shall be via smoke-stop lobby.

No unprotected openings of occupancy area within 1.5m horizontally from window opening of internal staircase. See Cl.3.8 for requirements on the provision of protected shaft.

(2) Approached via external exit passageway or external corridor

Where an internal exit staircase is directly approached from an external exit passageway or external corridor, such enclosure between the staircase and the external exit passageway or external corridor is not required.

Explanation and Illustrations

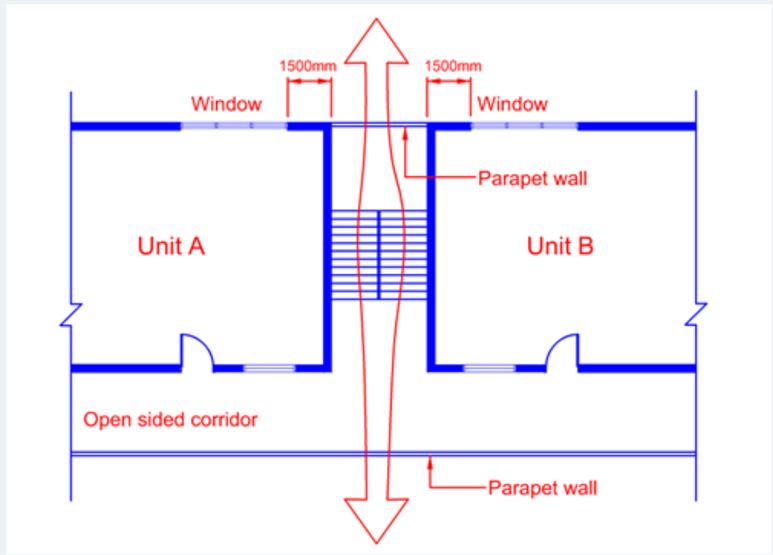


Figure 2.3.3a.(2) - 1 : Cross-ventilated exit staircase of industrial slab block with external corridor approach

Exit staircase is cross-ventilated & maintained under smoke-free condition at all times. Unprotected openings of the apartment or maisonette units are not facing (as shown in above figure) or ventilating into the exit staircase enclosure.

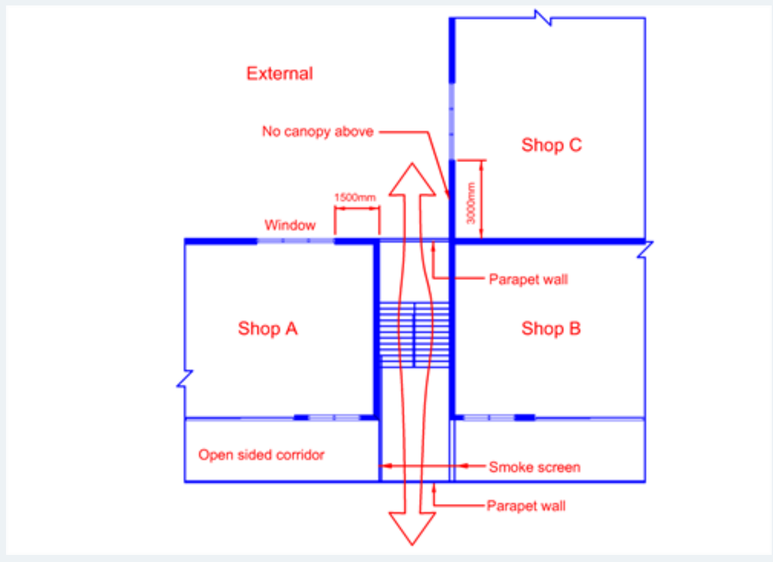


Figure 2.3.3a.(2) - 2 : Cross-ventilated exit staircase of commercial block with external corridor approach

Cross ventilation provided to staircase will help to disperse smoke more readily. No unprotected openings from the shop units should face or ventilate into the exit staircase enclosure. The rear portion of shop unit C shall have 3m blank wall next to the staircase, otherwise smoke could be channelled into the staircase where there is a fire in the shop.

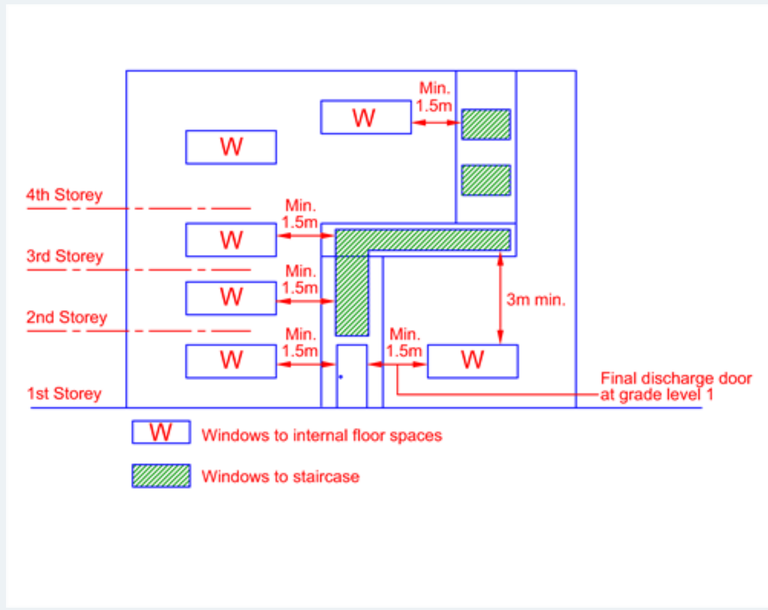
(3) Unprotected openings

There shall be no unprotected openings of occupancy area or combustible material/construction within 1.5m horizontally or within 3m vertically below any opening including final discharge openings located in the external walls of the internal exit staircase.

Rationale

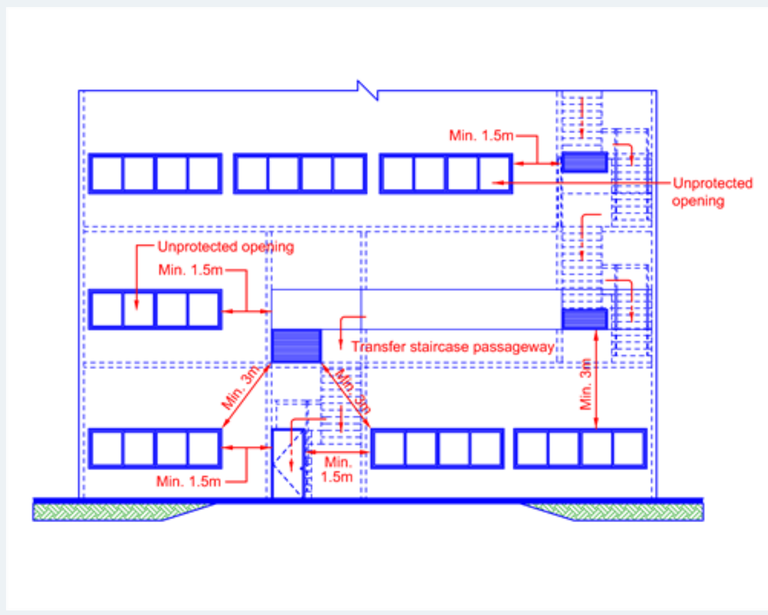
The minimum separation distances between openings of an internal exit staircase and nearby unprotected openings shall be maintained. This is to reduce the risk of smoke and fire spreading into the internal exit staircase during a fire emergency.

Explanation and Illustrations



Elevation

Figure 2.3.3a.(3) – 1: Unprotected openings of external wall to staircase



Elevation

Figure 2.3.3a.(3) – 2: Unprotected openings of external wall to staircase

(4) Exception

(a) Single storey basement car park

Exit staircases serving a single storey basement of PG II to VII buildings are not required to be protected with fire-rated enclosures, provided the travel distances in the car park measured to the exit doors at ground level comply with *Table 2.2A*.

Rationale

The reasons for the relaxation are:

The car parking areas are provided with either automatic fire alarm or sprinkler system.

Car parking areas are usually not occupied, except during the times when people are parking or retrieving their cars.

Adequate ventilation for smoke, either by natural means or smoke purging.

Only single basement floor is involved.

(b) Standalone car park

Doors to exit staircases of standalone car park buildings that are without any commercial activities or non-ancillary usage can be omitted, provided that all of the following conditions are complied with:

(i) The car park building shall not exceed five storeys above ground. It shall not consist of any basement storey, and shall not be connected to any other building, except by open-sided covered link-way.

(ii) At least two exit staircases shall be provided to serve every upper storey. The two staircases shall be located as remotely from one another as practicable. The exit openings to the staircases at each storey shall have a clear width of not more than 1m or less than 850mm and a clear height of not more than 2m. The staircases shall be ventilated by fixed openings in the external walls, such openings being of area not less than 10% of the floor area per floor of the staircase. Exit staircase and occupancy area shall not share the same air well or void for lighting and ventilation.

(iii) Every storey shall be provided with cross ventilation. The building shall be open-sided having not less than 50% of the sides (front, rear and sides elevations) permanently open, with such openings being evenly distributed around the perimeter walls, excluding perimeter walls to air well, so as to provide effective cross ventilation to all parts of the car parking decks.

(iv) No part of the floor space shall be more than 12m from the openings on the perimeter walls of the building or air wells. Air wells where provided for this purpose shall have a superficial plan area of not less than 10m², and have a minimum dimension on plan of 2m, open vertically to the sky for its full height.

(v) The travel distance within each car parking deck shall comply with *Table 2.2A*. For upper storeys, the travel distance requirement shall be measured to a position where the exit door to the staircase would have been installed if otherwise required.

(vi) The separation distance between the nearest edge of exit opening to exit staircase and the nearest edge of any vehicle parking lot shall not be less than 3m.

Rationale

Fire safety engineering simulations using typical model of a 3-storey car park building were carried out to evaluate whether the fire-rated doors to the exit staircases could be omitted. The result was convincing as it indicated that occupants are able to escape safely to the exit staircases without being subject to untenable conditions in terms of temperature and visibility. The rationale of stipulating exit opening size is to avoid total removal of the staircase enclosures. Other supporting reasons include cross ventilation and low occupancy.

Explanation and Illustrations

(No illustration)

Fire modelling using a typical model of a 3-storey car park building to evaluate whether the fire-rated doors to exit staircases within the MSCP could be permitted. The results gathered from the study indicated that occupants are able to escape safely from the staircases without being subject to untenable conditions in terms of temperature and visibility.

To qualify for the omission of the fire-rated doors in standalone car park building, the exit staircase must be positioned as remotely from one another as possible. The rationale of stipulating exit opening size is to avoid total removal of the staircase enclosures. In addition, the car park buildings must be without commercial activity or non-ancillary usage. The 3m buffer separation distance between the exit door and the nearest car park lot is intended to provide unobstructed movements to occupants getting in and out of the staircase. The omission of fire door to exit staircases is a relaxation and will eliminate maintenance aspects.

b. External exit staircase

(1) An exit staircase can qualify as an external exit staircase provided it complies with Cl.1.4.50.

(2) An external exit staircase can be used as required exit in-lieu of internal exit staircase provided:

(a) it complies with the requirements for exit staircase, and

(b) there is no unprotected opening, or combustible material/construction within 3m horizontally or within 3m vertically below, or adjacent or facing it.

Exception:

In a building designed with external corridor access, the access to the external exit staircase can be by means of the open-sided external corridor adjoining the occupancy areas, subject to the following:

(i) the external corridor shall be served by at least two exit staircases; and

(ii) unobstructed ventilation openings shall be provided along the long side of the external corridor above the parapet or balustrade; and

(c) its final discharge leads directly to an external space.

(3) Fire-rated doors to the external exit staircases shall be provided unless the conditions given in *Cl.2.3.3a(4)* are fully complied with.

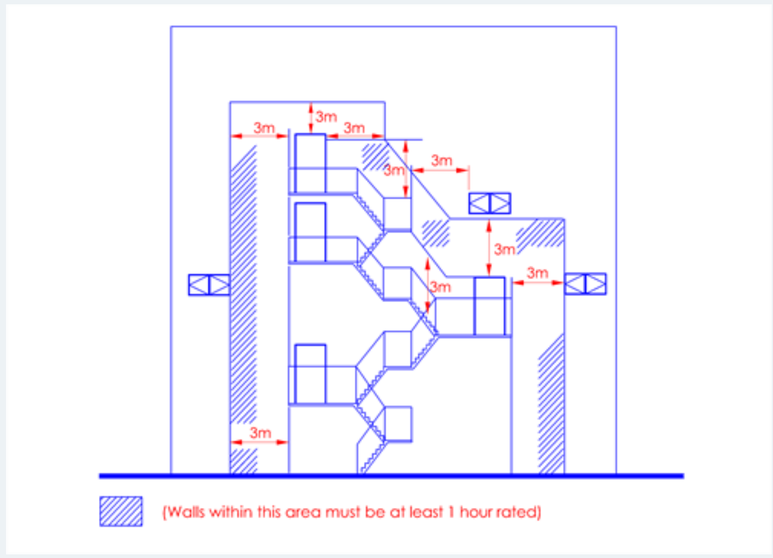
c. Discharge

Rationale

The minimum separation distances between openings of an external exit staircase and nearby unprotected openings shall be maintained. This is to reduce the risk of smoke and fire spreading into the internal exit staircase during a fire emergency.

Comparing to the internal exit staircase, a horizontal separation distance of 3m is mandated. This is because an external exit staircase has less protected enclosure.

Explanation and Illustrations



Elevation

Figure 2.3.3b.(2)(b) – 1

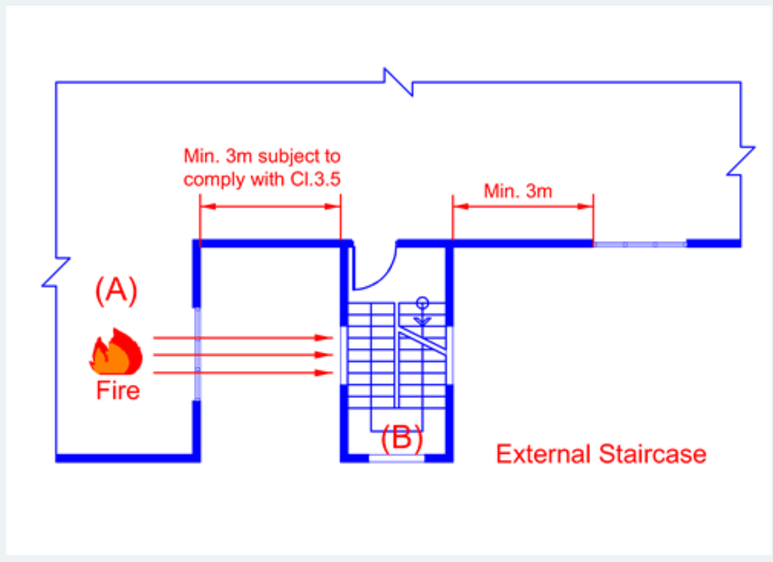


Figure 2.3.3b.(2)(b) – 2

Requirements on setback requirements under Cl.3.5 shall be used to determine the separation distance between building's openings at A and staircase's openings at B, subject to minimum 3m.

Heat radiation from a fire through external window in part of the building at (A) would affect occupants escaping down the external staircase at (B). To avoid this situation, the separation distance between that part of the building and the staircase shall comply with the separation requirements under Cl.3.5.

Cl.3.5 would prescribe the separation distance between that part of the building (A) and the external staircase (B) in accordance with the amount of unprotected openings provided in the external wall to part of the building (A).

Alternatively, to omit the unprotected openings in the external wall of staircase (B) facing part of the building (A).

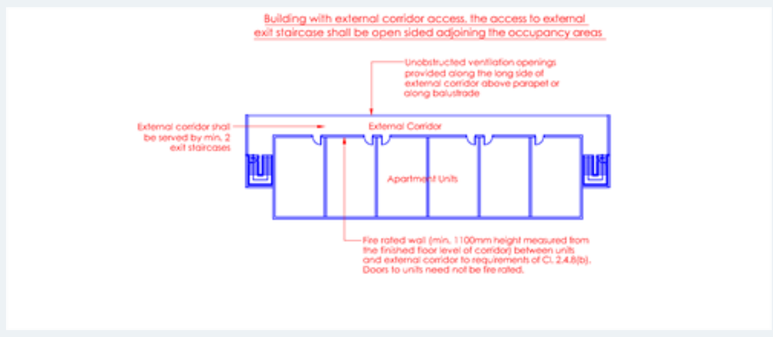


Figure 2.3.3b.(2)(b) – 3

(No illustration)

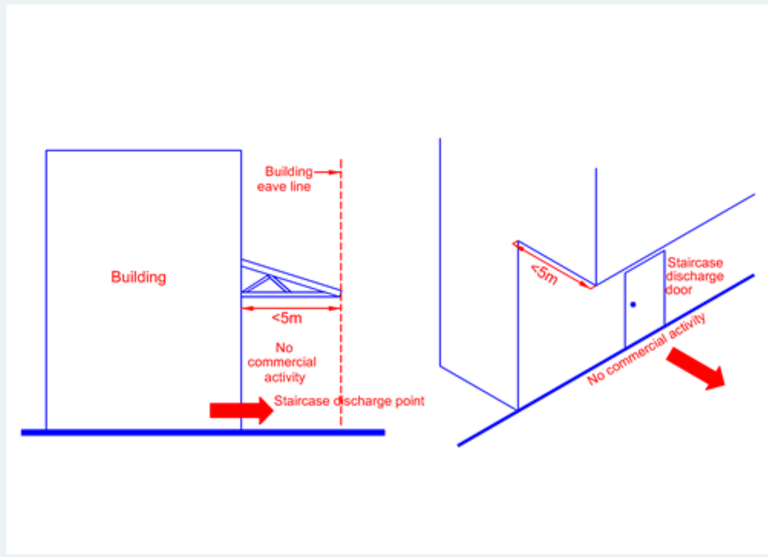
Figure 2.3.3b.(2)(b) – 4

(1) All exit staircases shall discharge at ground level directly into:

(a) an external space, or

(b) an open-sided external corridor with no commercial activity and is not more than 5m from the building eave line, or

Explanation and Illustrations

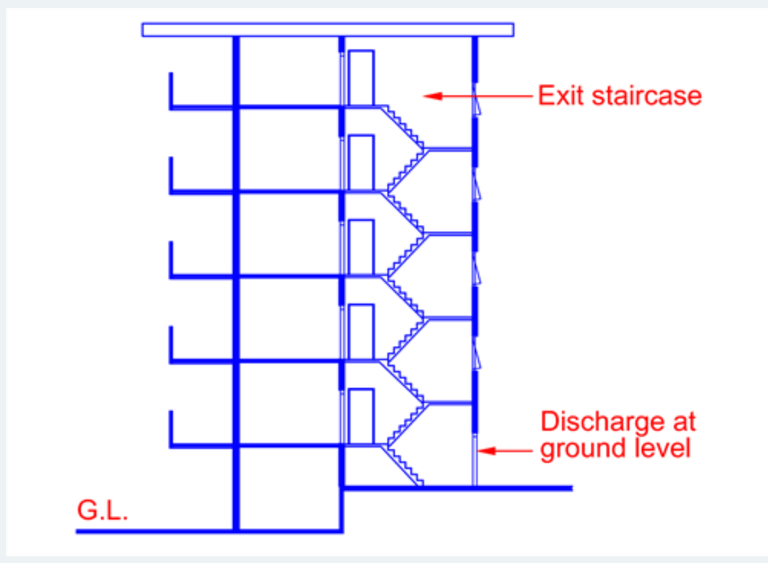


Left Figure : Section

Right Figure : Axonometric view

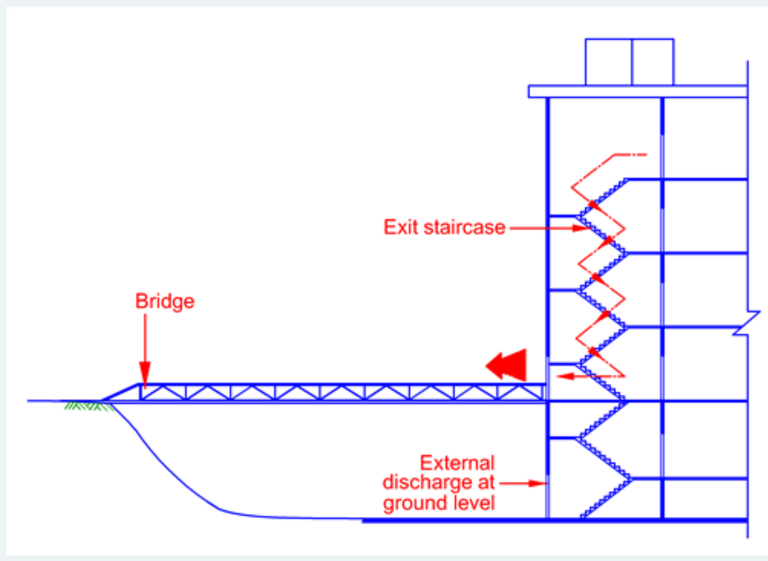
Figure 2.3.3c.(1) – 1

Note : This relaxation follows the exemption for sprinkler provision for external open-sided linkways not exceeding 5m in width. There shall be strictly no commercial activities or storage within these areas.



Section

Figure 2.3.3c.(1) – 2



Section

Figure 2.3.3c.(1) – 3

Exit staircase is provided with discharge into unenclosed bridge leading to safe exterior space at ground level.

PROVISION OF ADEQUATE SEPARATION BETWEEN COMMERCIAL SPACES AND EXIT PATH

Currently, the code allows minimum 50% of the staircase exits in a sprinkler-protected building to be discharged through the ground level circulation space, which must be within 10m from exterior safe area. As there is possibility that part of the circulation space is used for commercial activities such as shops and kiosks, the SCDF conducted a study on the effect of radiation from a fire involving such commercial activities on occupants evacuating pass them. The intent of the study is therefore to look into the provision of an adequate separation between commercial activities on provision of an adequate separation between commercial spaces and the escape path such that radiation from the shop/kiosk fire would not jeopardize the occupants' safety.

The SCDF has conducted the study through the use of CFD modelling. In the study, a sprinkler controlled 5MW shop fire was adopted. The study is confined to radiation from fire at the shop and it is assumed that the building is installed with engineered smoke control system. The study found that a minimum of 10m separation distance is needed between the commercial activities and the designated escape, as illustrated below.

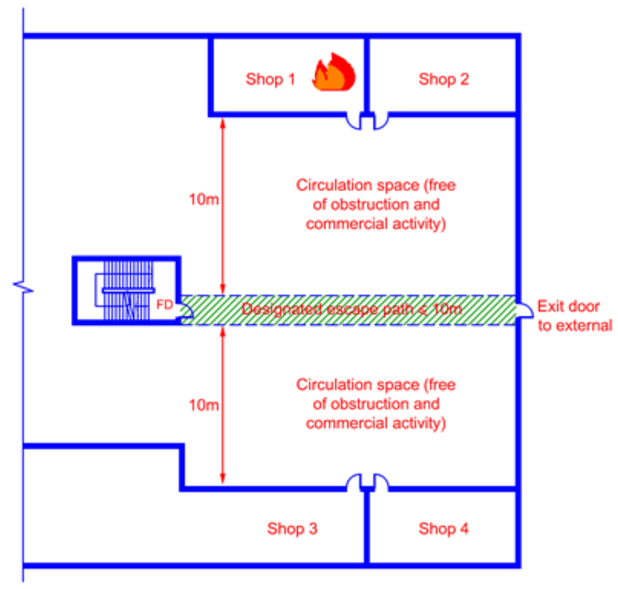


Figure 2.3.3c.(1) - 4

Standard distance between shop and designated escape route

(c) an open-to-sky corridor having minimum width of 1.2m. and two-way escape paths leading to an external space. Any unprotected openings along the corridor shall not be located lower than 1.8m from the floor level.

(d) an air well of size complying with *Table 1.4.2* and with discharge point at the grade level having at least 2 separated egress routes with direct access through circulation space to the building external.

(2) In a sprinkler-protected building, a maximum of 50% of the total number of exit staircase can be discharged directly to the ground level covered circulation space provided all of the following are complied with:

(a) The discharge point of the exit staircase into the ground level circulation space shall be within sight of and with direct access to an external space.

(b) The maximum distance between the discharge point of an exit staircase and the external space shall not exceed 10m.

(c) Where there are commercial activities e.g. shops or kiosks/carts located along one side or both sides of the designated escape passageway leading to an external space, a minimum separation distance of 10m shall be maintained between the commercial activities and the designated escape passageway. The circulation space shall also be installed with engineered smoke control system. Alternatively, the commercial activities shall be fire compartmented with walls and doors of minimum 1-hr fire resistance rating.

(d) The clear width of the exit doors leading to an external space shall be adequate to receive the occupant load in the 1st storey circulation space and the total number of people discharging from the internal exit staircases.

Rationale

A study on the effect of radiation from a fire involving such commercial activities on occupants evacuating pass them was initiated. In the study, a sprinkler controlled 5MW shop fire was adopted. The study concluded that a minimum of 10m separation distance is needed between the commercial activities and the designated escape route to ensure the radiation is at the acceptable level along the escape path.

(3) In the case of a PG II residential building not fitted with an automatic sprinkler system, at least 50% of the total number of exit staircases shall discharge to an external space and the remaining exit staircase can be discharged to the ground level covered circulation space provided the following are complied with:

(a) the ground level covered circulation space shall be free of any commercial activity;

(b) the discharge point into the ground level circulation space shall be within sight of and provided with at least two alternative routes to an external space;

(c) the maximum distance between the discharge point of an exit staircase and the external space shall not exceed 10m;

(d) there shall not be more than four residential units opening into the designated escape passageway at grade level into which the exit staircase discharges; and

(e) the discharge point of an exit staircase shall be effectively cross- ventilated such that:

(i) each end has at least 50% permanent openings; and

(ii) no part of the circulation space shall be more than 10m from the openings on the perimeter walls of the building or air well.

Explanation and Illustrations

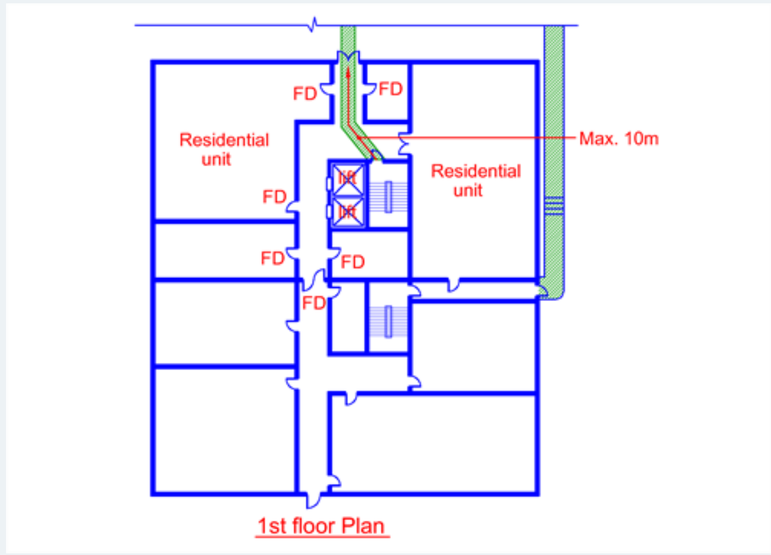


Figure 2.3.3c.(3) – 1: Spaces consisting exit discharge

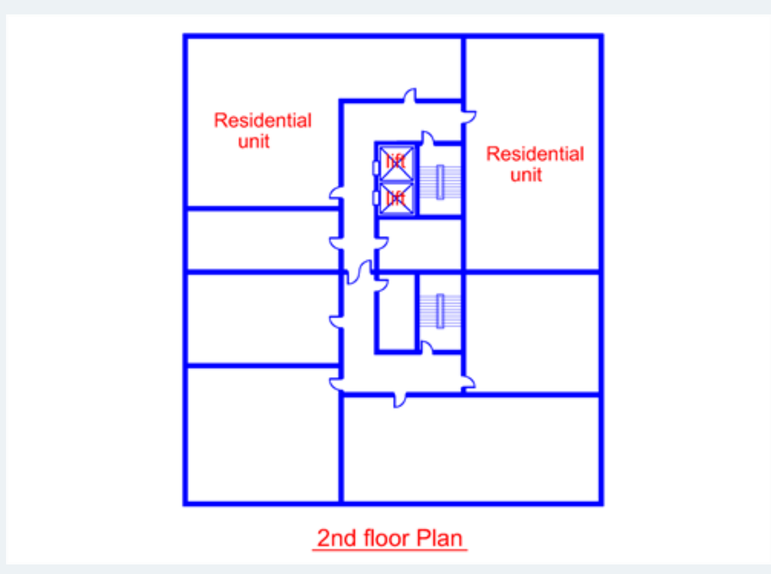


Figure 2.3.3c.(3) - 2

Building occupants with path of travel from the termination of an exit to a public way. This path of travel might be inside the building, or outside. Where an exit opens onto an alley, court, or yard, a safe path of travel is to be provided to a public way or some equivalent safe area. This portion of the means of egress is the exit discharge.

Forms of exit discharge are shown in *Figure 2.3.3c.(3) - 1* as shaded areas.

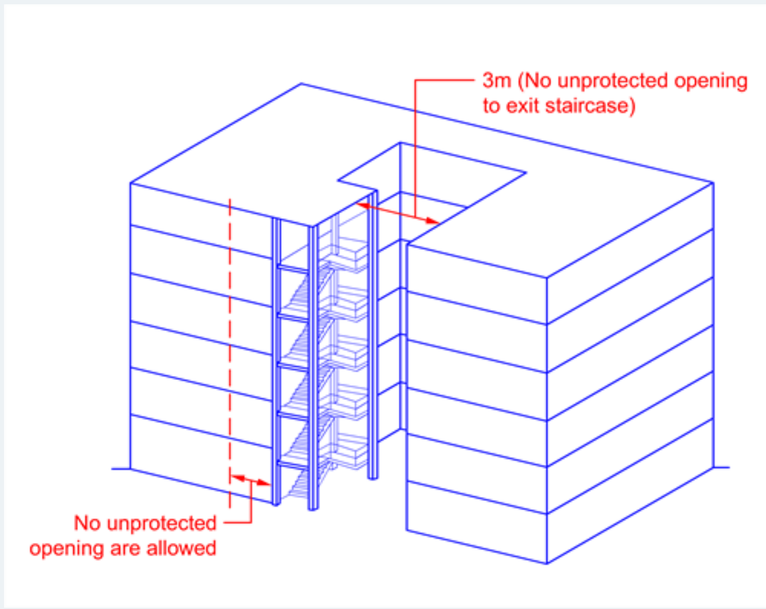
(4) There shall be no unprotected openings of occupancy area or combustible material/construction within 3m from discharge point of the exit staircase (both internal and external). This distance can be reduced to 1.5m if the unprotected openings are along the same plane of the staircase exit.

(5) There shall be no obstruction or any object encroaching, including any door swinging, onto the egress path at the discharge point of the exit staircase. The width of the egress path at the discharge point shall not be less than the width of the exit staircase.

Rationale

The specification of minimum distance between exit staircase discharge and nearby unprotected opening serves to minimize the risk of evacuees being affected by fire and smoke emitting from openings close to the staircase discharge. These distances specified have been validated through fire engineering study.

Explanation and Illustrations



Axonometric view

Figure 2.3.3c.(4) - 1

If an unprotected opening was next to the exit staircase, a separate distance of 3m was required. However, this distance can be reduced to 1.5m horizontal distance if the unprotected openings are along the same plane of the staircase exit.

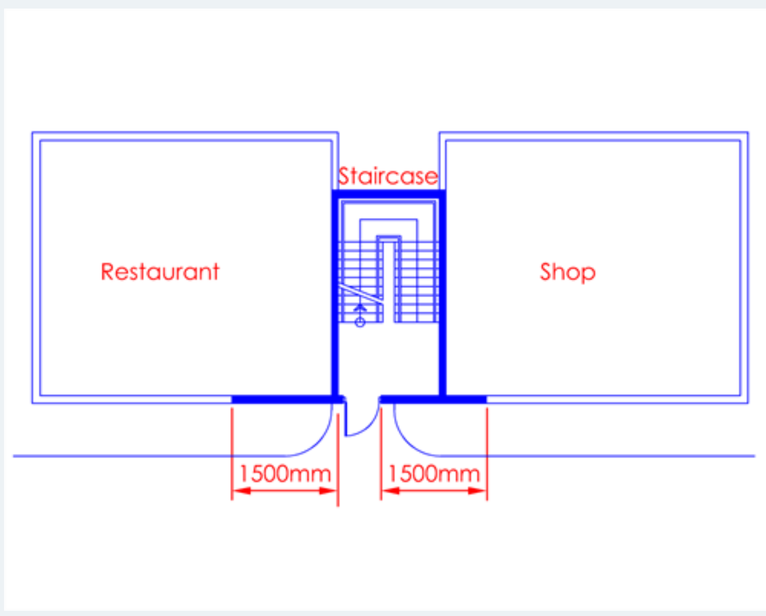


Figure 2.3.3c.(4) - 2

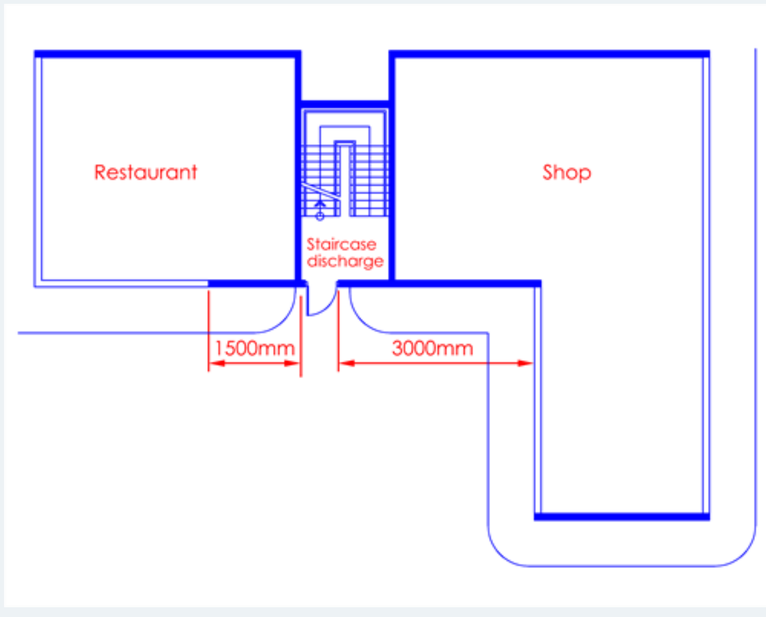


Figure 2.3.3c.(4) - 3

d. Minimum width and capacity

The minimum width and capacity of exit staircases shall be as specified in *Table 2.2A*, and such staircases shall comply with all of the following:

(1) Winders

Winders are not permitted in any building other than for access staircases in a residential unit and in such cases, there shall be not more than one winder per 90° turn.

Rationale

A winder is a tapered tread used to change the direction of a stairway. As it introduces a sudden change in the stair geometry, a winder could cause unwary occupants to trip and fall.

Explanation and Illustrations

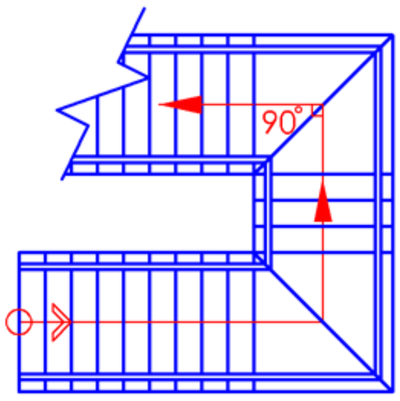


Figure 2.3.3d.(1) – 1

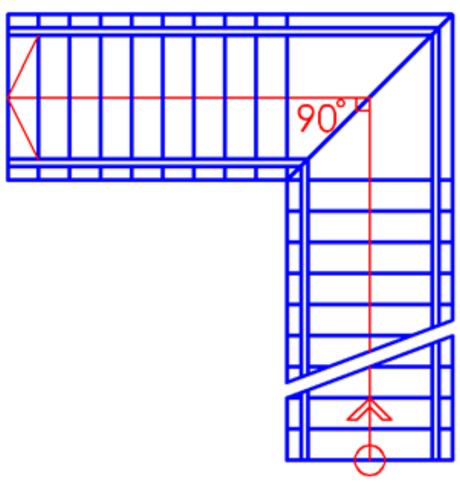


Figure 2.3.3d.(1) -2

Winders are only permitted in access staircase within the residential unit. They shall not be provided in exit staircase. Winder is a tapered tread used to change the direction of a stairway. As it introduces a sudden change in the stair geometry, winder could cause unwary occupants to trip and thus winder is not permitted in non-residential building.

(2) Treads for circular staircase

Where a circular staircase is used as an exit staircases or access staircase in PG I & II buildings, the width of treads measured at the narrower end shall be not less than 100mm in residential buildings and 125mm in other buildings and at a distance of half metre from the narrower end shall be not less than 225mm in residential buildings and 250mm in other buildings. Such staircase shall not be more than 10m in height.

Explanation and Illustrations

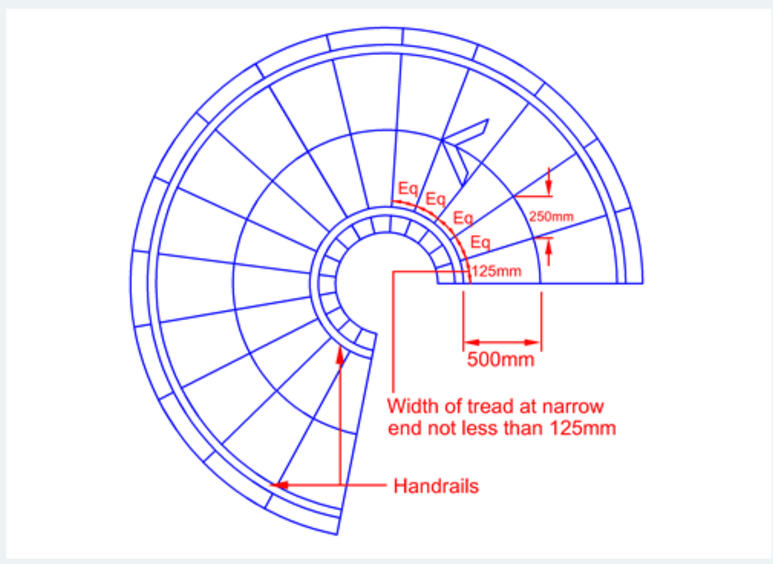


Figure 2.3.3d.(2) : Circular staircase

Circular staircases are not recommended for use as exit staircases due to their varying tread size, which can cause escaping occupants to lose footing and falling more frequently than straight run staircases. However, it may be permitted with limitations as provided for under Cl.2.3.7, or otherwise consented by the SCDF.

(3) Landings

The minimum clear width and length of a landing, where there is a change in direction, shall not be less than the clear width of the exit staircase.

Rationale

In view that BCA does not have any specific requirements for staircase landings, risers, treads and headroom for specific usages or spaces and has removed them from its code. These requirements are reinstated in this edition of the Fire Code to ensure the exit staircases meet minimum requirements for safe evacuation of occupants and access by firefighters for rescue and firefighting.

(4) Risers and treads

The height of the riser for any exit staircase shall not be more than 175mm and depth of tread shall not be less than:

(a) 225mm within residential units and 275mm for common areas of residential buildings;

(b) 250mm for PG VI and VIII buildings; and

(c) 275mm for all other buildings.

(5) Headroom

The clear headroom shall be at least 2m measured from the pitch line of the exit staircase or finished floor level of the landing to the underside of any obstruction.

(6) Handrails

Rationale

Handrail provides support for occupants using the staircase. It also serves as a guide when smoke enters the staircase in a quantity sufficient to interfere with one's vision, or when the exit staircase emergency lighting system fails. Staircase of not more than 1.25m in width is not too wide and evacuees using it can easily reach the handrail for support/guidance if necessary.

Explanation and Illustrations

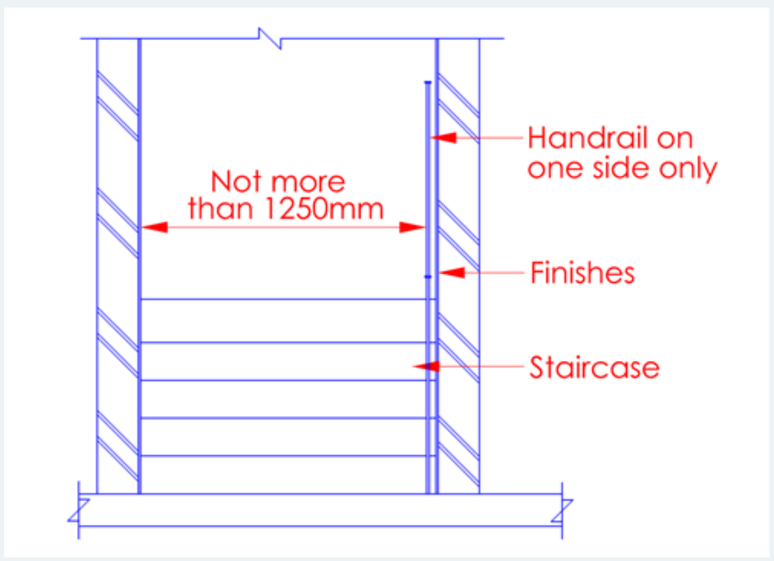


Figure 2.3.3d.(6) - 1

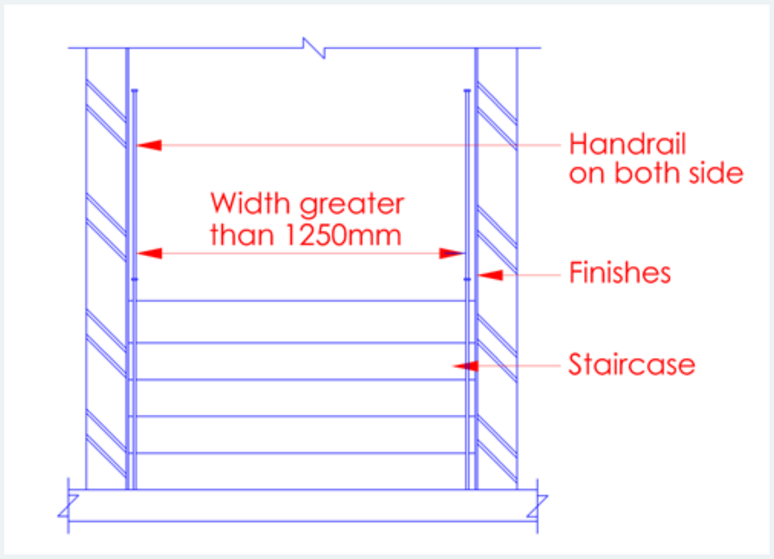


Figure 2.3.3d.(6) - 2

Handrail provides support for people using the stair. It also serves as a guide when smoke enters the stairway in a quantity sufficient to interfere with ones vision or when the stair lighting system fails. Handrail may be constructed of timber or metal with plastic finish.

(a) Every exit staircase shall have handrails on both sides. For exit staircases with only 1.25m or less in width, a handrail can be provided only at one side, i.e. the opposite side shall be either wall, parapet or grilles.

(b) Where the width of the exit staircase exceeds 2m, handrails shall be provided in accordance with the requirements of Cl.2.2.8.

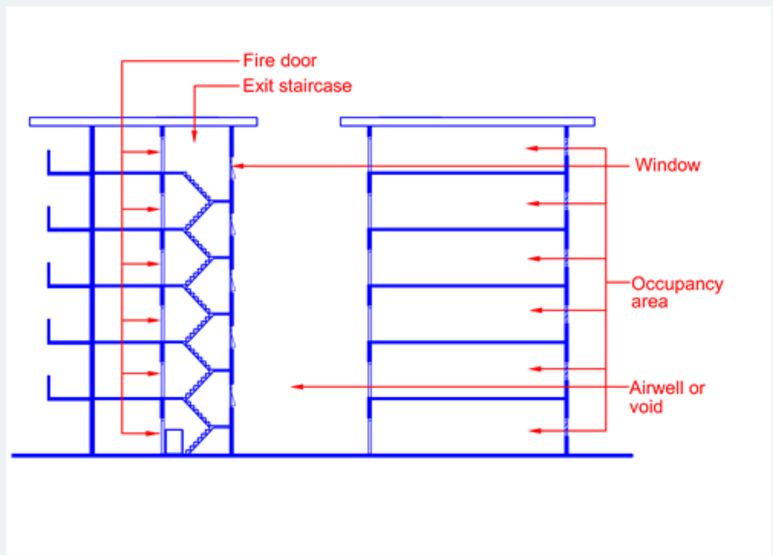
(7) Ventilation

All exit staircases shall be ventilated by fixed openings in the external walls, such openings being of area not less than 10% of the floor area per floor of the staircase, or mechanically ventilated to comply with the requirements in Chapter 7. Ventilation openings fronting an air well, external recessed space or external shall be in accordance with *Table 1.4.2*. Mechanical ventilation is not allowed for PG II buildings, except for a staircase storey shelter.

Rationale

The minimum ventilation openings stipulated provide effective smoke ventilation for exit staircases. These dimensions have been validated through fire engineering study.

Explanation and Illustrations



Section

Figure 2.3.3d.(7)

Exit staircase and occupancy area shall not share the same air well or void for lighting and ventilation to prevent smoke from being drawn into the staircase, unless otherwise permitted by the SCDF.

(8) Pressurisation

In any building, except PG II for which the habitable height exceeds 24m, any internal exit staircases without provision for natural ventilation shall be pressurised to comply with the requirements in Chapter 7. In a building comprising more than four basement storeys, the exit staircase connecting to the fire lift lobby shall be pressurised.

Explanation and Illustrations

(No illustration)

In addition to the provision of pressurisation, the entry into the internal staircase shall be through a smoke-stop lobby. The smoke-stop lobby acts as a buffer to prevent smoke from getting into the staircase. It is not common to have pressurised staircase for buildings under PG II.

Where the internal exit staircase is pressurised, there shall be a means to activate the pressurisation fan system.

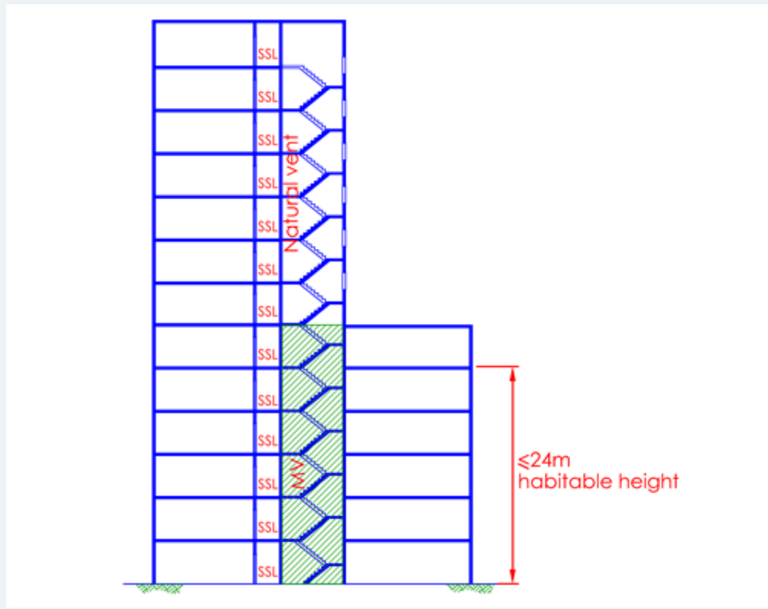
(9) Different modes of ventilation within a single staircase shaft

For buildings exceeding 24m in habitable height, the internal exit staircase can be naturally ventilated at its upper part and mechanically ventilated at its lower part provided this lower part does not exceed 24m in habitable height and there shall not be any intermediate staircase landing door separating the two modes of ventilation. If the lower part exceeds 24m in habitable height, this lower part shall be pressurised instead. For pressurisation of exit staircase, an intermediate staircase landing door is permitted.

Rationale

This clause serves to address different modes of ventilation allowed within a single staircase shaft. Door at landing is only permitted for a partially pressurised internal exit staircase for the purpose of maintaining positive pressure within the staircase.

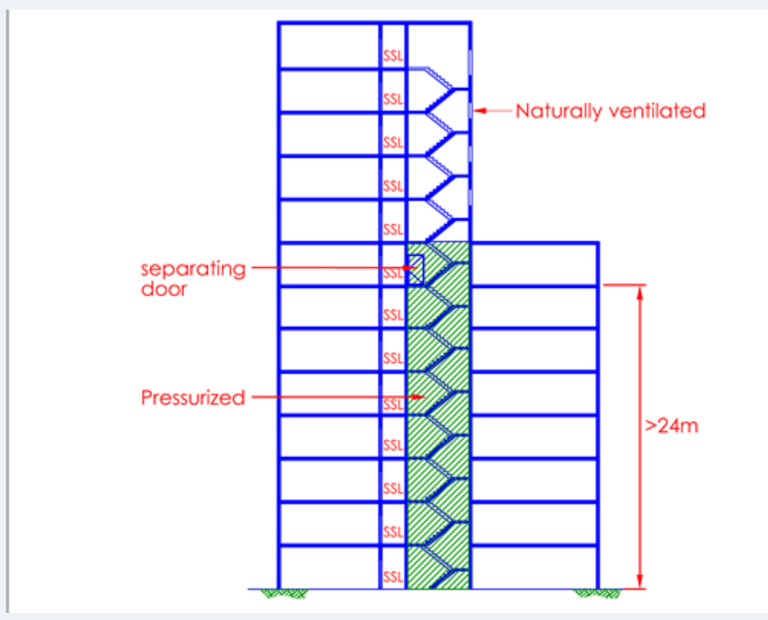
Explanation and Illustrations



Section

Figure 2.3.3d.(9) - 1

This is a relaxation towards the mode of ventilation whereby the lower part of exit staircase is mechanically ventilated instead of pressurised. This provision is only possible if the habitable height of the lower part of staircase shaft is less than 24m. No door is required within the staircase shaft to separate different mode of ventilation provision.



Section

Figure 2.3.3d.(9) - 2

Lower part of staircase shaft where habitable height exceeding 24m, it shall be pressurised. Door at the mid-landing separating the naturally ventilated and pressurised portion of exit staircase shall be provided to enable effective pressurisation.

2.3.4 Scissor exit staircase

Scissor exit staircase shall comply with the following:

a. where two separate internal exit staircases are contained within the same enclosure, each exit staircase shall be separated from the other by non- combustible construction having fire resistance for a minimum period equal to that required for the enclosure;

b. such scissor exit staircases shall comply with all applicable provisions for exit staircase;

c. for exit door openings of scissor exit staircases, the separation distance between the two closer edges of staircase doors shall be at least 7m;

d. where there is only one pair of scissor exit staircases, the door opening into scissor exit staircases shall be spaced at least 1/3 the diagonal dimension of the area to be served in a sprinkler-protected building and ½ the diagonal dimension in a non-sprinkler-protected building in accordance with Cl.2.3.12; and

Explanation and Illustrations

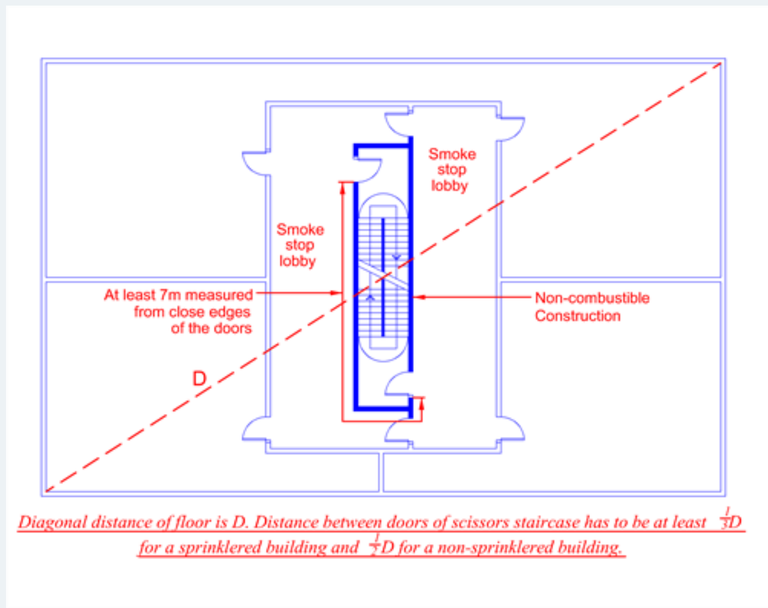


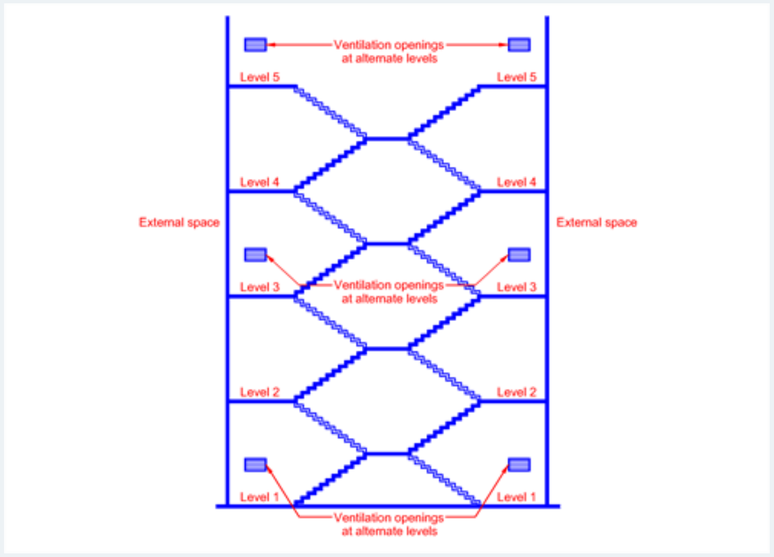
Figure 2.3.4a.-d.

e. the ventilation openings of each staircase shall be located on alternate storeys if such openings or windows are serving both staircases on the same wall.

Rationale

The purpose of this arrangement of ventilation openings for a scissor exit staircase is to ensure that if one of the staircase if breached, the smoke flowing out from that staircase ventilation opening will not enter into the other staircase.

Explanation and Illustrations

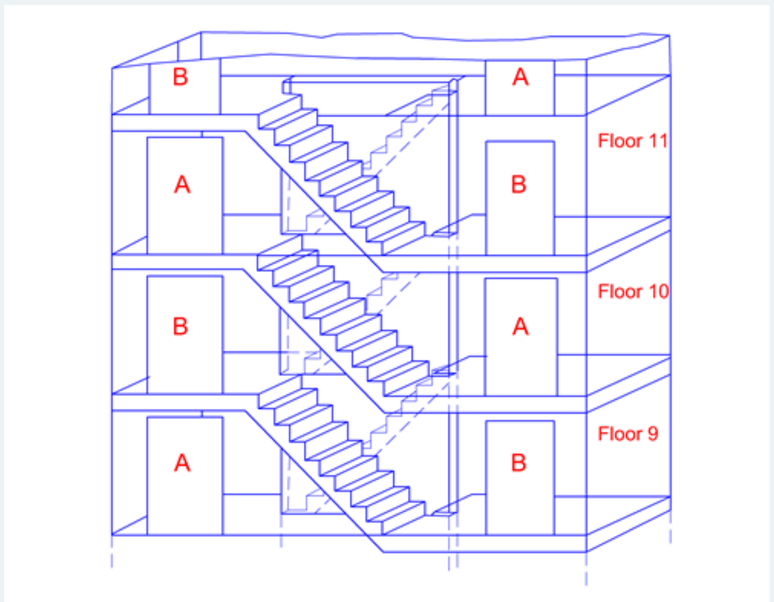


Section

Figure 2.3.4e. – 1 : Ventilation openings

Ventilation opening sizes are to comply with *Cl.2.3.3d(7)*.

Where there is only one pair of scissor exit staircases, designer shall ensure *Cl.2.3.4d.* is strictly adhered to. If the minimum 7m is less than the computed diagonal distance, the designer shall apply the latter diagonal separation distance.



Axonometric view

Figure 2.3.4e. – 2 : Scissor stair

2.3.5 Basement exit staircase

a. Any exit staircase which serves a basement storey of a building, unless otherwise stated in *Cl.2.3.3a.(4)(a)*, shall comply with all the applicable provisions for exit staircase.

b. Such exit staircase shall not be made continuous with any other exit staircase which serves a non-basement storey of the building.

Explanation and Illustrations

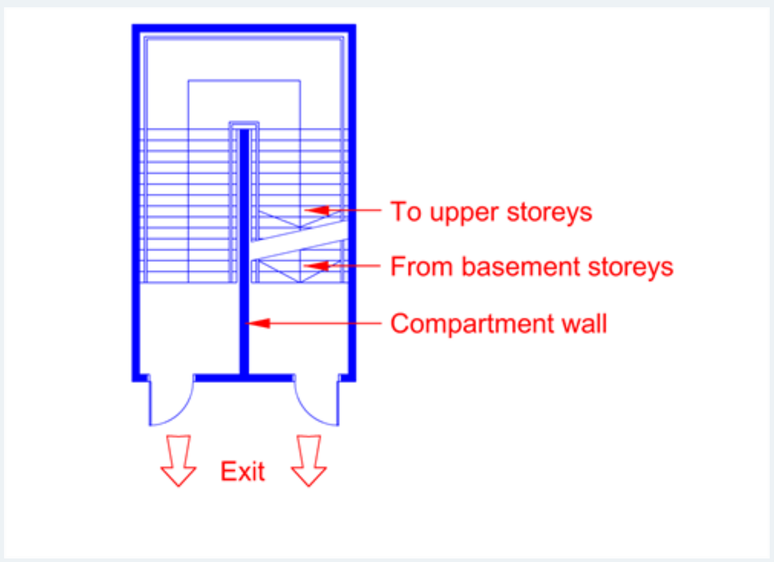


Figure 2.3.5b

c. Separate protected shaft

Basement exit staircases which are vertically aligned with the exit staircases of non-basement storeys shall be separated from such other exit staircases by construction having fire resistance for a minimum period equal to that required for the enclosure.

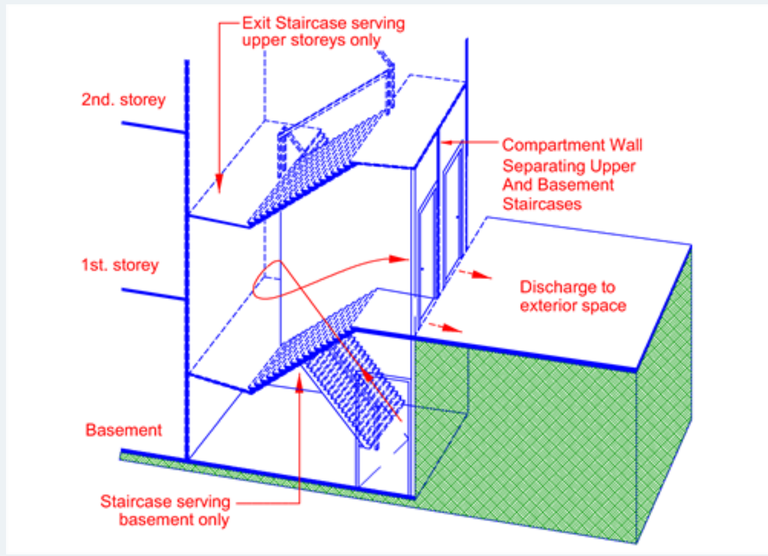
d. Upper storey staircase that continues into basement

Where upper storey staircase is allowed by the SCDF to be continuous with that serving a basement which is naturally ventilated, all of the following shall be complied with:

(1) Entry at basement

The entry into the basement staircase shall be through a protected lobby, or directly from the basement occupancy area provided the door to the basement staircase is at least 1-hr fire-rated.

Explanation and Illustrations



Axonometric view

Figure 2.3.5c

The provision of compartment wall is to separate the basement staircase from the non-basement staircase so that each is located in a separate shaft.

(2) Barrier

To prevent occupants exiting continuously from upper storeys into the basement storey during an emergency, a physical barrier in the form of a door or gate (self-closing type) shall be provided across the staircase landing at ground level to separate the discharge route of upper storeys from the basement staircase.

(3) Smoke-free lobby

A smoke-free lobby shall be provided for entry into the staircase at all storeys, including basement storeys if the staircase serves more than four storeys, including basement storeys.

(4) Signage

Appropriate signage shall be provided inside the staircase enclosure to direct occupants out of the building at ground level.

Rationale

The barrier serves as a physical restriction to prevent occupants evacuating from upper storeys from continuing into the basement levels. This, with the aid of an exit directional sign, would help to alert occupants in the staircase enclosure that they on the level of exit discharge.

Explanation and Illustrations

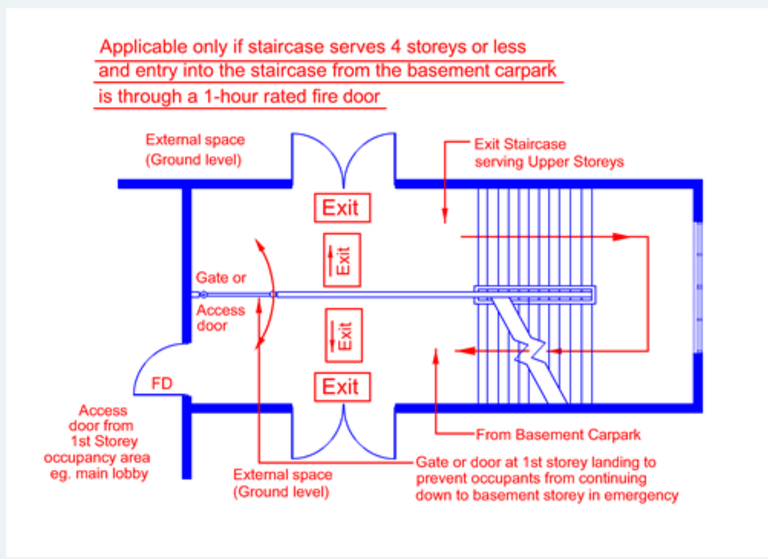
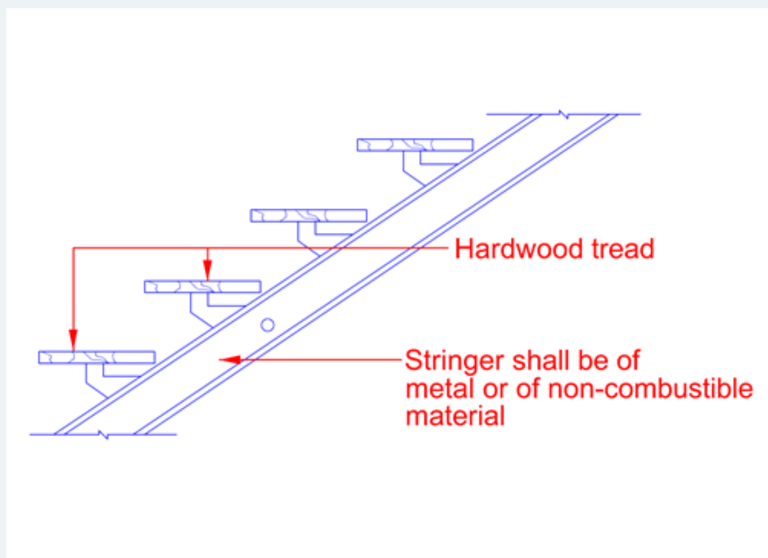


Figure 2.3.5d.(2) : Interruption of exit stair at level of exit discharge

This can be done by placing a physical barrier, like the gate shown above, to prevent occupants from continuing to the basement in emergency. This, together with the aid of exit directional sign, helps to alert occupants in the stair enclosure that they are on the level of exit discharge.

2.3.6 Hardwood staircase

Explanation and Illustrations



Section

Figure 2.3.6 : Unenclosed staircase

As stringer is considered as part of an element of structure, it shall be of non-combustible material having the necessary fire resistance rating of ½ hour or 1 hour as the case may be under Cl.3.3

Hardwood staircase is allowed to be used as internal access staircase.

a. A hardwood staircase can be used as an internal access staircase in building.

b. Where timber staircases are used in units in PG I and II buildings, which are not under conservation, the structural elements such as the stringer supporting the treads and risers shall be constructed of non-combustible materials.

2.3.7 Spiral staircase

Rationale

Spiral staircases are not suited as required exits because they are typically steep and winding, thus causing occupants to take a longer time to complete their descent. The varying thread size also leads to the increased risk of occupants slipping and losing their footings.

Explanation and Illustrations

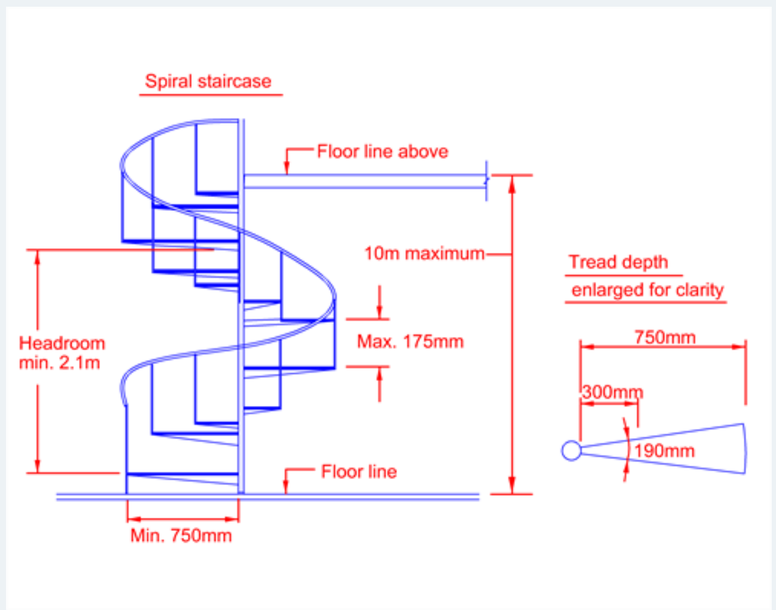


Figure 2.3.7

Minimum and maximum dimensions for spiral stairs are shown above. All treads must be identical, and the stair can serve a maximum occupant load of 25 persons. Spiral staircase is slightly different from curved or other geometric staircases, as all its treads must be identical, subject to a height restriction of 10m and being located on the external facade of the building to qualify as exit staircase.

As spiral staircase is very steep and winding, the time taken by occupants to exit downwards during an emergency would be much longer, hence there is a need to limit the occupant load to max. 25 persons. In permitting the spiral staircase to be used as exit staircase in case of fire, and for rescue and firefighting operations by firefighters, the width of the staircase should not be less than 750mm. This width would be just adequate to permit movement of firefighters in full body gear and carrying casualties in moving down the stair.

a. Spiral staircases shall not serve as required exits, unless they comply with all of the following conditions. They shall:

1. be external and unenclosed;
2. serve only mezzanine floors, balconies, or any storey of occupant load not exceeding 25 persons;
3. be constructed of non-combustible materials;
4. have a tread length of at least 750mm; and
5. be not more than 10m high.

b. Spiral staircase shall not be designed as the sole means of escape for buildings under PG I and for PG II maisonettes and penthouses.

2.3.8 Exit ramp

Rationale

A ramp can be used for vertical exit similar to that of an exit staircase provided its gradients meet the requirements. This is to prevent accidents as steep or abrupt elevations may cause tripping or hamper movement during evacuation.

Internal and external exit ramps can be used as exits in lieu of internal and external exit staircases subject to compliance with Cl.2.3.3 and all of the following:

a. Slope

The slope of such exit ramps shall not be steeper than 1 in 10.

b. Changes in direction

Exit ramps shall be straight with changes in direction being made at level platforms or landings only, except that exit ramps having a slope not greater than 1 in 12 at any place can be curved.

Explanation and Illustrations

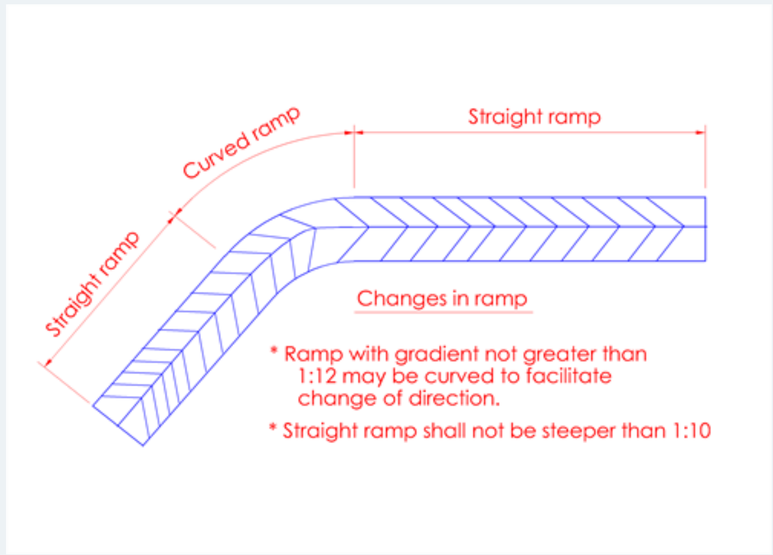


Figure 2.3.8b. - 1: Changes in ramp direction

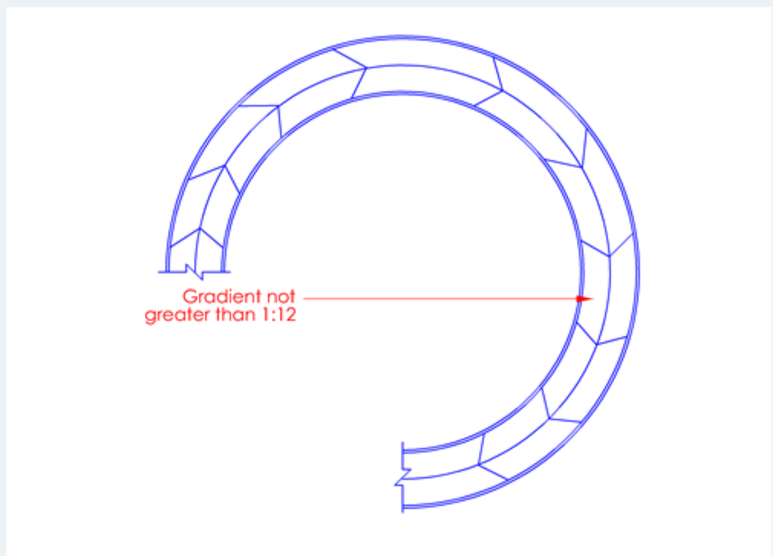


Figure 2.3.8b. - 2 : Circular ramp

Circular ramp having a gradient not greater than 1:12 is acceptable as an exit ramp.

c. Platform

(1) Level platforms or landings shall be provided at the bottom, at intermediate levels where required and at the top of all exit ramps.

(2) Level platforms shall be provided at each door opening into or from an exit ramp.

(3) The minimum width and length of a platform or landing shall be not less than the width of the ramp, except that on a straight run ramp, the length of the level platform or landing need not be more than 1m.

Explanation and Illustrations

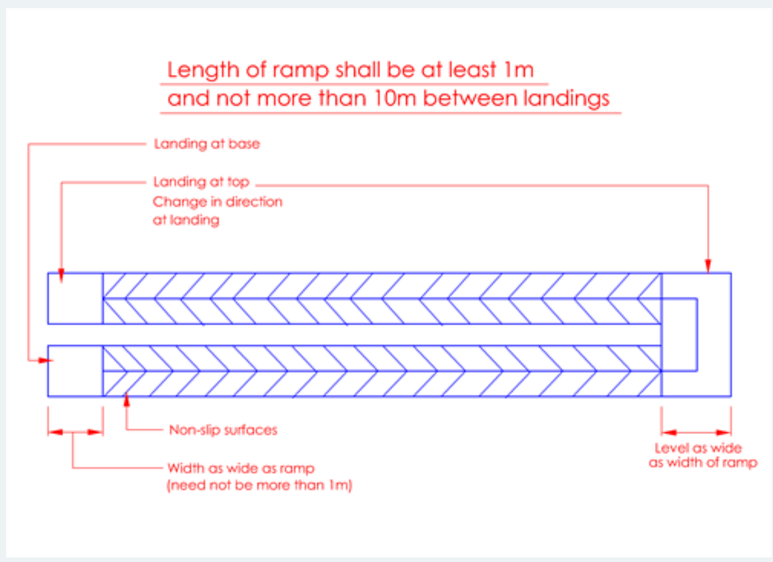


Figure 2.3.8c.

d. Guards and handrails

Exit ramps shall have walls, guards or handrails and shall comply with the applicable requirements of *Cl.2.3.3d.* for exit staircases.

e. Surface

All exit ramps shall be provided with non-slip surface finishes.

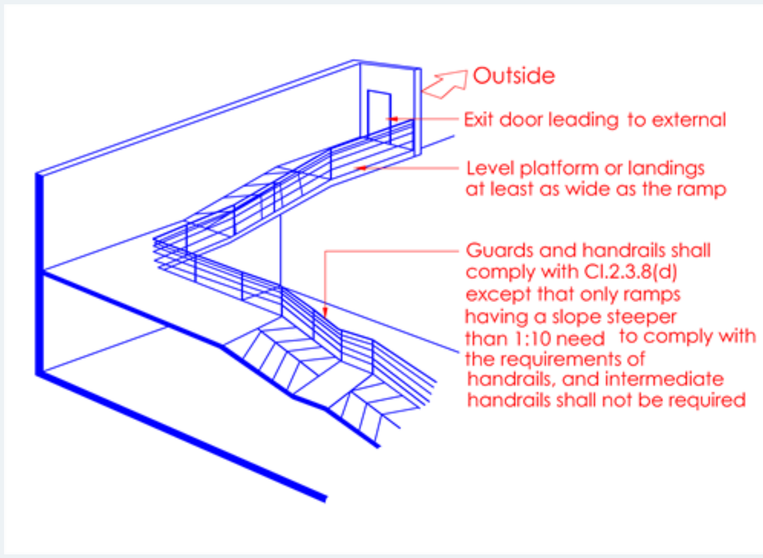
f. Ventilation

Exit ramps shall be ventilated to comply with the requirements for ventilation of exit staircases.

g. Enclosure exemption

Exit ramps serving a single storey basement of PG II to VII buildings are not required to be protected with fire-rated enclosures, provided the travel distances measured to the exit doors at ground level comply with *Table 2.2A*.

Explanation and Illustrations



Axonometric Section

Figure 2.3.8d. & g.

Occupants using the exit ramp would be able to travel at a quicker pace to exit directly into the exterior space at grade level. As only one level is involved and that final exit is within sight of exiting occupants, there is no need to protect the ramp with enclosure walls, provided travel distance is measured to the door at grade level and complies with *Table 2.2A*.

All exit ramps shall be constructed of non-combustible materials to have the necessary fire resistance rating as exit staircase. Similarly, the width of the exit ramp shall have the adequate exit capacity to receive the occupant load from the floor space it serves.

2.3.9 Exit doors and exit access doors

Explanation and Illustrations

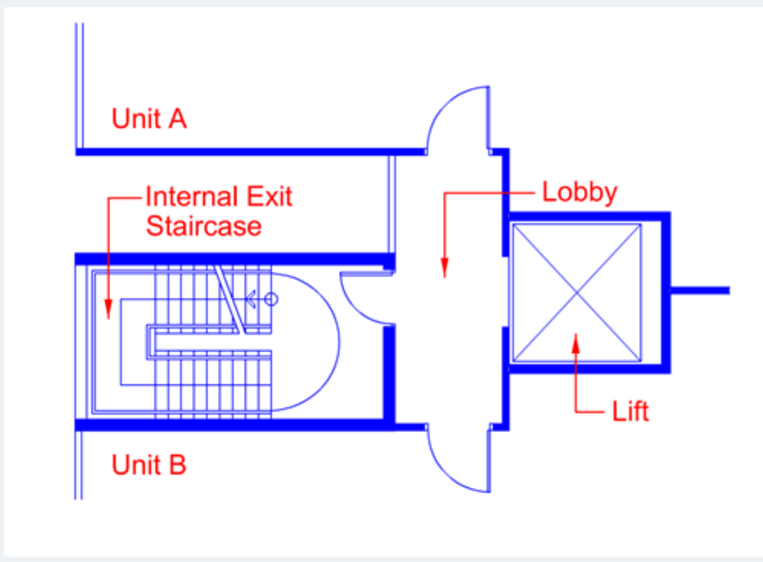


Figure 2.3.9 - 1

Exit door opening into the exit staircase must satisfy the following requirements:

1. The dotted lines indicate the space that would be used by occupants exiting in the staircase.

2. Exit doors to Industrial or warehouse units may open inward as shown in Figure 2.3.9 - 1 if the conditions mentioned Cl.2.3.9 can be complied with. However they are normally constructed to open outwards due to its usually larger than 50 occupant load.

3. Exit doors which consist of 2 leaves, the smaller leaf is not required to be provided with sequential door closer if it is bolted in closed position and the clear width of opening of the larger leaf is not less than 850mm.

4. Providing locking devices to exit door to exit staircase would hamper escape, unless there is other means of meeting both security and fire safety requirements. Usually, the final exit door of exit staircases at ground level are allowed to be provided with one-way locking mechanism for security reason, such as panic hardware or push bar opening devices.

5. Provision of one-way locking devices hooked to the alarm system shall not be allowed unless otherwise permitted via waiver applications by the SCDF.

6. In situations where the door of the industrial or warehouse unit opens directly into the staircase enclosure, there would be a need to provide locking devices to the door for security reasons.

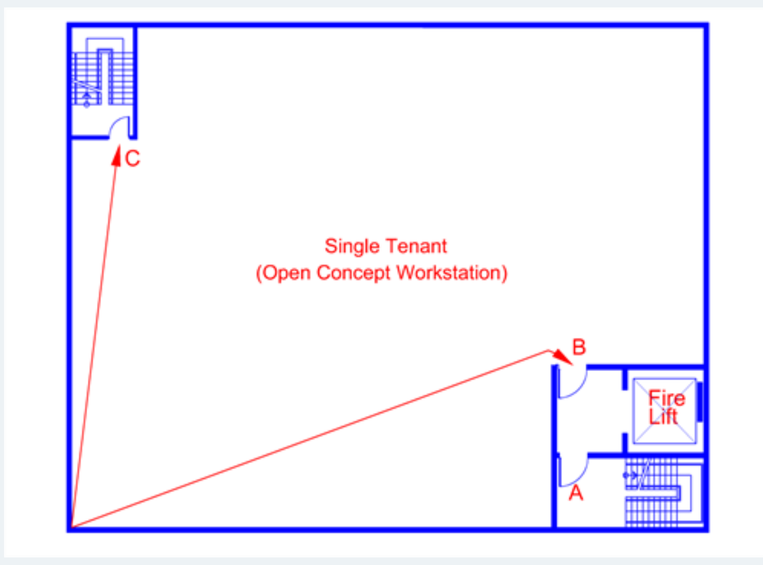


Figure 2.3.9 - 2

Door A - One-way locking device is allowed, provided it is linked to the building's fire alarm system.

Door B & C - One-way locking device allowed (e.g. panic bolt, thumb turn or card access system with provision for unhindered exit in an emergency)

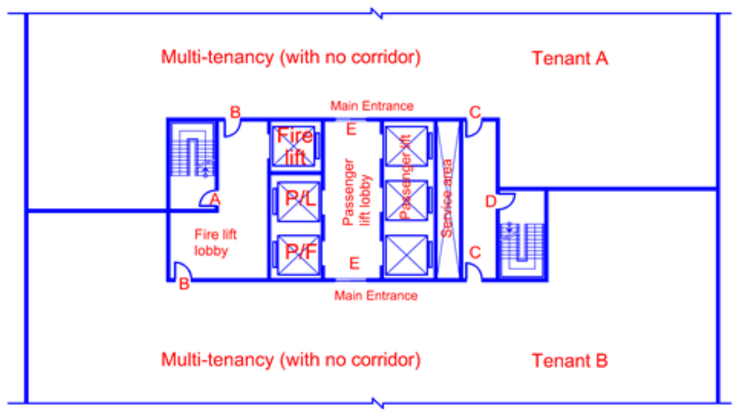


Figure 2.3.9 - 3

Doors A & D - One-way locking device allowed, provided it is linked to building's fire alarm system. (e.g. panic bolt, thumb turn, card access system with provision for unhindered exit in an emergency)

Door B - One-way locking device allowed (door fitted with vision panel)

Door C - One-way locking device allowed

Door E - Locking device allowed, provided the fire wardens to ensure that persons stranded will be released and intercom system is linked to FCC.

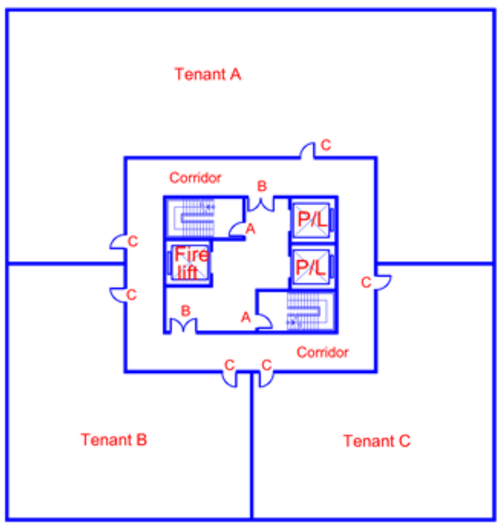


Figure 2.3.9 - 4 : Multi-tenancy with corridor

Doors A & B - One-way locking device allowed provided it is linked to building's fire alarm system.

Door C - One-way locking device allowed (e.g. panic bolt, thumb turn or card access system with provision for unhindered exit in an emergency).

Door to the exit staircase adjacent to a fire lift shall not be fitted with any form of locking device. This would facilitate the firefighters to gain re-entry at any floor for the purposes of conducting firefighting and rescue operations.

However, for security reasons, doors to exit staircases adjacent to fire lifts and selected re-entry doors to exit staircases are allowed to be fitted with one-way locking device that is linked to the building's fire alarm system. Upon activation of the fire alarm system, the locking device would be unlocked. It shall be a fail-safe system.

Exit door opening into the exit staircase must satisfy the following requirements:

1. Exit door opening into the exit staircase shall satisfy the requirements above. The dotted lines indicate the space that would be used by occupants exiting in the staircase.

2. Exit doors to units A & B in the Figure 2.3.9 - 1 are shown to open inward. It is allowed if the exit door does not serve a room or space with more than 50 persons.

3. Where an exit door consists of 2 unequal leaves, the smaller leaf may not be required to be provided with sequential closer if it is bolted in closed position, provided the clear width of opening of the larger leaf is not less than 1m, and able to meet the full exit capacity in terms of units of width required.

4. Doors on escape routes

Normally a door used for means of escape should open in the direction of escape. It should always do so : -

a. if it is from a room in which a fire may develop very rapidly e.g. kitchen etc., or

b. if the door is from an area from which more than 50 persons may be required to escape e.g. exit doors to auditorium, multi-purpose hall function room, etc. should be kept unlocked at all times when people are in the building and should be fastened so that they can be immediately opened by persons escaping without the use of a key. The door should be fastened only by means of panic bolt or panic bolt fastening which ensures that it can be readily opened by pressure applied by occupants using the door. Panic bolts and panic latches should be properly maintained at all times.

5. The door should also: -

a. be hung so that, when open, it does not obstruct any escape route;

b. open through not less than 90 degrees; and

c. be provided with a vision panel if it is hung to swing both ways.

6. Self-closing devices for doors

All fire doors except those to cupboards and service ducts should be fitted with self-closing devices to ensure the positive closure of the door. Generally, rising butt hinges are not acceptable. Fire doors to cupboards, service ducts and any vertical shafts linking floors should be kept locked shut when not in use.

Exit doors and exit access doors shall comply with all of the following:

a. Door operation

Exit/ exit access doors shall be capable of being opened manually, without the use of a key, tool, or special knowledge or effort for operation from the inside of the building. (Not applicable within residential units under PG I and II)

Rationale

Occupants of PG I & II buildings are familiar with the floor layouts and exit facilities of their own premises. Hence, there isn't any need to control how the exit doors of the units should be secured in order not to hamper escape during an emergency.

b. Fire resistance

Exit/ exit access doors which are required to have fire resistance rating shall comply with the relevant provisions for fire resisting doors under Cl.3.9.2

c. Door swing

Exit doors and exit access doors shall open in the direction of exit travel in the following situations:

(1) when leading to an area of refuge, exit and exit passageway, or

(2) when used in an exit enclosure, including smoke-free and fire lift lobbies in a building, but excluding doors of individual residential units that open directly into an exit enclosure, or

(3) when serving a high hazard area, or

(4) when serving a room or space with more than 50 persons.

d. Exit/ exit access door openings

Rationale

Doors located along escape routes should preferably swing in the direction of escape to facilitate smooth evacuation. This requirement is especially important for exit access doors serving more than 50 persons and all exit doors.

(1) Opening into exit staircase

Exit doors opening into exit staircases and exit passageways shall not impede the egress of occupants when such doors are swung open.

Explanation and Illustrations

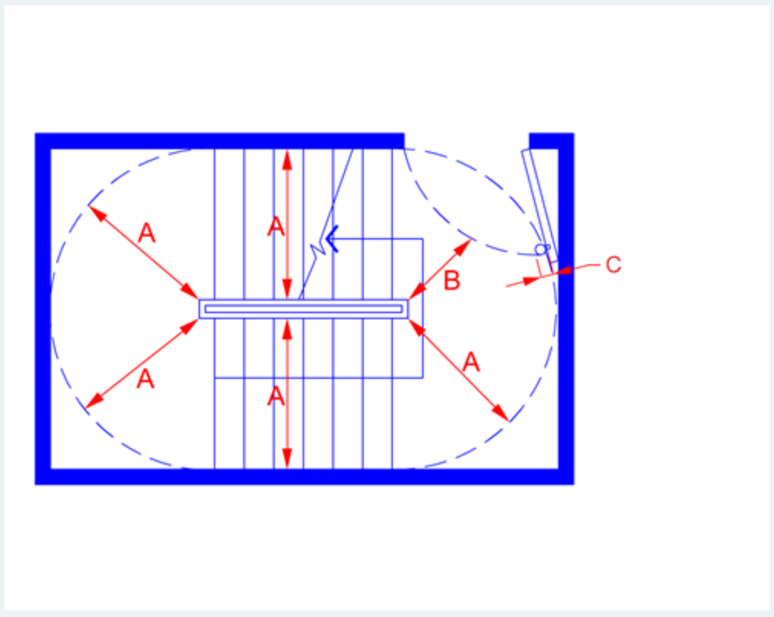


Figure 2.3.9d.(1)

Doors serving as main entrance into an enclosed stair shall not unduly block the stair landing or the stairs. The door shall not reduce the required width either during its swing or while at rest, i.e. B shall be > A and C shall be < 80mm.

(2) Opening into corridor

All doors which open into the corridor shall not hinder the movement of occupants. When such a door(s) is swung open, the corridor's clear width shall be at least half of the required clear width as stipulated under *Table 2.2A*.

Explanation and Illustrations

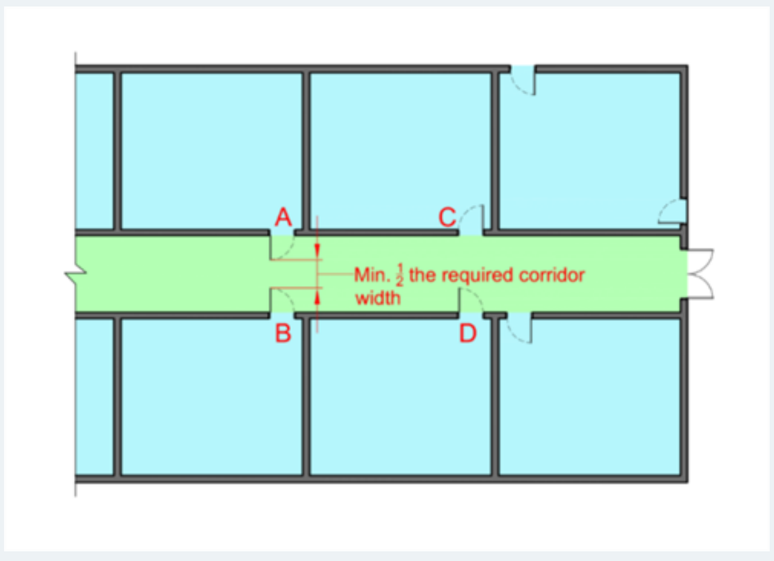


Figure 2.3.9d.(2)

Doors in horizontal exits shall not be required to swing in the direction of egress travel if the occupant load within the unit space is less than 50 persons.

Doors A & B are positioned directly each other. It is to be noted that doors shall not be arranged to swing in a direction that blocks the use of the corridor when both are open.

(3) Opening force

The maximum exit doors and exit access doors opening force shall be 30N at 0° and 20N at 30° opening.

e. Vision panel

The fire door to an exit staircase and/ or smoke-free/ fire lift lobby shall be constructed to incorporate a vision panel. The vision panel shall have a clear view size of 100mm (width) by 600mm (height). The vision panel shall have the requisite fire resistance rating and shall not turn opaque when subject to heat. The bottom edge of the vision panel shall be located at 900mm above the finished floor level. The provision of vision panel shall not apply to fire doors of residential apartment or maisonette units and public accommodation units (see *Table 1.4A*).

Rationale

The main purpose of vision panel is to enable firefighters to appreciate the fire situation within the occupied spaces before entering. It will also help to prevent wheelchair users from being accidentally struck/knocked by the door swing. The revised vision panel mounting height of 1200mm to 900mm was also found to be suitable for use by wheelchair users.

Explanation and Illustrations

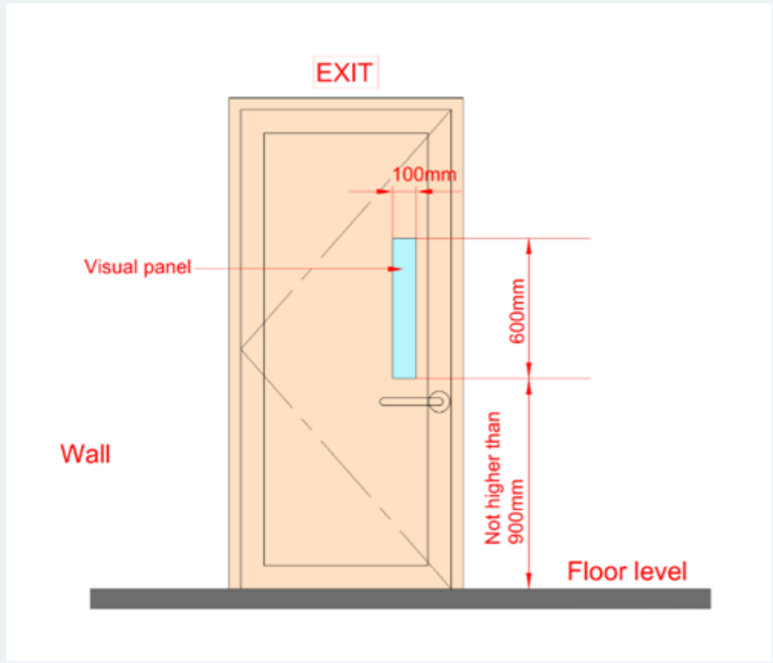


Figure 2.3.9e.

1. Fire doors with vision panels 60,000 m² shall pass the fire test under BS 476: Part 20 – 23.

2. Fire rated glass doors shall only be permitted in sprinkler-protected buildings. In addition, any oversized (>60,000mm²) glass panels in the doors and fire-rated glass doors shall meet the Class A of the Impact Performance requirements when subject to test under BS 6206 or AS 2208. To overcome direct heat radiation through the doors, the oversized glass doors or fire-rated glass doors would be required to pass the fire test on insulation requirements under BS 476: Part 20 – 23, subject to complying with Cl.3.15.13, which prohibits fire rated glass door to protected shafts containing exit staircase and fire lift. The lowering of vision panel to height not higher than 900mm and top edge lower than 1500mm is in line with the Accessibility Code requirement and enable firefighter to appreciate the situation during a fire emergency.

There is no need to provide vision panel to the entrance door of residential units.

f. Revolving doors

Revolving doors shall not be used as exit/ exit access doors for required exits.

Rationale

Owing to the high possibility of jamming, revolving doors cannot be accepted as exit doors for escape purposes. When a revolving door is present, an exit door with an exit sign shall be provided adjacent to it.

Explanation and Illustrations

(No illustration)

Revolving doors are not acceptable as exit door as the revolving mechanism would mal-function and the speed of egress is slow.

Due to the risk of jamming, conventional type of revolving doors are not normally allowed as doors for means of escape purposes. Where such door is used, exit door must be clearly indicated with exit sign.

g. Exit/ exit access door of residential unit

Exit/ exit access door of each residential unit shall be located at not more than 500mm from the strata-title line to prevent the creation of a large entrance alcove/ corridor. However, in situations where the entrance alcove/ corridor leads into an open- sided common corridor which meets the requirements for smoke-free approach under *Cl.9.2.1a.(4)(e)* & *(f)*, the separation distance between the entrance alcove/corridor and the nearest exit staircase shall not be less than 3m.

Rationale

The purpose of controlling the depth and location of the entrance alcove/corridor is to limit/prevent storage of combustible items within this space and to maintain the integrity of the egress path and the exit staircase(s).

Explanation and Illustrations

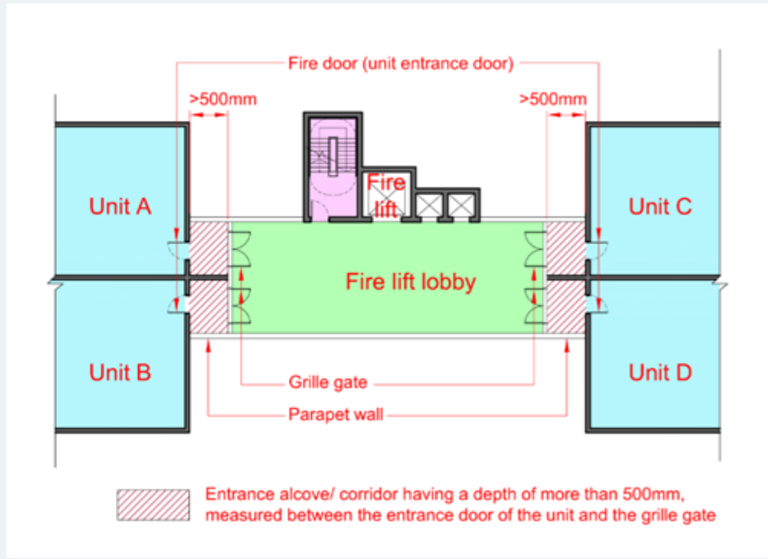


Figure 2.3.9g. – 1 : Not acceptable layout

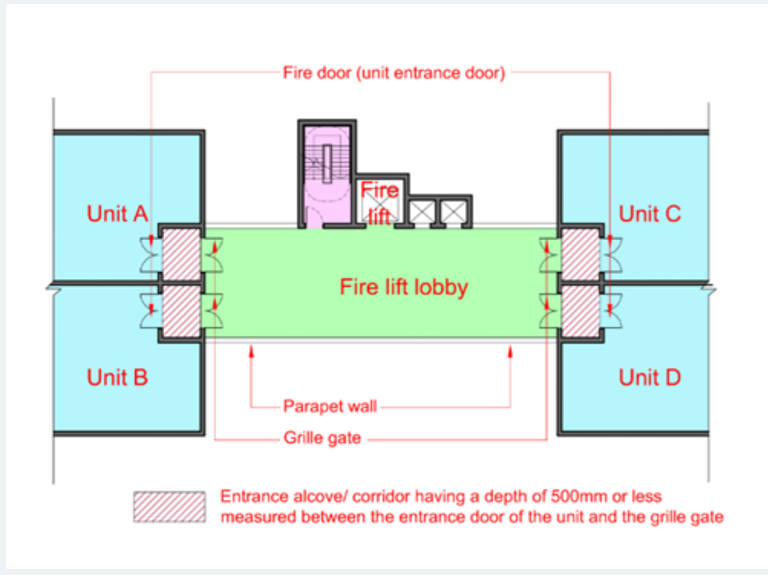


Figure 2.3.9g. – 2 : Acceptable layout

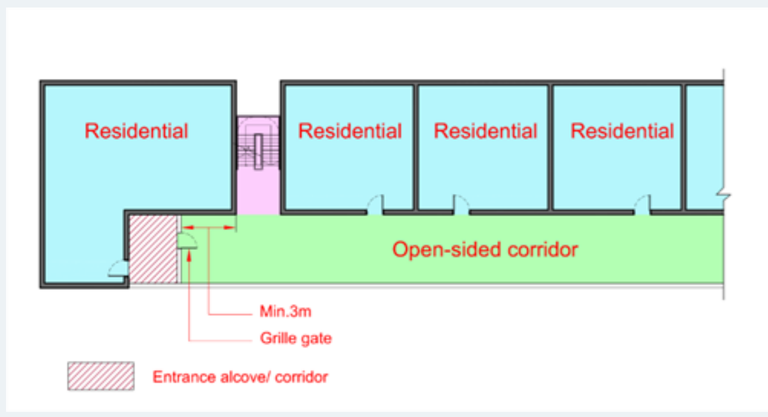


Figure 2.3.9g. – 3

Separation distance between grilles/gate and exit staircase shall not be less than 3m.

h. Door located in a path of travel

(1) Any door located in a path of travel shall be of the side-hinged or pivoted swing type. The door shall be designed and installed so that when swung open, it does not prevent full use of the opening. The minimum clear width of the door opening shall not be less than the required door clear width.

Exception

(a) Requirement on door swing shall not apply to buildings under PG I and residential units under PG II.

(b) Locking device

With prior consent from the SCDF, locking of exit/ exit access doors are permissible at certain rooms or spaces of healthcare occupancies and detention and correctional occupancies.

(c) Sliding doors & roller shutters

Sliding door and roller shutter as listed in *Cl.2.3.9h.(2)(a)* to *(e)* below are permitted to be installed across the exit access leading to exits, including the exterior door openings, except in areas stipulated under *Cl.2.3.9c.(1)* and *(3)*. These doors shall not form part of the fire compartment integrity.

(2) Manually operable sliding doors/roller shutters

(a) Manually operable sliding doors or roller shutters shall be capable of being opened and closed manually from either side of the door. The maximum opening force for sliding doors/roller shutters shall not be more than 30N.

(b) A manually operable sliding door or roller shutter that can remain in closed position during the period of occupation is permitted for rooms or spaces with occupant load not exceeding 50 persons. When opened, it shall not reduce the effective width/height of the doorway leading to the escape route. The sliding door or roller shutter is allowed for room or space that serves more than 50 persons provided it shall remain in the full open position during the period of occupation. A readily discernible sign with the lettering “THIS DOOR TO REMAIN OPEN WHEN THE BUILDING IS OCCUPIED” shall be permanently pasted on both sides of such a sliding door or roller shutter at a height of 1.4m from the finished floor level. The lettering shall be 25mm in height and painted in white on a red background with reflective surface.

Explanation and Illustrations

(No illustration)

If the occupant load to a room or space exceeds 50 persons, sliding door or roller shutter located across means of escape shall be kept in the open position during the period when the premise is occupied. The main concern is that extra effort and time would be needed to manually open the roller shutter or sliding door. Alternatively, wicket door can be built into the roller shutter or sliding door.

For warehouse buildings, most of the time the warehouse area would not be occupied unless there is a need to move goods or materials in or out of the building. Also, the actual number of people occupying a warehouse is usually very low.

For the above reasons, when the warehouse area is occupied, selected roller shutters or sliding doors that are not provided with wicket doors and located across means of escape would be kept in the open position to provide the required means of escape in an emergency.

However, should any warehouse building be open to the public for the purpose of Warehouse Sale, all the roller shutters or sliding doors, that are not fitted with wicket doors and located across the means of escape in the warehouse area, are required to be kept in the open position when the premise is occupied.

In areas provided with A/C or MV and the roller shutters or sliding doors are required to be kept in the closed position most of the times, wicket doors shall be incorporated into the roller shutters or sliding doors. Alternatively, a by-pass exit door shall be provided next to the roller shutter or sliding door that is to be kept in the closed position most of the times.

All roller shutters or sliding doors that are not provided with wicket doors and located across means of escape are required to be kept in the open position when premise is occupied.

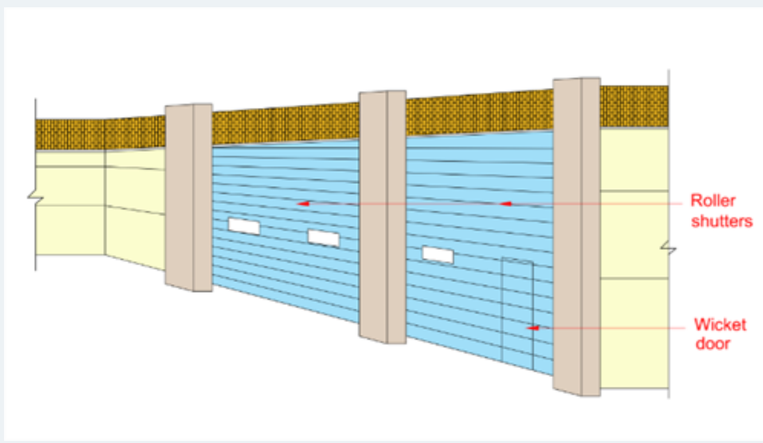
(c) Wicket door

A wicket door can be incorporated within a roller shutter or sliding door. The wicket door shall be of the swing type having a minimum head height of 2m and a clear width of not less than the required door clear width. The wicket door shall comply with all the requirements of an exit access door, and be clearly marked and readily visible so that the occupants can readily see where the door is. It shall be fitted only with simple fastenings that can be manually operated for ease of escape.

(d) Sliding door with swing-out feature

A sliding door which can be swung open shall swing in the direction of escape travel when a certain horizontal force is applied to the door. When the sliding door is converted to a swing door, it shall comply with all the requirements of an exit access door. The maximum door opening force shall be 30N at 0° and 20N at 30° opening. A readily visible sign with the letterings “IN EMERGENCY, PUSH TO OPEN” shall be affixed onto the door.

Explanation and Illustrations



Axonometric view

Figure 2.3.9h.(2)(c) : Wicket door

Wicket doors are permitted to be incorporated within a roller shutter or sliding door. The wicket doors shall be able to perform the same functions as side hinged door and shall be able to be swung open in the direction of exit travel when used. Wicket doors shall comply with all requirements of exit access door, clearly marked and readily visible.

(3) Power operated sliding doors/roller shutters

Power operated automatic sliding doors/roller shutters, shall be linked to the building fire alarm system. The sliding door/ roller shutter shall automatically open to the required width/ height (of door opening) upon the activation of the fire alarm. The automatic sliding door/ roller shutter shall also comply with all of the following:

(a) Fail-safe type

The automatic sliding doors/roller shutters shall be of the fail-safe type. Should there be any fault in the electrical or sensor device, or any power failure (either mains or battery powered), these doors shall automatically open and remain in an open position until power is restored.

Explanation and Illustrations

(No illustration)

Members of the public and building owners opined that powered sliding doors, roller shutters and swing doors that belong to unit owners or tenants should not be linked to the building fire alarm system. The main concern is that in the event of false alarm, such doors would be activated to open, thus posing security risk to the unit owners and tenants.

In response to the feedback, it was decided that powered sliding doors, roller shutters and swing doors that belong to the unit owners or tenants are not required to be linked to the building fire alarm system, provided that they are designed fail safe type, installed with manual over-ride, and do not form part of the building’s protection system, for example, smoke control systems.

(b) Manual override

A manual override mechanism (a device to trigger the immediate opening of sliding doors/roller shutters) shall be provided. The doors shall open and remain open upon activation of this device. This device shall be housed in a break glass box located beside the sliding doors or roller shutters and fixed at a height of 1.2m above the finished floor level. It shall be easily accessible, conspicuous and be free from obstructions. A readily discernible sign with the lettering “EMERGENCY DOOR RELEASE” shall be permanently displayed beside the switch. The letterings shall be of at least 15mm in height.

(c) Exception

Powered sliding doors, roller shutters and swing doors as listed below that belong to the unit owners or tenants are not required to be linked to the building fire alarm system, provided they are designed as fail-safe type, installed with manual override, and do not form part of the building’s fire protection system, e.g. smoke control system.

(i) Those belonging to the unit owners or tenants; or

(ii) Those serving individual washrooms, family washrooms, or nursing rooms, where all points within the space are visible from the entrance.

Rationale

The provision of manual override mechanism is an additional measure to ensure occupants can still get out of their unit should the powered-operated door/shutter failed to open its door/shutter on activation of the building fire alarm and/or localised detector.

i. Exit/ exit access door serving spaces of mass occupation

Any exit door or exit access door serving spaces of assembly/ mass occupation, namely, auditorium, concert hall, theatre, assembly hall, exhibition hall, conference hall, cinema, stadium, function hall, casino, or any other spaces with an occupant load factor of not greater than 1m^2/person and occupant load greater than 50, which has to be kept shut and fastened while the building or part of the building is occupied shall be fitted with ‘panic exit device’. The panic exit device shall operate to open the door when a pressure is applied on the bar in the direction of travel and be appropriately marked ‘Push Bar To Open’ in letters not less than 50mm high.

Rationale

The purpose of panic exit device is to provide an intuitive means of escape for spaces housing large crowds to prevent stampede in a panic situation.

j. Locking of doors to exit staircase, smoke-free lobby and fire lift lobby

One-way locking device e.g. panic bolt or thumb turn locking device is not permitted under the following situations:

(1) for the exit door between exit staircase and fire lift lobby;

(2) for the exit door between exit staircase and smoke-free lobby/ fire lift lobby/ occupancy area on re-entry floor; and

(3) for the exit access door between smoke-free lobby/ fire lift lobby and occupancy area on re-entry floor.

k. Access control using electromagnetic/electromechanical locking device

Rationale

The specific doors shall not have locking device so as to enable firefighting crews to have direct and immediate access to occupied spaces. This requirement will cut down unnecessary time wasted on breaking open the locked doors.

(1) Where access control using electromagnetic/ electromechanical locking device is installed on any exit access door and/or exit door, excluding revolving doors and doors to residential units, such doors shall comply with the requirements stipulated in *Table 2.3.9k.(1) - 1 & Table 2.3.9k.(1) - 2*. The access control locking devices installed on exit access door and/ or exit door in the escape path shall be connected directly to the building automatic fire alarm system to de-activate the locking devices. Linking of the locking devices or its control panels through other systems such as access control, building management system, etc., that will cause delay to the de-energising of locking devices is not permitted.

(2) Access control belonging to tenanted spaces

Where the escape route is permitted to go through another occupied space in accordance with *Cl.2.2.12b.*, the exit access door within the tenant unit for escape purpose shall release when the alarm on that floor activates.

(3) Where doors opening into a passenger lift lobby are provided with access control and are locked after normal operation hours, the lobby shall be designed to have direct access to at least one exit staircase to prevent any occupant from being trapped in the lobby when the lifts are recalled to the 1st storey, or other designated floor during fire emergency or building power failure.

l. Staircase re-entry

(1) Every exit staircase enclosure serving more than 7 storeys of a non- residential building, excluding buildings of detention and correctional occupancies, shall allow re-entry from the staircase enclosure to the interior of the building. There shall be at least one level where it is possible to re-enter into the interior of the building from the exit staircase enclosure.

(2) The re-entry points shall be located not more than 6 storeys apart. There shall not be more than three storeys above the highest re-entry door in the building.

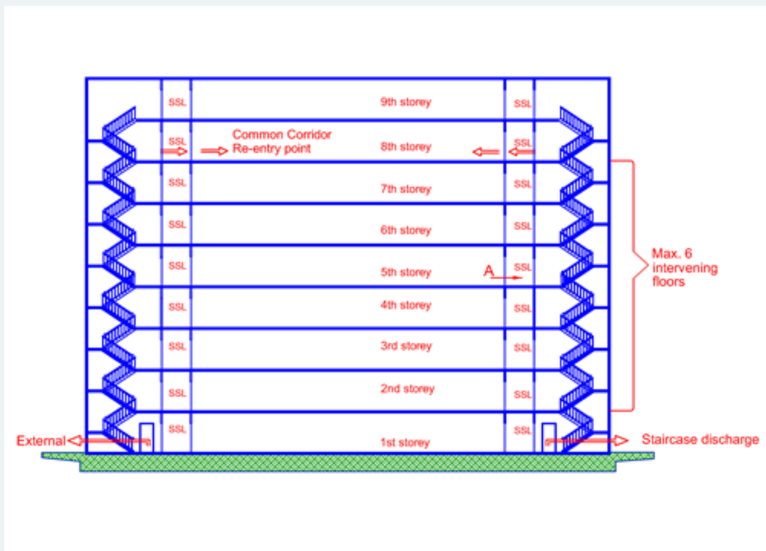
(3) Where re-entry is provided from the staircase enclosure, it shall open into a common corridor that is connected directly to at least one other exit staircase.

(4) Exit doors permitting re-entry into the building, shall be identified with a signage “Re-entry door” of at least 50mm lettering height on the staircase side of the exit door.

Rationale

The concept of re-entry floor is originated from the recommendation by the National Institute of Standards and Technology (NIST) after the 911 incident. The purpose is to facilitate occupants ability to gain access to another exit staircase should the egress via an exit staircase be blocked off or it being rendered unusable in an emergency situation.

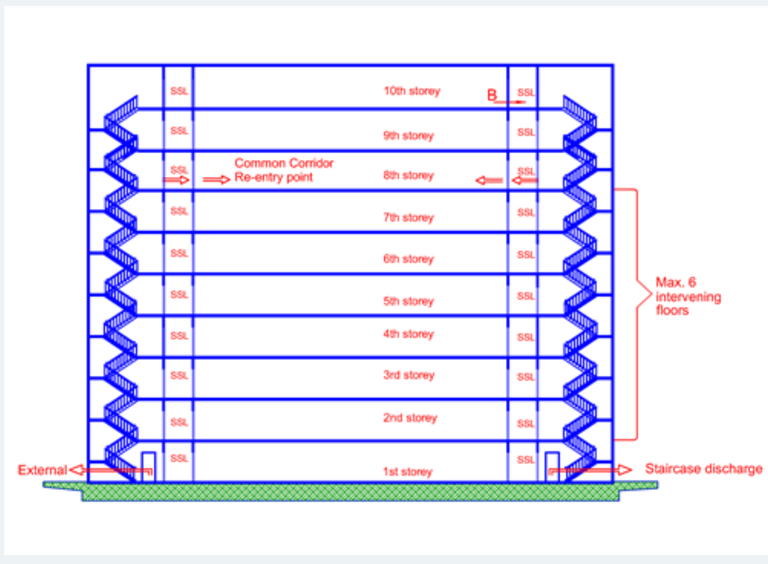
Explanation and Illustrations



Section

Figure 2.3.9l. - 1 : Example of a 9-storey building requiring 1 re-entry point to the exit staircase

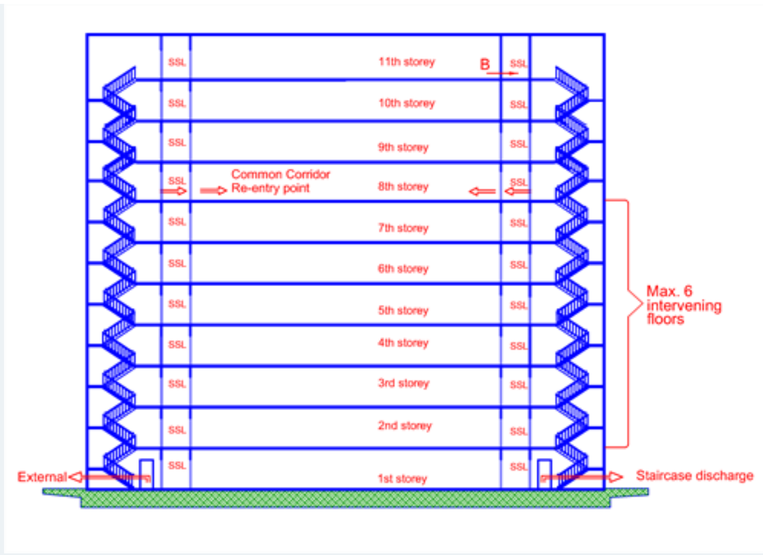
Occupant A needs not travel more than 3 floors up to gain re-entry at 8th storey .The main purpose of re-entry door is to allow occupants to re-enter the building space to look for an alternative exit via a common corridor. This need would arise if the evacuation descend in the staircase is being held-up because of locked exit door at 1st storey or other reasons.



Section

Figure 2.3.9l. - 2 : Example of a 10-storey building requiring 1 re-entry point to the exit staircase

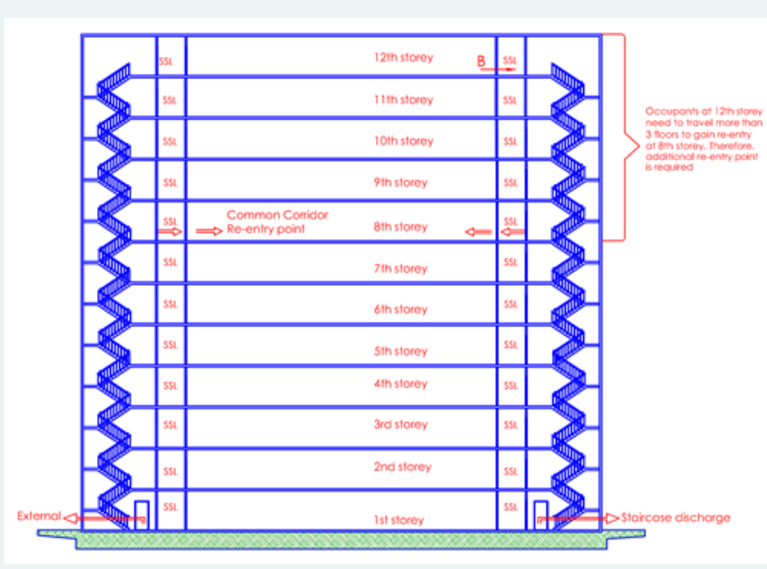
Occupant B needs to travel 2 floors down to gain re-entry at 8th storey.



Section

Figure 2.3.9l - 3 : Example of a 11-storey building requiring 1 re-entry point to the exit staircase

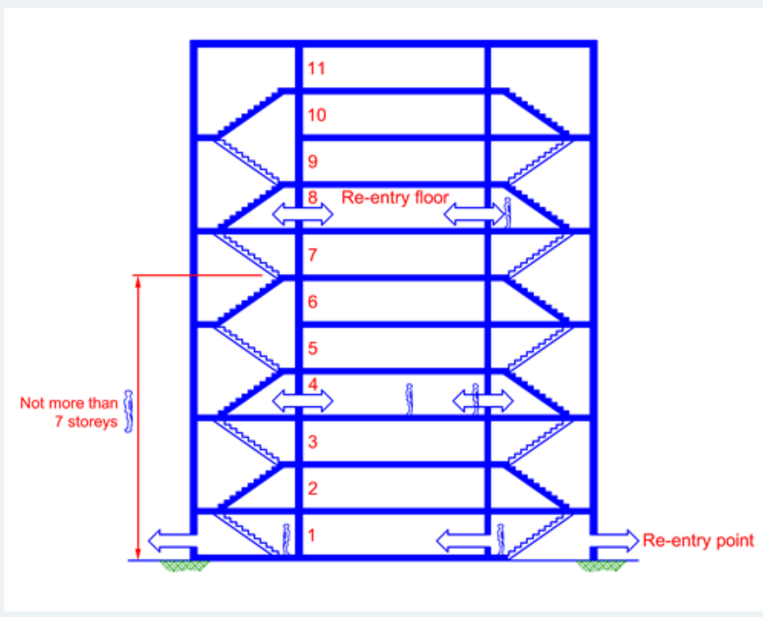
Occupant B needs to travel not more than 3 floors down to gain re-entry at 8th storey.



Section

Figure 2.3.9l - 4 : Example of a 12-storey building requiring more than 1 re-entry point to the exit staircase

Occupant B needs to travel more than 3 floors down to gain re-entry at 8th storey. An additional re-entry point to each exit staircase shall be provided.



Section

Figure 2.3.9l - 5

For staircase enclosures serving more than seven storeys, more than two unlocked re-entry points are required. This arrangement provides flexibility, especially in office buildings that, for security reasons, might need to prevent re-entry on certain floors. At the same time, the provision ensures that one can re-enter the building without having to travel up or down too many flights of stairs. Any door providing a way out of the staircase enclosure must be identified as such on the stairwell side.

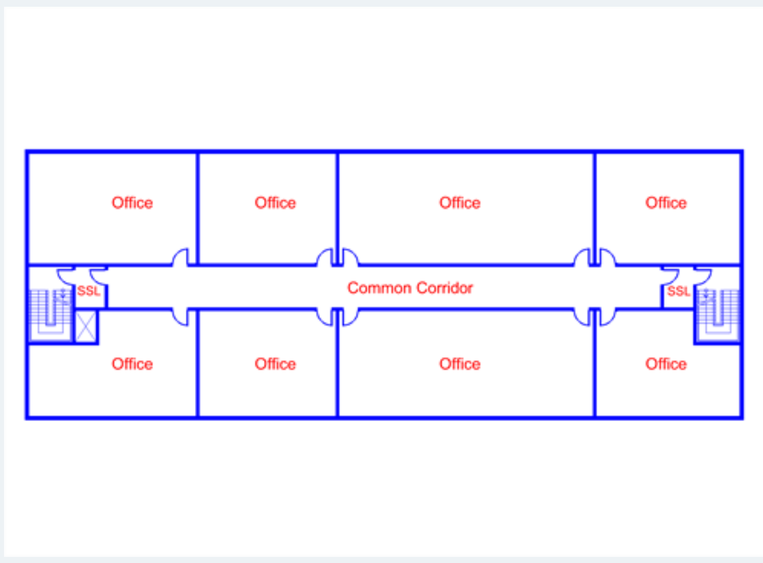


Figure 2.3.9l - 6 : Staircase re-entry floor

Typical office floor plan – Staircase doors that provide re-entry to the floor space shall be linked to at least one other exit staircase via common corridor.

(5) Where locking is required for doors of smoke-free lobby, fire lift lobby or exit staircase on the re-entry floor, they shall be fitted with an electromagnetic/ electromechanical locking device complying with *Cl.2.3.9k.(1)*. For re-entry floor, manual override device shall be provided on both sides of the door.

(6) All non-re-entry floors shall be identified with a sign to show the designated re-entry floors on the staircase side of the exit door.

m. Warning signage for exit doors with one-way lock

Where one-way locking devices or electromagnetic/ electromechanical locking devices are installed at the doors of exit staircases, a signage shall be provided to warn occupants that they would not be able to re-enter the floor should they exit from it. A readily visible sign with the lettering “EXIT ONLY, NO RE-ENTRY TO BUILDING” shall be positioned at the entrance into the exit

staircase. This signage shall be applicable for all buildings except PG I & II.

n. Access control using digital locksets

Where a digital lockset is installed on an exit door or exit access door, these digital locksets shall come with mechanical fail-safe features on the non-secure side (i.e., shall not rely on electrical energy) to ensure occupant escape.

2.3.10 External corridor

External corridor shall comply with the following requirements:

a. the vertical height of the unobstructed and uninterrupted ventilation opening measured from the parapet wall/ balustrade/ grille/ railing up to the top edge of the opening or eaves of overhang shall not be less than 1.2m;

Explanation and Illustrations

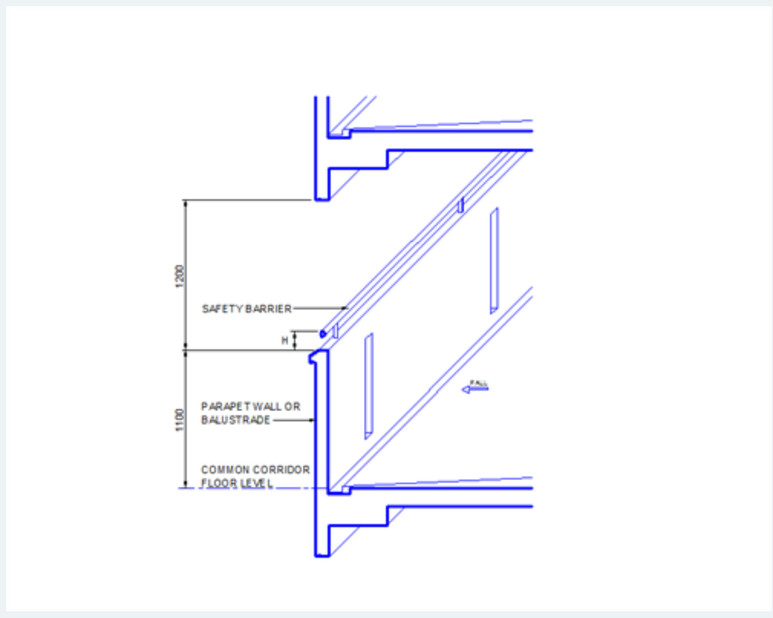


Figure 2.3.10a. - 1 : Safety barrier above parapet wall/balustrade

Safety barrier of dimension not greater than 50 X 50mm or diameter 50mm is permitted to be installed above the parapet wall/balustrade. Where this dimension is exceeded, the required clearance of 1.2m above the parapet wall/balustrade shall be measured from the top of the safety barrier to the underside of the eaves of overhang. There is no control on the installation height 'H' of the safety barrier.

Figure 2.3.10a. - 1 : Example of safety barrier

b. where the external corridor is roofed over, the depth of the covered area/ portion shall not exceed 3m;

c. where any room or space with sleeping risk is located along the corridor, a 1-hr fire resistance rating wall of height not less than 1.1m, measured from the finished floor level of the external corridor to the sill level of the opening, shall be provided along the corridor leading to the exits. Any ventilation openings above the fire-rated wall shall be of non-combustible construction;

d. the door opening into the external corridor need not be fire-rated;

Explanation and Illustrations

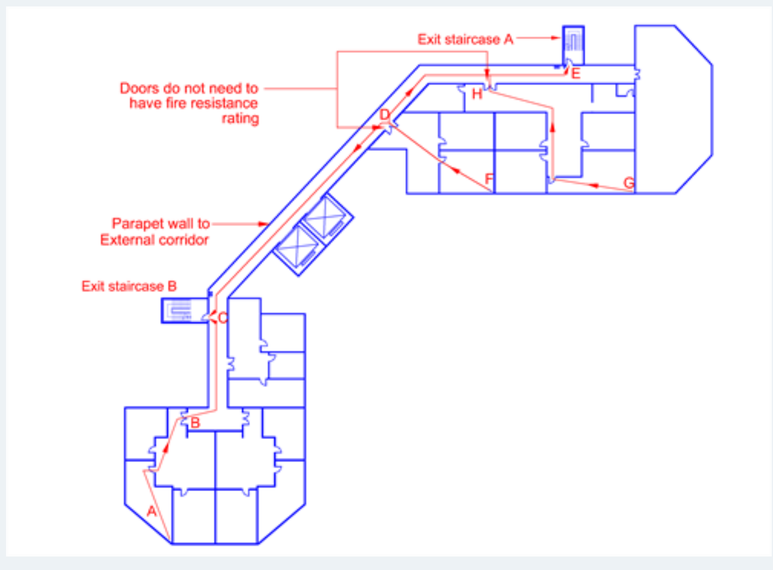


Figure 2.3.10d.

As external corridors, mentioned in Cl.2.2.13 and *Cl.9.2.1a.(7)*, would be able to provide good venting for smoke and heat, doors of apartment or maisonette units opening into such external corridors, as shown in *Figure 2.3.10d.,* need not have fire resistance rating.

e. the provision of parapet wall, or balustrade for an external corridor shall be at least 1m in height and at most 1.5m in height along the outer side of the corridor; and

f. the length of unobstructed and uninterrupted openings above the parapet wall of the external wall shall not be less than 6m and shall abut an external space.

2.3.11 Air well

a. The minimum size of an air well shall comply with Table 1.4.2 for ventilation of:

(1) exit staircases; and

(2) exit passageways (as an extension to an exit staircase).

b. An air well shall have a minimum clear area of 93m2 and minimum width of 6m and without obstruction vertically throughout the airspace for ventilation of:

(1) smoke-free lobby;

(2) external corridor;

(3) external exit passageway;

(4) cross-ventilated corridor/lobby;

(5) common internal corridor stipulated under *Cl.9.2.1a.(10)(b)*; and

(6) internal corridor of hotel, hostel, service apartment, healthcare occupancy, workers' dormitories and the like.

2.3.12 Remoteness of exits

a. Where more than one exit is required from a building or portion thereof, such exits shall be remotely located from each other and shall be arranged and constructed to minimise the possibility that more than one can be rendered unusable by any one fire or other emergency condition.

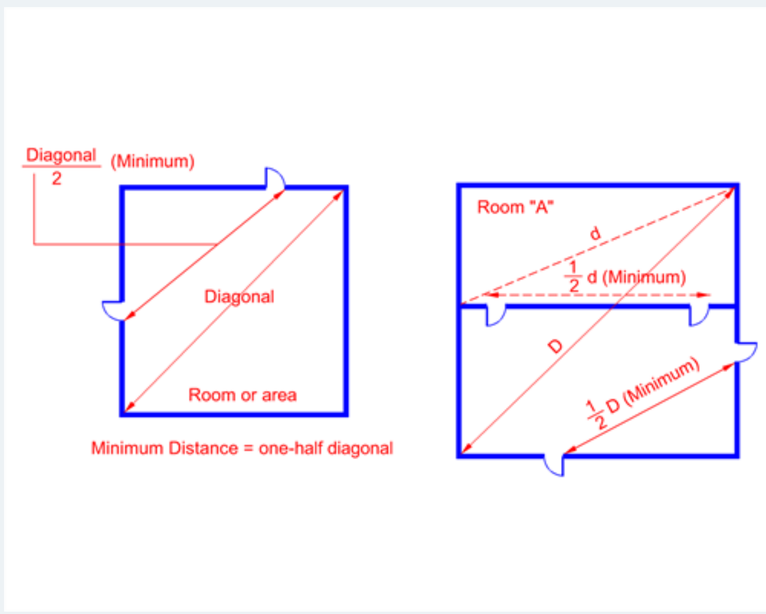
b. If two exits or exit access doors are required, they shall be placed at a distance from one another equal to or not less than half the length of the maximum overall diagonal dimension of the building or area to be served, measured in a straight line between the furthest edges of the exit doors or exit access doors (see *Diagram 2.3.12b. - 1 to 5)*, subject to the following:

(1) if the distance between the 2 exits or exit access doors is less than half the length of the maximum overall diagonal dimension of the building or area to be served, it shall be considered as a one-way escape arrangement;

(2) the separation distance measured in a straight line between the furthest edges of the doors of the two exits (exit staircases, exit passageways or exit ramps) shall not be less than 7m.; and

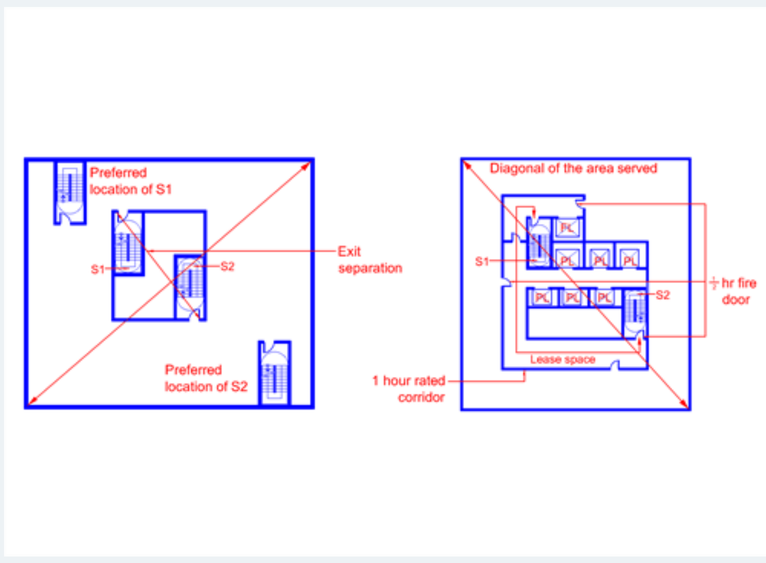
(3) for PG II buildings, the separation distance of the exits on the residential floor shall not be less than half the length of the maximum overall diagonal dimension of the protected lobby/corridor or external corridor.

Explanation and Illustrations



Left : Figure 2.3.12b. - 1

Right : Figure 2.3.12b. - 2



Left : Figure 2.3.12b. - 3

One-way escape arrangement

The distance between the exit of staircases S1 & S2 is less than half the length of the max. overall diagonal dimension of the building or floor space.

Right : Figure 2.3.12b. - 4

Two-way escape arrangement

Exit separation between the exit staircases S1 & S2 can be based on the travel distance in the exit access corridor enclosed with 1-hr fire-rated walls and ½-hr fire-rated door.

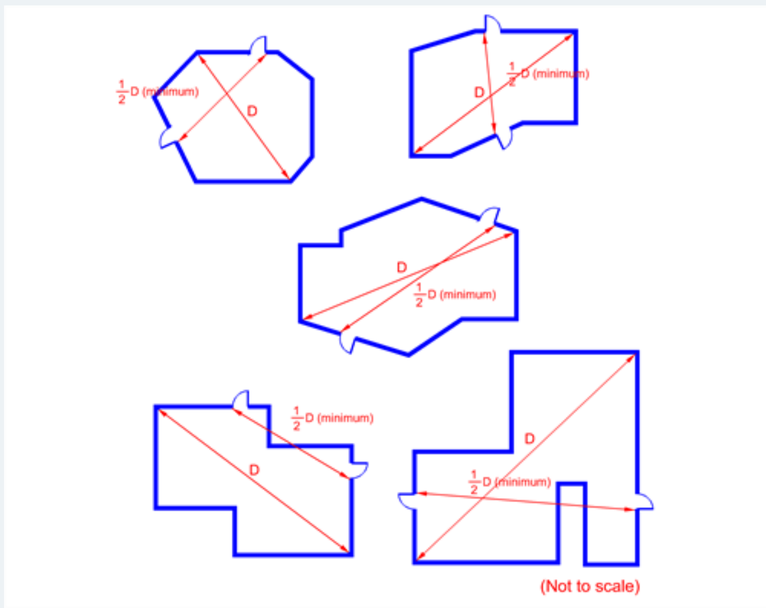


Figure 2.3.12b. - 5 : Remoteness of exit staircase - Arrangement of exits

c. Reduction in exit separation

In buildings protected throughout by an approved automatic sprinkler system which complies with the requirements of Chapter 6, the minimum separation distance between two exits or exit access doors measured in accordance with *Cl.2.3.12a.*& *b.* shall be not less than one third the length of the maximum overall diagonal dimension of the building or area to be served. The separation distance measured in a straight line between the furthest edges of the doors of the two exits (exit staircases, exit passageways or exit ramps) shall not be less than 7m.

Explanation and Illustrations

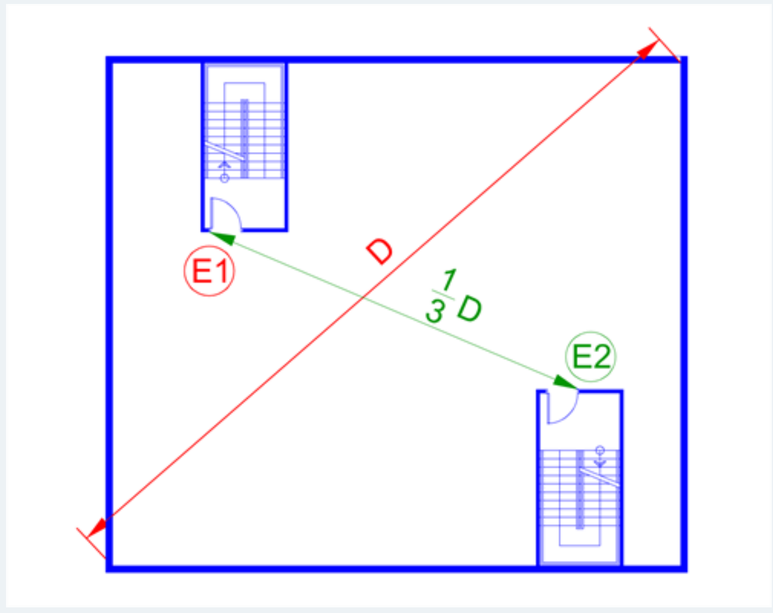


Figure 2.3.12c.

The minimum separation distance (E1) and door (E2) shall not be less than ⅓ the maximum overall diagonal dimension of the building (D).

d. Exit separation measured along exit access corridor

Where two exit staircases, exit passageways or exit ramps are inter-connected by a corridor, exit separation can be measured along the line of travel within the exit access corridor. The exit access corridor connecting the exit staircases, exit passageways or exit ramps shall be protected by minimum 1-hr fire-rated enclosures. Doors opening into this corridor shall have minimum ½-hr fire resistance rating (see *Diagram 2.3.12d.*). The separation distance measured along the line of travel within the exit access corridor between the furthest edges of the doors of the two exits (exit staircases, exit passageways or exit ramps) shall not be less than 7m.

Explanation and Illustrations

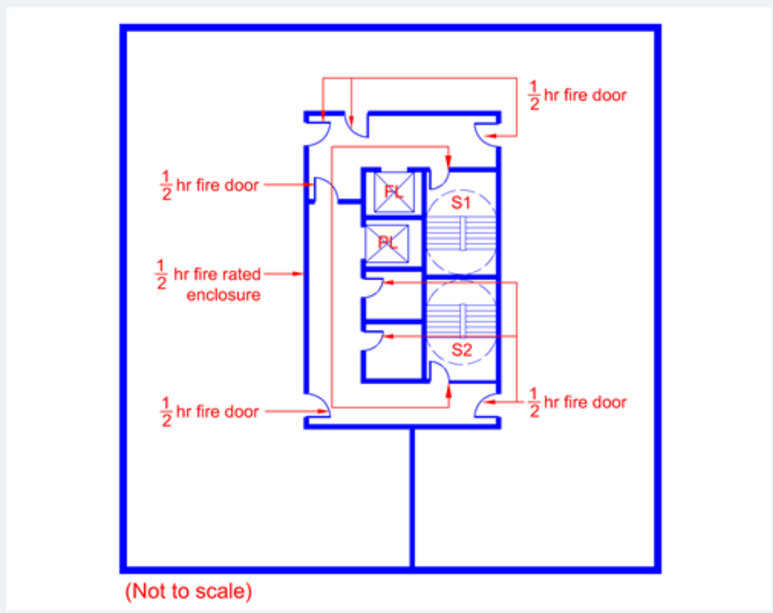


Figure 2.3.12d. - 1

Remoteness of exits is measured along 1-hr fire-rated corridor with ½-hr fire doors. In place of measuring physical distance between exit stair enclosures, distance for purposes of determining remoteness is permitted to be measured along a protected corridor, provided the separation distance between the furthest edges of the doors of the two exits is not less than 7m.

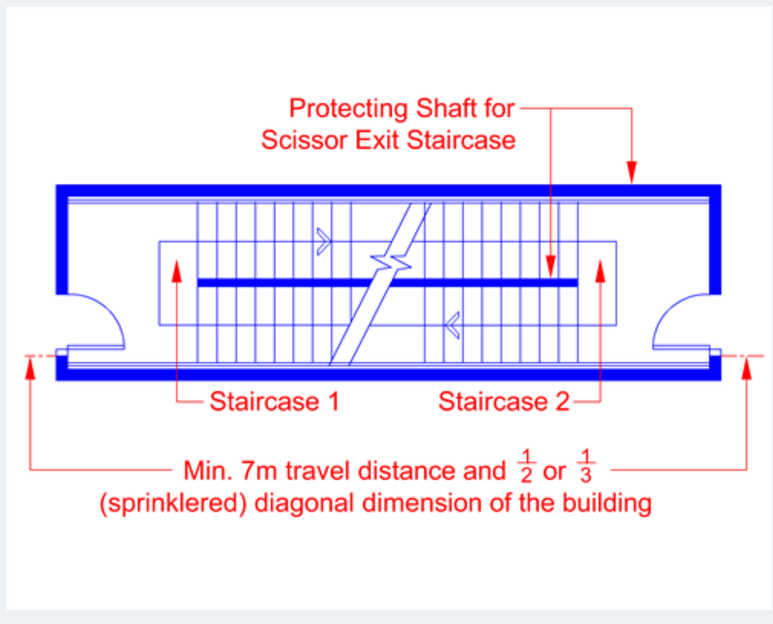


Figure 2.3.12d. - 2

When there is only one pair of scissor exit staircase, the door opening into scissor exit staircases shall be spaced at least ⅓ the diagonal dimension of the area to be served in a sprinkler-protected building and ½ the diagonal dimension in a non-sprinkler-protected building in accordance with Cl.2.3.12.

Door opening into scissor exit staircase shall be at least 7m measured as travel distance between the two closer edges of the staircase doors. The line of measurement for scissor exit staircase is measured to the nearest edge instead of furthest edge of the exit doors.

e. One-way travel

(1) A one-way travel or “common path” exists if a floor space is arranged or provided with partitioning works such that occupants within that space are able to travel in only one direction to reach any of the exits or to reach the splitting point where they have the choice of two or more routes of travel to remote exits.

(2) The travel distance from the most remote point to the splitting point shall not exceed the permissible one-way travel distance allowed in *Table 2.2A*. At the splitting point, the angle of divergence between any two alternative routes shall not be less than 90° in order that the routes originating from the splitting point can be considered as two-way travel.

(3) The aggregate travel distances of the one-way travel from the most remote point to the splitting point and the continuous two-way travel from the splitting point to the nearest exit shall not exceed the permissible two-way travel distance allowed in *Table 2.2A*.

Explanation and Illustrations

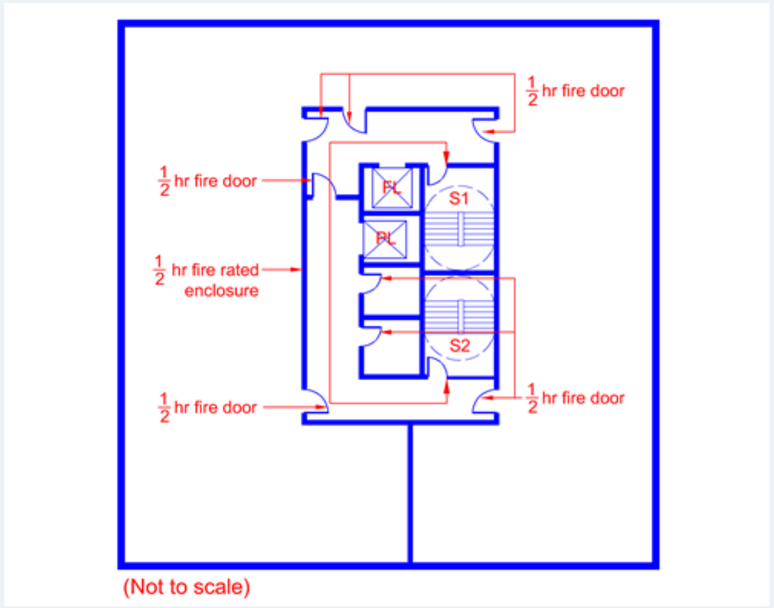


Figure 2.3.12e.

Remoteness of exits is measured along 1-hr fire-rated corridor with ½-hr fire doors. In place of measuring physical distance between exit stair enclosure, distance for purposes of determining remoteness is permitted to be measured along a protected corridor.

CLAUSE 2.4 SPECIAL REQUIREMENTS FOR PERSONS WITH DISABILITIES (PWDS)

2.4.1 General

a. The following buildings/ usages/ areas are exempted from these requirements:

(1) PG I and II buildings;

(2) hospitals and nursing care facilities;

(3) buildings/ usages/ areas that are exempted from barrier-free accessibility compliance, as required by the authority having jurisdiction on accessibility in the built environment; and

(4) non-residential buildings/ usages/ areas, such as car parks, clubhouses and gardens/ terraces located within residential developments and which are intended for ancillary use, are not required to comply with these requirements; and

(5) PG III to VIII buildings that are not served by any lift.

b. The escape routes shall be free from any obstacle that may cause undue delay to PWDs during evacuation, e.g. raised thresholds or steps. Where there are minor changes in level within any storey, a ramp conforming to the requirements stipulated in the "Code on Accessibility in the Built Environment" shall be provided.

2.4.2 PWD Holding Point

a. Purpose

A PWD Holding Point shall be provided on all storeys, including all basement levels, except first storey or storey at grade level, for PWDs to safely wait for assistance in evacuation.

b. Siting of PWD Holding Point

(1) There shall be at least two designated PWD Holding Points remotely positioned on every storey of a building except for a building designed with a single exit staircase allowed under this Code. The corridor serving as escape route shall have a minimum clear width of 1.2m.

(2) The PWD Holding Point shall be kept free of obstruction and sited within the following locations/ areas in the order of priority (see *Diagrams 2.4.2b.(2) – 1 to 4*):

(a) Evacuation lift lobby.

(b) Fire lift lobby.

(c) Smoke-free lobby or external corridor.

(d) Exit staircase.

(3) The PWD Holding Point located in the above areas shall be positioned away from the edge of the exit staircase and path of person escaping from the occupied space. It shall not reduce/ encroach onto the required dimensions/ spaces of the above areas.

c. Signage

Where a PWD Holding Point is located, a mandatory sign worded "PWD Holding Point" shall be prominently displayed.

2.4.3 Communication provisions

A suitable means of communication, as required under Cl.6.6.5c.(4), shall be provided between the PWD holding point and FCC or any 24-hourly manned station, for PWDs to call for assistance during a fire emergency. It can be in the form of a distress button or dedicated voice communication. The dedicated voice communication handset shall always be accessible and not to be locked. The means of communication shall:

a. be located between 800mm and 1.2m above finished floor level;

b. be appropriately labelled;

c. be provided with prominently displayed clear instruction sign on its operation; and

d. generate a clear visual indication to indicate that the distress signal has been relayed.

2.4.4 Dimension requirements of PWD Holding Point

A PWD Holding Point shall be adequately sized so as to accommodate a wheelchair user and to allow the user to manoeuvre easily. In this respect, the PWD Holding Point shall meet the following requirements:

a. the space provided for a wheelchair in a PWD Holding Point shall be at least 900mm X 1.4m to allow for manoeuvring of the wheelchair;

b. where a PWD Holding Point is sited inside an exit staircase, smoke-free lobby or fire lift lobby, the wheelchair space shall not result in reduced size of these spaces and its access shall not obstruct the flow of evacuation; and

c. the PWD Holding Point shall be marked on the ground with a wheelchair symbol in white against contrasting background, with a dotted white rectangular outline.

2.4.5 Protection of PWD Holding Point

A PWD Holding Point shall be enclosed with fire-resisting construction (other than any part that is an external wall of a building) and shall be served directly by a safe route to a storey exit, evacuation lift or final exit.

2.4.6 Exit staircase

a. Handrails

The handrails within an exit staircase shall be continuous.

b. Wheelchair stairlifts

A wheelchair stairlift, where installed, shall be sited inside an exit staircase. Such a stairlift, when in operating position, shall not encroach into the escape path of building occupants.

2.4.7 Ramp

Internal and external exit ramps can be used as exits in lieu of internal and external exit staircases or evacuation lifts subject to compliance with Cl.2.3.3 and Cl.2.3.8, and "Code on Accessibility in the Built Environment" and any subsequent amendment/ addendum.

RELATED TABLES AND DIAGRAMS OF CHAPTER 2

Related Diagrams & Tables

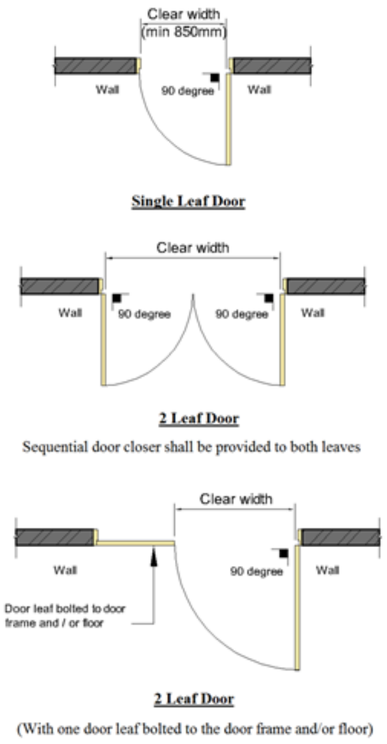


Diagram 2.2.9b. - Measurement of width of exit doors

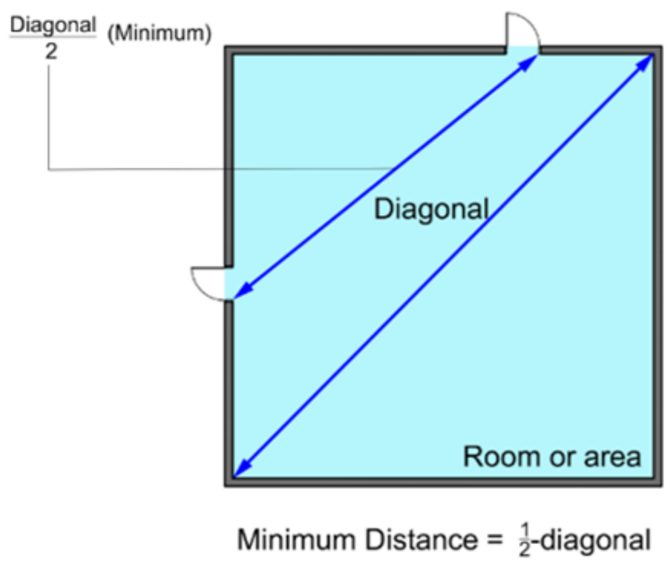


Diagram 2.3.12b. – 1

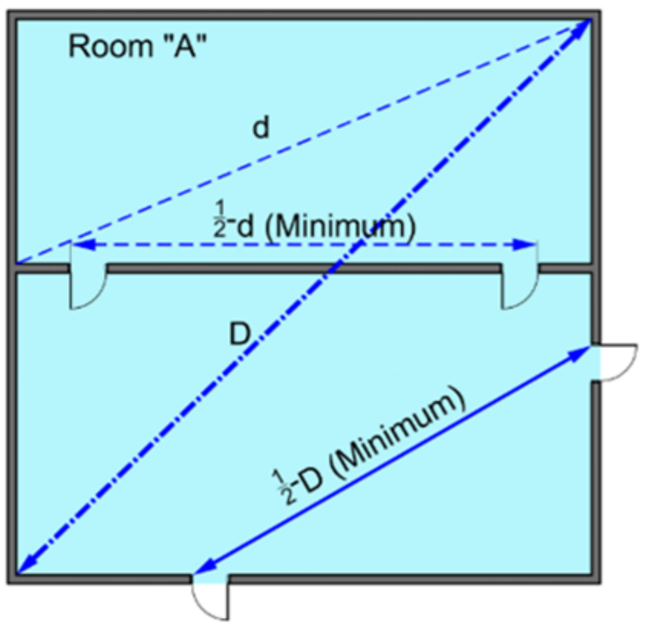


Diagram 2.3.12b. – 2

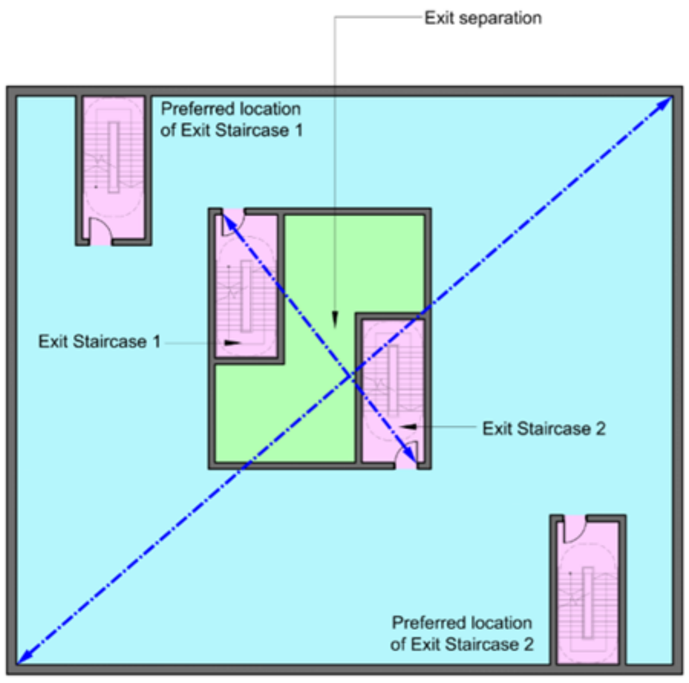
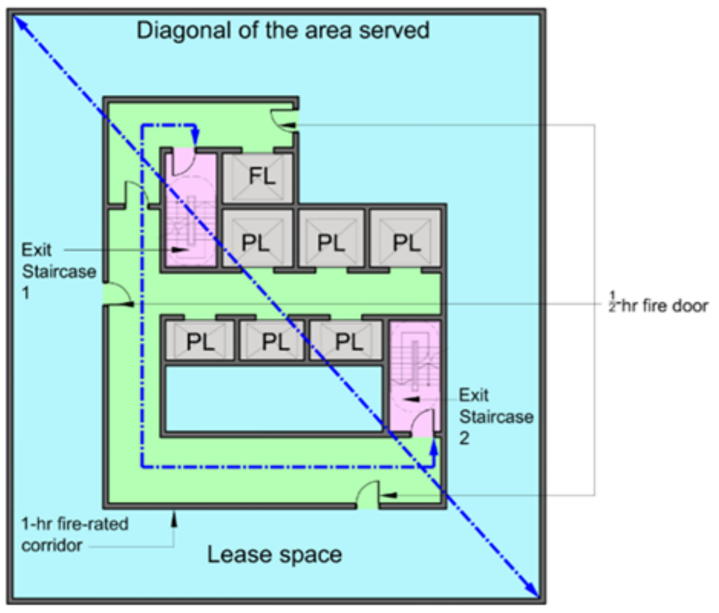


Diagram 2.3.12b. – 3

One-way escape arrangement

The distance between the exit of staircases S1 & S2 is less than half the length of the max. overall diagonal dimension of the building or floor space.



Right : Diagram 2.3.12b. - 4

Two-way escape arrangement

Exit separation between the exit staircases S1 & S2 can be based on the travel distance in the exit access corridor enclosed with 1-hr fire-rated walls and ½-hr fire-rated doors.

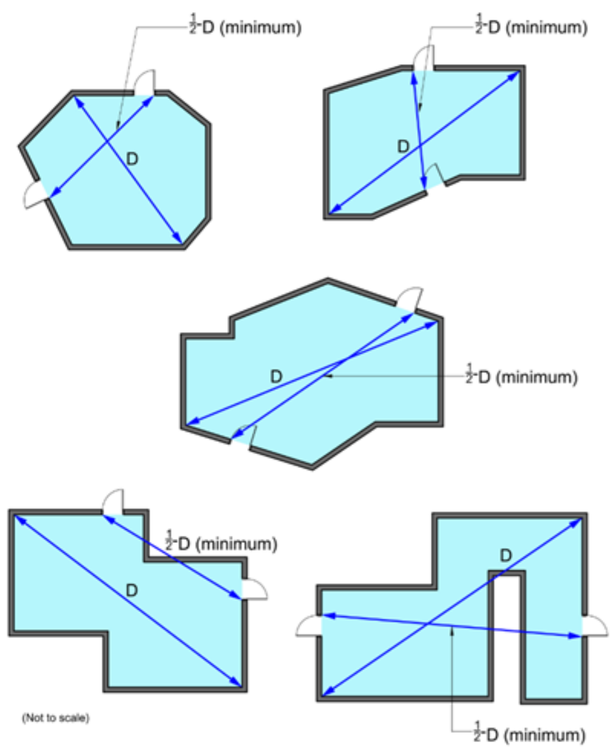


Diagram 2.3.12b. - 5 : Remoteness of exit staircase

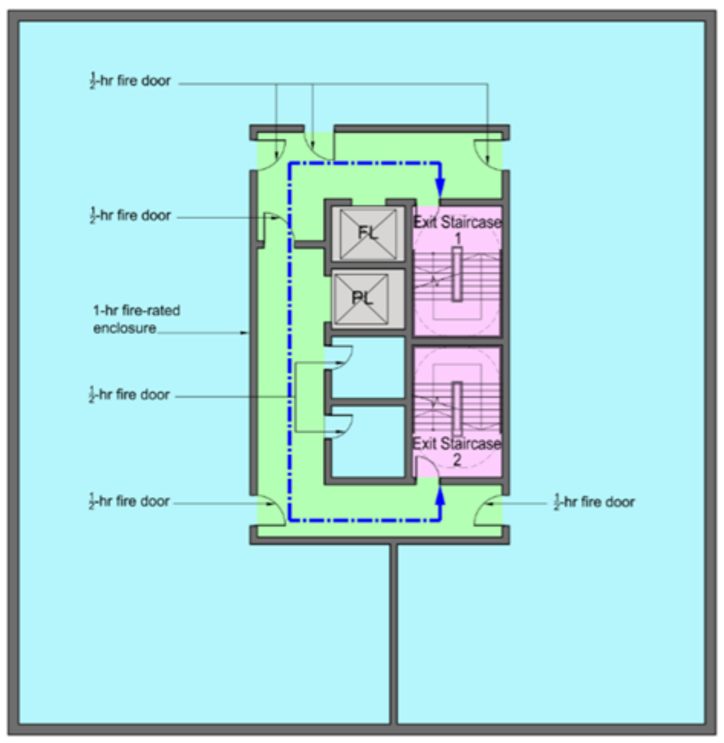


Diagram 2.3.12d. : Remoteness of exit staircase - Arrangement of exit staircase

Remoteness of exits is measured along 1-hr fire-rated corridor with ½-hr fire doors. In place of measuring physical distance between exit stair enclosure, distance for purposes of determining remoteness is permitted to be measured along a protected corridor.

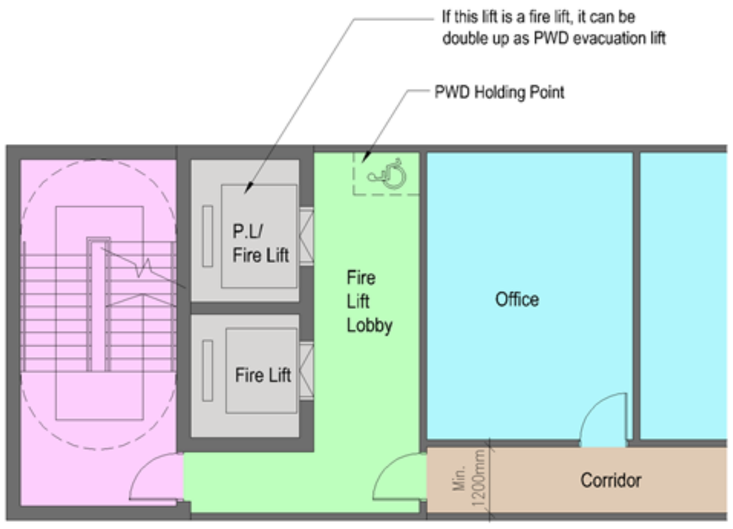


Diagram 2.4.2b.(2) - 1 : PWD Holding Point located within fire lift lobby

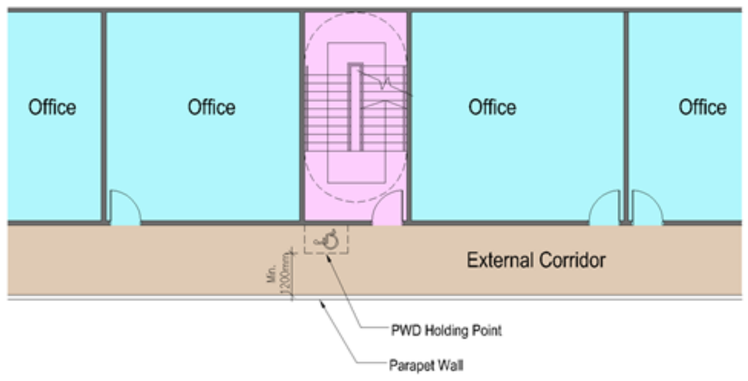


Diagram 2.4.2b.(2) - 2 : PWD Holding Point located within external corridor

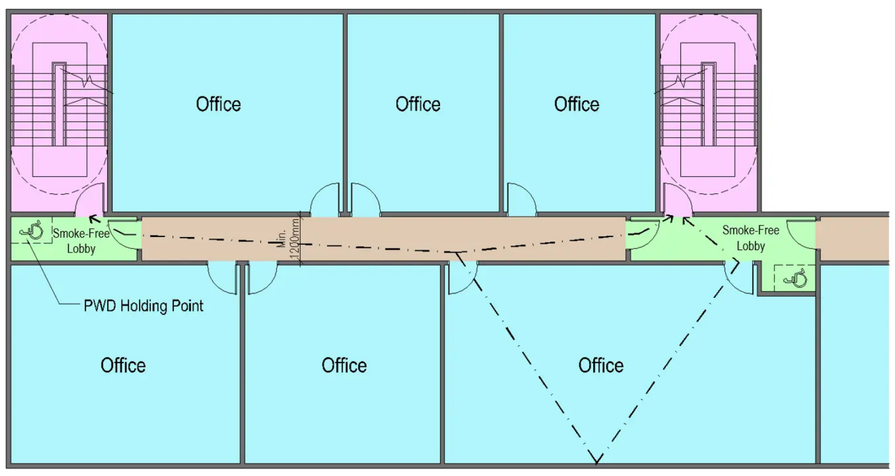


Diagram 2.4.2b.(2) - 3 : PWD Holding Point located within smoke-free lobby

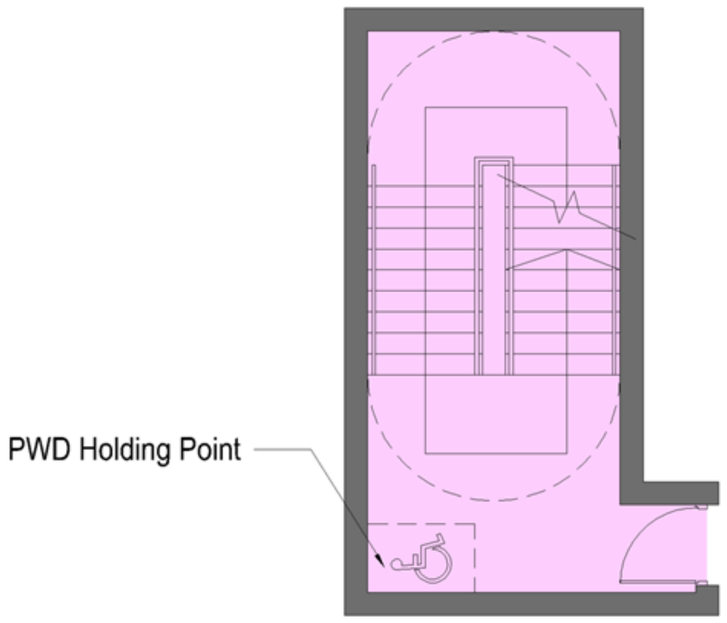


Diagram 2.4.2b.(2) - 4 : PWD Holding Point located within exit staircase

TABLE 2.2A : DETERMINATION OF EXIT REQUIREMENT												
Type of Occupancy	Max Travel Distance(m)				Capacity No of persons per unit of width(x)				Min Width (m)		Max Dead End (m)	
	One-way travel		Two-way travel									
	Non-sprinklered	Sprinklered	Non-sprinklered	Sprinklered	Door opening(c), (d) & (e)		Staircases(f)	Ramps Corridors Exits Passageways(d)	Staircases/ Exit Passageway	Corridors(l)	Corridors	
					Exit to outdoors at ground level	Other exit & corridor doors					Non-sprinklered	Sprinklered
High hazard	10	20	20	35	50	40	30	50	1	1.2	15	20
Industrial buildings (factories, workshops, godown/ warehouse)	15	25	30	60	100	80	60	100	1	1.2	15	20
Shops, healthcare facility (out patient)	15	25	45	60	100	80	60	100	1	1.2	15	20
Offices	15	30	45	75	100	80	60	100	1	1.2	15	20
Places of public resort & carparks	15	25	45	60	100	80	60	100	1(h)	1.2(h)	15	20
Schools & educational buildings	15	25	45	60	100	80	60	100	1	1.5(a)	15	20
Healthcare facility (inpatient)	15	25	30	45	30	30	15	30	1	2(b)	15	20

Hotels, Boarding Houses, Serviced A partments, Hostels, Ba ckpackers Hotel, Dor mitories	15	20	30	60	60	50	45	50	1	1.2	15	20
Blocks of fl ates/maiso nettes (k)	15(g) 20(j)	30(g) 40(j)	30 45(j)	75	50	40	30	50	1(i)	1.2	15	20
Detached, semi-deta ched & terrace house, including t ownhouses	NR	NR	NR	NR	NR	NR	NR	NR	0.9	0.9	NR	NR

Note:
NR = No requirements.
(x) = Unit of width 500mm
(a) = Applies to corridors serving classrooms. Other corridors shall have a minimum width of 1.2m
(b) = Applies to corridors serving patients. Other corridors shall have a minimum width of 1.2m
(c) = See Cl.2.3.9
(d) = See Cl.2.3.8
(e) = Where a door opening is divided by mullions into two or more openings, each such opening shall be measured separately in computing the number of units of exit width
(f) = See Cl.2.2.15 regarding reduction of exit provision
(g) = For travel distance in single staircase flats (see Cl.9.2.1a.(8))
(h) = Refer to Cl.9.7.3a.
(i) = Staircase within maisonette serving as an internal access to be at least 900mm width
(j) = Applies to external corridor (see Cl.2.3.10)
(k) = Measurement of travel distance is from the residential unit door to exit (see Cl.9.2.1a.(5))
(l) = For buildings/ usages/ areas that are exempted from barrier-free accessibility compliance, as required by the authority having jurisdiction on accessibility in the built environment, any corridor solely serving those buildings/ usages/ areas can be reduced to 1m. This is not applicable to Note (a) corridor serving classrooms, Note (b) corridor serving patient wards, and/ or PG I buildings

TABLE 2.3.9k.(1) -1 : PRE-REQUISITES FOR USE OF ELECTROMAGNETIC/ ELECTROMECHANICAL LOCKING DEVICE

Location	Approved automatic fire alarm or sprinkler systems	Emergency lighting*	Manual override device (Emergency Door Release)**
1. Exit access doors and/or exit doors in all common areas (e.g. exit staircase, internal exit passageway, final discharge doors, smoke-free/fire lift lobbies and common area corridors), but excluding revolving doors and doors to residential units	Yes	Yes	Yes
2. Exit access doors and/or exit doors used for staircase re-entry which comply with *Cl.2.3.9l.*	Yes	Yes	Yes Manual override device shall be located on both sides of the door
Doors to access essential rooms for fire protection systems, as stipulated under *Cl.8.2.2b.*	Yes	Yes	Yes
Exit access doors and/or exit doors within tenanted units	Not required provided in accordance with *Cl.2.3.9k.(2)*	Yes	Yes
Exit access door and/or exit door to rooms in common areas-which require restricted access and are not normally occupied, for instance: 1. Power Supply / Switch Room 2. Transformer Room 3. Chiller Plant Room / Cooling Tower 4. Air Handling Unit Room 5. Non-essential Fan Room 6. Control Centre / Room 7. Communication / Control / Signalling Equipment Room 8. Telecommunication Room 9. Server Room, etc.	Yes	Yes	Yes

Note:

- Linking of the locking devices through other systems to the building fire alarm system or sprinkler system is not permitted.
* Manual override devices shall be provided with a minimum level of illuminance in accordance with SS 563.

** Activation of manual override device for emergency door release shall automatically and immediately unlock the doors to facilitate egress. The manual override device shall be located within the occupancy space, 1.2m above the finished floor level and within 1.5m of the door jamb. The manual override device shall be readily accessible and clearly identified by a sign that reads "Emergency Door Release". Any device used by staff for access control to facilitate their day-to-day operations shall not be considered as a substitute for the manual override device.

TABLE 2.3.9k.(1) – 2 : DE-ENERGISE REQUIREMENTS FOR ELECTROMAGNETIC/ELECTROMECHANICAL LOCKING DEVICE

Location	Any power failure to affected spaces/areas	Under building fire alarm activation	Any fault in the locking devices/components related to the release of locking mechanism*
1. Exit access doors and/or exit doors in all common areas (e.g. exit staircase, internal exit passageway, final discharge doors, smoke-free/fire lift lobbies and common area corridors), but excluding revolving doors and doors to residential units	To be released immediately***	To be released immediately	To be released immediately
2. Exit access doors and/or exit doors used for staircase re-entry which comply with *Cl.2.3.9l.*	To be released immediately***	To be released immediately	To be released immediately
Doors to access essential rooms for fire protection systems, as stipulated under *Cl.8.2.2b.*	Release not required	To be released immediately	Release not required
Exit access doors and/or exit doors within tenanted units	Release not required	Release not required **	Release not required
Exit access door and/or exit door to rooms in common areas which require restricted access and normally not occupied, for instance: 1. Power Supply / Switch Room 2. Transformer Room 3. Chiller Plant Room / Cooling Tower 4. Air Handling Unit Room 5. Non-essential Fan Room 6. Control Centre / Room 7. Communication / Control / Signalling Equipment Room 8. Telecommunication Room 9. Server Room, etc.	Release not required	To be released immediately	Release not required

Note:

* Excluding faults on other access control devices such as card readers, override key-switches, non-emergency exit buttons, etc.
** Unless exception stated under *Cl.2.3.9k.(2)*
*** EM locking device can be manually re-engaged after it has been released, provided such a device complies with the following:
(1) There is no activation of any fire detection system and it has been visually verified that there is no fire; and
(2) A device to re-engage the EM locking shall be provided at the FCC, or any 24-hourly manned station if FCC is not available.

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
2.2.11		16 Jun 2016	Revised, extracted from SCDF's circular		15 Dec 2015
2.2.11 (dated 25 Aug 2023)	25 Aug 2023	25 Aug 2023	Revised/Clarification	2.2.11 Number of exit staircases or exits per storey There shall be at least two independent exit staircases or other exits from every storey of a building, unless otherwise permitted under other subsequent provisions of the Code. For non-habitable roof, at least one exit staircase shall be provided. Where the area of non-habitable roof is large and one-way travel distance to the exit cannot be met, an additional cat/ship ladder adequately separated in accordance with Cl.2.3.12 and leading to the circulation area of the floor below shall be provided. All access hatches, if provided, shall be readily accessible from the roof. Access hatch opening shall have a minimum clear width of 1m in diameter. The travel distances can be based on that for a sprinkler protected building for roof areas which are open-to-sky. For protruding structures above the non-habitable roof, namely exit staircase shaft and lift motor room is exempted from this clause.	25 Aug 2023
2.2.11(dated 1 Sep 2024)	1 Sep 2024	1 Sep 2024	Relaxation	2.2.11 Number of exit staircases or exits per storey ..... Exception: a. ..... b. ..... c.	1 Mar 2024
2.2.11(dated 15 Sep 2020)	15 Sep 2020	15 Sep 2020	Clarification	Number of exit staircases or exits per storey There shall be at least two independent exit staircases or other exits from every storey of a building, unless otherwise permitted under other subsequent provisions of the Code. For non-habitable roof, at least one exit staircase shall be provided. Where the area of non-habitable roof is large and one-way travel distance to the exit cannot be met, an additional cat/ship ladder adequately separated in accordance with Cl.2.3.12 and leading to the circulation area of the floor below shall be provided. All access hatches, if provided, shall be readily accessible from the roof. Access hatch opening shall have a minimum clear width of 1m in diameter. The travel distances can be based on that for a sprinkler-protected building for roof areas which are open-to-sky.	15 Sep 2020
2.2.12b.	15 Mar 2021	15 Mar 2021	Revised	2.2.12b. Every occupant or tenant within a building or storey of a building shall have direct access to the required exit or exits without the need to pass through the spaces or rooms occupied by other occupants or tenants	15 Sep 2020
2.2.13b(7)(a)	10 May 2019	10 May 2019	Clarification	Permanent fixed ventilation openings which are located in the external wall of the lobby and have a total area of not less than 15% of the floor area of the lobby. Each opening shall not be less than 1m2 and shall abut an external space or air well, having a minimum clear area of 93m2 and minimum width of 6m and without obstruction vertically throughout the airspace for ventilation. No part of the lobby floor area shall be more than 9m away from the air well or external space.	10 May 2019
2.2.14	25 Aug 2023	1 March 2024	Revised/Clarification	2.2.14 Smoke-free approach to exit staircase in basement a. In a building comprising more than four basement storeys, the entry to exit staircases serving the basement storeys at every basement storey level shall be through smoke-free lobbies, one of which shall be designated as a fire lift lobby. The exit staircase connecting to the fire lift lobby shall be pressurised to comply with the requirements in Chapter 7. b. In a building comprising two, three, or four basement storeys, entry at every basement storey level to at least one of the exit staircases serving the basement storeys shall be through a smoke-free lobby. Where only one smoke-free lobby is provided, it shall be required to serve as a fire lift lobby. c. Smoke-free lobbies in basement occupancies shall be required to comply with the relevant provisions under Cl.2.2.13b. and shall be mechanically ventilated to comply with the requirements in Chapter 7.	25 Aug 2023
2.2.4	25 Aug 2023	25 Aug 2023	Revised/Clarification	2.2.4 Non-simultaneous occupancy The floor areas of toilets, locker rooms, storage rooms, lobbies, corridors and similar rooms and spaces that serve other rooms and spaces on the same storey but are not occupied at the same time as such other rooms or spaces, can be omitted from the occupant load calculations of that storey of the building on which they are located.	25 Aug 2023
2.2.6f.	2 Mar 2025	2 Mar 2025	Revised	Where permitted under Cl.2.3.3 for exit staircases to be entered without the provision of an exit door, the travel distance shall be measured to a position where the exit door would be installed if otherwise required.	2 Sep 2024
2.2.7a.	1 Mar 2022	1 Mar 2022	Clarification	No exit, exit staircase or other exit facilities shall be narrower than the minimum width requirement as specified under Table 2.2A. The minimum clear width of an exit door opening shall be not less than 850mm.	1 Mar 2022
2.3.1	1 Mar 2021	1 Sep 2021	Revised/Clarification	General a. listed herein. Access and exit facilities not specifically covered in this Code shall not be used without the approval of the SCDF. Required exits shall be kept readily accessible, and doors shall be openable and unobstructed at all times during the occupancy of the building. b. Exit staircase signage	1 Mar 2021
2.3.10		01 Mar 2019	New		--
2.3.10b	10 May 2019	10 May 2019	Clarification	where the external corridor is roofed over, the depth of the roofed over portion shall not exceed 3m;	10 May 2019
2.3.10f	10 May 2019	10 May 2019	Clarification	the length of external corridor with unobstructed and uninterrupted openings above the parapet wall shall not be less than 6m and shall abut an external space.	10 May 2019
2.3.11		01 Mar 2019	New		--

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
2.3.1a.	1 Mar 2021	1 Sep 2021	Revised/Clarification	General a. listed herein. Access and exit facilities not specifically covered in this Code shall not be used without the approval of the SCDF. Required exits shall be kept readily accessible, and doors shall be openable and unobstructed at all times during the occupancy of the building. b. Exit staircase signage	1 Mar 2021
2.3.3a.(4)(a)		01 Mar 2019	Revised, formerly 2.3.3(a)(iv)(1)		--
2.3.3a.(4)(a) (dated 25 Aug 2023)	25 Aug 2023	25 Aug 2023	Revised/Clarification	2.3.3a.(4)(a) Single storey basement car park Exit staircases, including exit ramps in compliance with Cl.2.3.8a. & Cl.2.3.8b., serving the single storey basement of PG II to VII buildings are not required to be protected with fire-rated enclosures, provided the travel distances in the car park measured to the exit doors at ground level comply with Table 2.2A.	25 Aug 2023
2.3.3b.	1 Mar 2022	1 Mar 2022	Clarification	External exit staircase (1) recessed more than 3m from the building façade and has: (a) (b)	1 Mar 2022
2.3.3b.(1)		01 Mar 2019	New		--
2.3.3c.(1)(c)		01 Mar 2019	New		--
2.3.3d.(3) to (5)		01 Mar 2019	New		--
2.3.3d.(6)(a)		01 Mar 2019	Revised, formerly Cl.2.3.3(e)(i)		--
2.3.3d.(7)	10 May 2019	10 May 2019	Clarification	All exit staircases shall be ventilated by fixed openings in the external walls, such openings being of area not less than 10% of the floor area per floor of the staircase, or mechanically ventilated to comply with the requirements in Chapter 7. Ventilation openings fronting an air well, external recessed space or external shall be in accordance with Table 1.4.2. An exit staircase and occupancy area shall not share the same air well or void for lighting and ventilation. Mechanical ventilation is not allowed for PG II, except for a staircase storey shelter.	10 May 2019
2.3.3d.(8)	10 May 2019	Immediate	Clarification	In any building for which the habitable height exceeds 24m, any internal exit staircases without provision for natural ventilation shall be pressurised to comply with the requirements in Chapter 7. In a building comprising more than four basement storeys, the exit staircase connecting to the fire lift lobby shall be pressurised.	10 May 2019
2.3.3d.(9)		01 Mar 2019	Revised, formerly Cl.2.3.3(h)		--
2.3.9.k.(1)		01 Mar 2019	Revised, formerly Cl.2.3.9(k)		---
2.3.9.k.(1) (dated 25 Aug 2023)	25 Aug 2023	25 Aug 2023	Revised/Clarifications	2.3.9k. Access control using electromagnetic/ electromechanical locking device (1) Where access control using electromagnetic/ electromechanical locking device is installed on any exit access door and/ or exit door, excluding revolving doors and doors to residential units, such doors shall comply with the requirements stipulated in Table 2.3.9k.(1) - 1 & Table 2.3.9k.(1) - 2. (2)	25 Aug 2023
2.3.9a.	25 Aug 2023	25 Aug 2023	Revised/Clarifications	2.3.9 Exit doors and exit access doors Exit doors and exit access doors shall comply with all the following: a. Door operation Exit doors shall be capable of being opened manually, without the use of a key, tool, or special knowledge or effort for operation from the inside of the building. (Not applicable to buildings under PG I & II) b. Fire resistance Exit doors which are required to have fire resistance rating shall comply with the relevant provisions for fire resisting doors under Cl.3.9.2. c. ..... d. Exit door opening (1) ..... (2) ..... e. ..... f. Revolving doors Revolving doors shall not be used as exit doors for required exits.	25 Aug 2023
2.3.9d.(3)		01 Mar 2019	New		--
2.3.9e.	3 Mar 2025	3 Sep 2025	Relaxation/ Revised	2.3.9e. Vision panel The fire door to an exit staircase and smoke-free/ fire lift lobby shall be constructed to incorporate a vision panel. The vision panel shall have a clear view size of 100mm (w) x 600mm (h). The vision panel shall have the requisite fire resistance rating and shall not turn opaque when subject to heat. The bottom edge of the vision panel shall be located at 900mm above the finished floor level. The provision of vision panel shall not apply to fire doors of residential apartment or maisonette units.	3 Mar 2025
2.3.9h.(2)(e)(ii)	10 May 2019	10 May 2019	Change in requirements	A manual override mechanism (a device to trigger the immediate opening of sliding doors/roller shutters) shall be provided. The doors shall open and remain open upon activation of this device. This device shall be housed in a break glass box located beside the sliding doors or roller shutters and fixed at a height of 1.4m above the finished floor level. It shall be easily accessible, conspicuous and be free from obstructions. A readily discernible sign with the lettering "EMERGENCY DOOR RELEASE" shall be permanently displayed beside the switch. The letterings shall be of at least 15mm in height.	10 May 2019
2.3.9j		01 Mar 2019	Revised, formerly Cl.2.3.9(j)		---
2.3.9k.(2)		01 Mar 2019	New		---

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
2.3.9k.(2) (dated 15 Sep 2020)	15 Sep 2020	15 Sep 2020	Clarification	Access control belonging to tenanted spaces Where access control belonging to tenanted spaces are installed with smart card locking device, magnetic bar, electromechanical locking device and the like to prevent unauthorised access, such locking mechanism shall be arranged to unlock from a manual override device in accordance with Cl.2.3.9k.(1)(b). The manual override device serves as a means for occupant to get out of the occupied space during a fire emergency. Any form of staff access control facilitating daily operation shall not be considered as a substitute for manual override device. Cl.2.3.9k.(1)(a) is not applicable to tenanted spaces.	15 Sep 2020
2.3.9l.(5)		01 Mar 2019	New		--
2.3.9l.(5) (dated 15 Sep 2020)	15 Sep 2020	15 Sep 2020	Clarification	Where locking is required for doors of smoke-free lobby, fire lift lobby or exit staircase on the re-entry floor, they shall be fitted with an electro¬mechanical locking device complying with Cl.2.3.9k.(1). Note: Where the doors of exit staircases, smoke-free lobbies or fire lift lobbies are provided with one-way locking device or electromechanical lock, a signage, though not mandatory, should be provided to warn occupants that they would not be able to re-enter the floor should they exit from it. The signage should be positioned at the entrance into exit staircase, smoke-free lobby or fire lift lobby.	15 Sep 2020
2.3.9n.	1 March 2024	1 March 2024	New	Nil.	25 Aug 2023
2.4.1		1 Nov 2011, 25 Jun 2013 and 2 Jul 2015	Relocated from Appendix 20 of Fire Code 2013, extracted from SCDF's circulars		21 Jan 2011, 25 Jun 2013 and 2 Jul 2015
2.4.1 (dated 1 Sep 2021)	1 Sep 2021	1 Mar 2022	Revised/ Clarification	General a. (1) (2) (3) ..... (4) within residential developments and which are intended for ancillary use, are not required to comply with these requirements; and (5)	1 Sep 2021
2.4.1 (dated 2 Mar 2020)	2 Mar 2020	2 Mar 2020	Clarification	General a. (1) (2) healthcare centre; (3) compliance, as required by the authority having jurisdiction on accessibility in the built environment; and (4) within residential developments and which are intended for ancillary use, are not required to comply with these requirements.	2 Mar 2020
2.4.1a	1 Sep 2024	1 Sep 2024	Relaxation	2.4.1a. The following buildings/ usages are exempted from these requirements: (1) ..... (2) .... (3) industrial buildings/ usages that are exempted from barrier-free accessibility compliance, as required by the authority having jurisdiction on accessibility in the built environment; (4) non-residential buildings/ usages, such as car parks, clubhouses and gardens/ terraces located within residential developments and which are intended for ancillary use, are not required to comply with these requirements; and (5)	1 Mar 2024
2.4.3		Immediate	Relocated from Appendix 20 (Cl.3.2.6) of Fire Code 2013		--
2.4.3 (dated 2 Mar 2020)	2 Mar 2020	2 Mar 2020	Clarification	Communication provisions A suitable means of communication shall be provided between the PWD holding point and FCC or any 24-hourly manned station, for PWDs to call for assistance during a fire emergency. It can be in the form of a distress button or voice communication. The means of communication shall: a. be located between 800mm and 1.2m above ground level; b. be appropriately labelled; c. be provided with prominently displayed clear instruction sign on its operation; and d. when the device for communication is activated, it shall generate a clear visual indication to indicate that the distress signal has been relayed.	2 Mar 2020
Table 2.2A	1 Sep 2024	1 Sep 2024	Relaxation	Existing Table 2.2A	1 Mar 2024

CLAUSE 3.1 GENERAL

The purpose of this chapter of the Code is to stipulate requirements to minimise the risk of spread of fire between adjoining buildings by separation, prevent the untimely collapse of buildings in the event of fire by the provision of a stable and durable form of construction and prevent the spread of fire between specified parts of the buildings by the division of such buildings into compartments.

Explanation and Illustrations

(No illustration)

Structural fire precautions relate to the integrity and stability of building elements during fire for a required period of time. “Structural” does not only apply to the structural elements of buildings but other building components, e.g. doors, shafts, walls/ceiling finishes.

The objectives of structural fire precautions are:

1. to unload the spread of fire between adjoining buildings by adequate separation;

2. to prevent the untimely collapse of building, including walls and floors of each unit in the event of a fire; and

3. to prevent spread of fire from one unit to another within the building envelope by compartmentalising each unit with walls, floors and doors having the requisite fire resistance rating.

CLAUSE 3.2 PROVISION OF COMPARTMENT WALLS AND COMPARTMENT FLOORS

Rationale

Compartmentation serves to reduce the rate of fire spread to enable safe evacuation and firefighting in buildings. It also serves to isolate high risk areas from other parts of a building.

3.2.1 Compartment size - floor area & cubical extent

Explanation and Illustrations

Generally, the compartment size of apartment or maisonette unit would not exceed 4000m² or a cubical extent of 15000m³ as given in *Table 3.2A* which is reproduced below:

3.2A : SIZE LIMITATION OF BUILDING & COMPARTMENT

Compartments	Maximum Floor Area	Maximum Cubical Extent
Compartment below ground level (No compartment shall comprise more than one storey)	2000m²	7500m³
Compartments between average ground level and a height of 24m (No compartment shall comprise more than 3 storeys)	4000m²	15000m³
Compartments above a height of 24m from average ground level (No compartment shall comprise more than one storey)	2000m²	7500m³

However, for non-residential areas in buildings under PG II, such as communal area or car parking area irrespective of location in either upper storeys or basement, there would be a need to apply the size limitation of 4000m² or 15000m³. The above non-residential areas would be dealt with under their respective PG VII & VIII respectively.

Compartment below ground level

1. Under Table 3.2A no compartment shall comprise more than one storey and exceed floor area of 2000m² and a cubical extent of 7500m³. However, exceptions are allowed in the following situations:

   a. Only 1st basement having a floor area of less than 100m² can form part of the 1st and upper storey compartment under Cl.3.2.5c., provided the building is sprinkler-protected including the basement.

   b. Basement floors can be interconnected for use as car parking, if sprinkler system is provided.

2. Basement floor or compartment shall not be used for bulk storage of highly inflammable liquids or substances of any explosive nature.

Compartments between average ground level & a height of 24m

No compartment shall comprise more than 3 storeys and floor area greater than 4000m² and cubical extent exceeding 15000m³. However, exceptions are allowed under Cl.3.2.3, *Cl.3.2.4a*. and Cl.3.2.8.

Compartments above a height of 24m from averaged ground level

1. No compartment shall comprise more than 3 storeys and floor area greater than 4000m² and cubical extent exceeding 15000m³. Every storey above a height of 24m shall be a fire compartment.

General: In computing the extent of a compartment, protected shafts e.g. lift, staircases etc. and separately compartmented lavatory/locker room can be disregarded. See Cl.1.4.29 for further illustration.

2. High bay warehouse (HBW) and mechanised car parking buildings are treated differently from normal industrial buildings.

The requirement of restricting the compartment to max. 3 storeys would not be applicable. Such types of buildings are usually not occupied or have very limited people working in the premises.

Automatic sprinkler system and smoke extraction or venting system are required to be provided for high bay warehouses and mechanised car parking buildings which exceed 24m in building height.

Compartments above a height of 24m from averaged ground level

No compartment shall comprise more than one storey and exceed the floor area of 2000m² and cubical extent of 7500m³.

This requirement would not apply to high bay warehouses and mechanised car parking buildings. Prior consent is to be obtained from the SCDF before submission of building plan.

Any building other than a building of PG I which has any storey the floor area of which exceeds that specified as relevant to a building of that height in column (2) of *Table 3.2A*, or a cubic capacity which exceeds that specified as relevant in column (3) of *Table 3.2A*, shall be divided into compartments by means of compartment walls and compartment floors so that:

a. no such compartment has any storey the floor area of which exceeds the area specified as relevant to the building in column (2) of the table; and

b. no such compartment has a cubic capacity which exceeds that specified as relevant in column (3) of the table.

3.2.2 Cubical extent for compartment exceeding 4m in height

a. In computing the cubical extent of compartments in single storey buildings such as factories, sport halls, markets, food courts, multi-purposes halls, cinemas, concert halls, churches, temples and similar buildings, the height of 4m shall be used where the actual height exceeds that figure.

b. If any compartment comprises more than one storey or contains mezzanine, galleries or lofts, the full height of the compartment shall be used in computing the cubical extent for each storey, mezzanine, galleries or lofts.

c. Where two buildings are connected by external open-sided covered walkway or open-sided covered link-bridge, the buildings are considered as separate buildings, if they comply with the following conditions:

(1) There is no commercial activities or other usage that would pose a fire risk within the covered walkway or link-bridge.

(2) The width of the covered walkway or covered link-bridge shall not exceed 5m measured from eave to eave.

Rationale

The 4m in height serve as a relaxation for purpose of computing cubical extent, instead of using the actual height, for single storey buildings of non-warehouse usage. The consideration takes into account that such spaces are meant to facilitate placement of machinery and for purpose of viewing, and are unlikely to have high level storage.

3.2.3 Exemption of compartmentation

Note

QPs should consult SCDF for all atrium designs. Requirements provided under Cl.7.5, *Cl.3.2.6*, Cl.3.2.4 and Cl.9.8.3 are to be complied with respectively.

Explanation and Illustrations

(No illustration)

To avoid providing fire compartmentation in building to comply with the cubical extent and floor area control under *Table 3.2A*, automatic sprinkler system would be proposed as an alternative. Where automatic sprinkler system is to be provided to a building, compliance with *Table 3.2A* on max 3 storeys per compartment is still required, unless atrium design is proposed subject to obtaining the SCDF 's prior approval before submission of building plan.

Cl.3.2.1 is not applicable if the building:

a. is fitted throughout with an automatic sprinkler system which complies with the requirements in *Chapter 6*; and

b. complies with Cl.3.2.4, Cl.3.2.6, Cl.7.4 and Cl.9.8.3.

3.2.4. Compartmentation by height

a. In any compartment except those mentioned under Cl.9.1, up to a habitable height of 24m, no compartment shall comprise more than three storeys. This requirement can be relaxed for atrium spaces provided the design of such spaces complies with the conditions stipulated under Cl.3.2.6.

Explanation and Illustrations

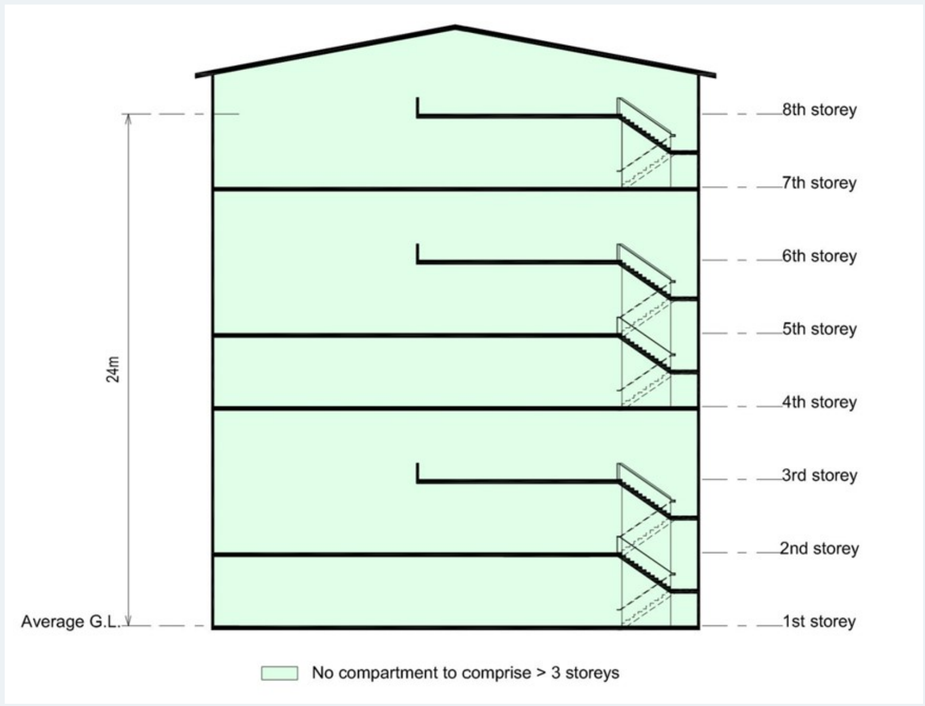


Figure 3.2.4a.

Where 3 storeys or levels form one compartment, the total floor area shall not exceed 4000m² and the total cubical extent shall not exceed 15000m³, subject to compliance with travel distance requirements under Chapter 2.

In the case of atrium design space, it can go beyond 3 storeys per compartment but shall not exceed habitable height of 24m. in other words, every storey beyond 24m in height is a fire compartment.

b. In any building which exceeds 24m in habitable height, no compartment shall comprise more than one storey for compartments at storey level exceeding 24m above average ground level, other than a compartment which is within a residential maisonette which may comprise two storey levels.

Explanation and Illustrations

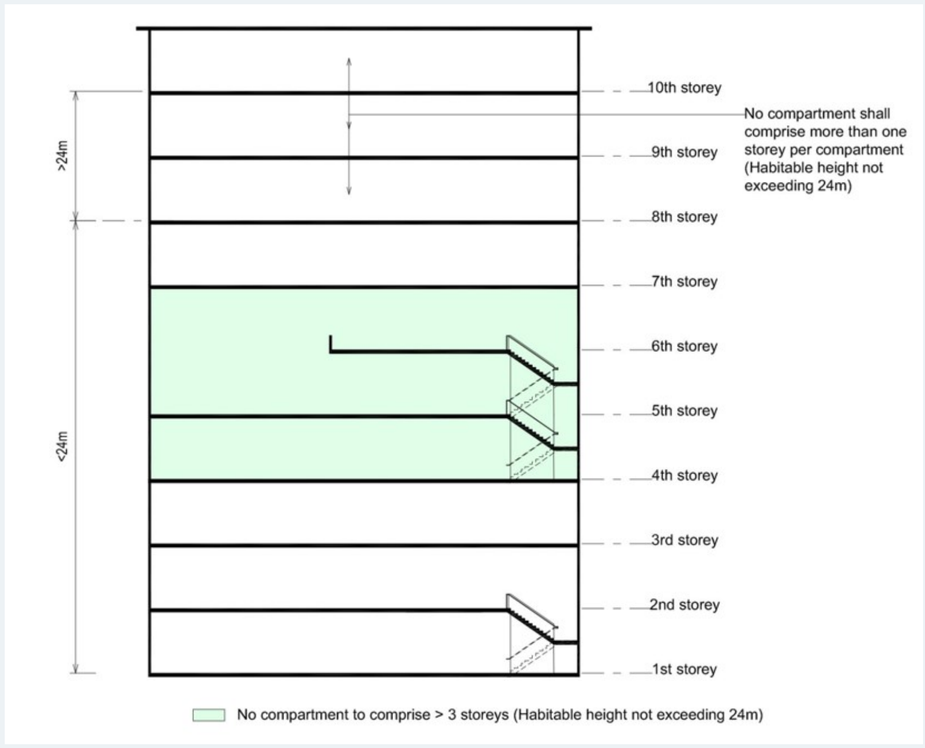


Figure 3.2.4b. - 1

In any commercial building which exceeds 24m in habitable height, no compartment shall comprise more than one storey per compartment from storey level exceeding 24m above average ground level. There is a need to keep the fire compartment size small within 2000m² or 7500m³ above that habitable height, as it would otherwise pose difficulties to firefighting and control of fire spread should there be a fire occurrence in one of those high-rise units.

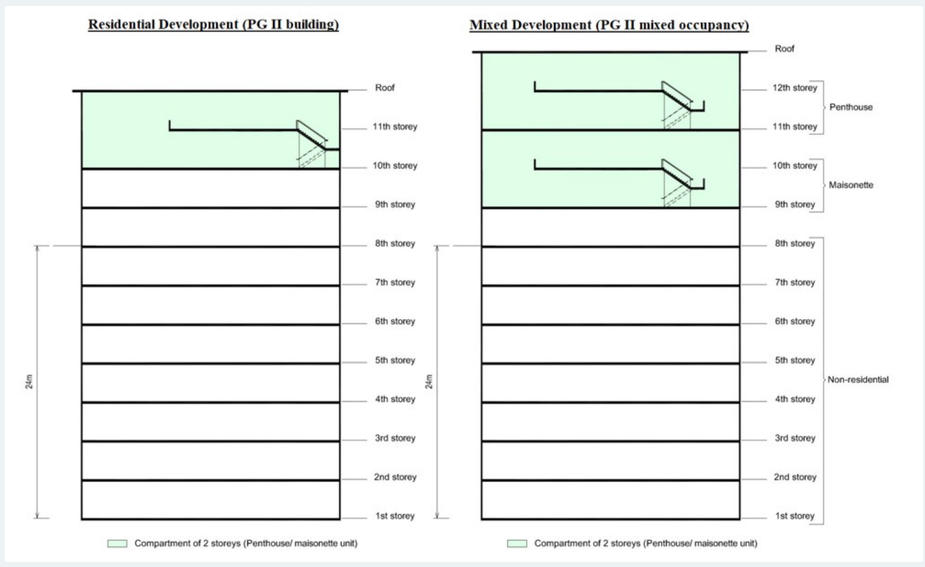


Figure 3.2.4b. - 2

In any residential building which exceeds 24m in habitable height, no compartment shall comprise more than one storey per compartment from storey level exceeding 24m above average ground level. However, for residential maisonette or penthouse unit, maximum two storey levels are allowed to form one compartment. This should be taken as a relaxation. There is a need to keep the fire compartment size small within 2000m² or 7500m³ above that habitable height as it would otherwise pose difficulties to fire fighting and control of fire spread should there be a fire occurrence in one of those high-rise units. In situation where there are maisonette or penthouse units located in non-residential building, fire protection/detection system applicable to the building shall be extended to cover the residential units.

3.2.5 Areas requiring compartmentation

The following situations shall require compartmentation by provision of compartment walls and/ or compartment floors:

a. PG II buildings

Any wall and floor separating a residential apartment or maisonette from any other part of the same building, unless permitted (as in the case of an external wall adjoining an external corridor, for provision of window openings).

Explanation and Illustrations

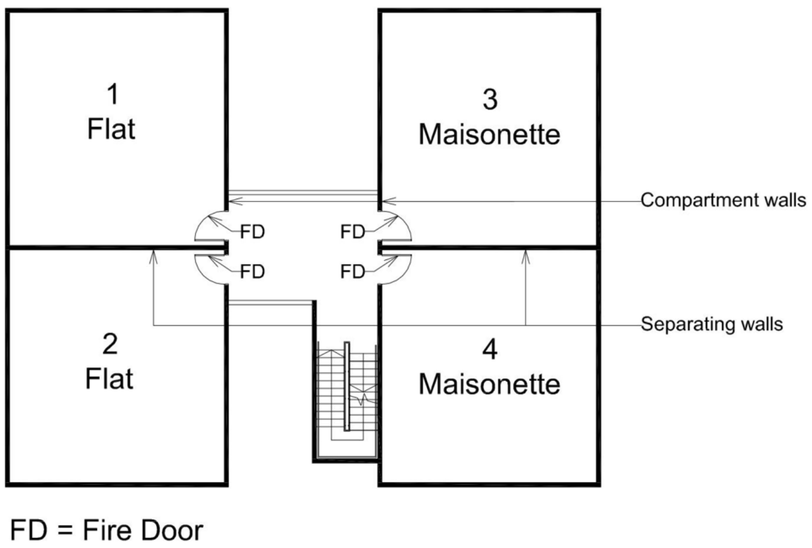
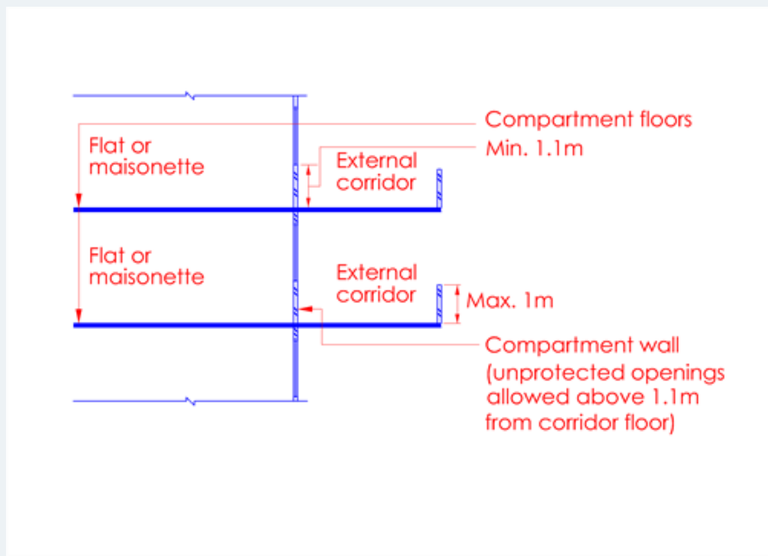


Figure 3.2.5a. – 1 : Compartment walls in PG II building



Section

Figure 3.2.5a. – 2 : Compartment walls & floors in PG II building

b. Areas of different purpose groups

Any wall and floor separating part of a building from any other part of the same building which is used or intended to be used mainly for a purpose falling within a different purpose group, as identified under *Table 1.4A*, except the following:

(1) ancillary offices located within a building or compartment of PG III, V, VI, VII and VIII, or

(2) rooms or spaces for ancillary usage located within a building or compartment of PG III to VIII as stipulated under Cl.1.4.5, or

(3) rooms or spaces located within a sprinkler-protected building, unless otherwise stated in following Cl.3.2.5 or other clauses in the Code.

Explanation and Illustrations

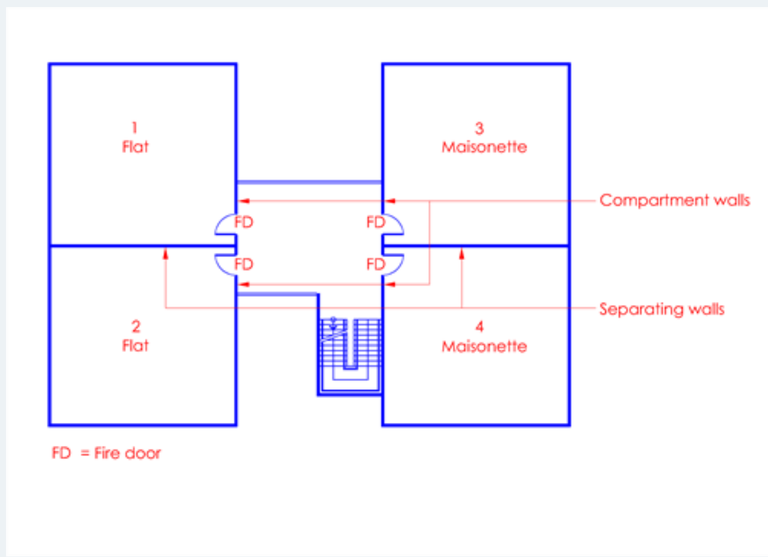


Figure 3.2.5b. – 1 : Compartment walls separating different PGs

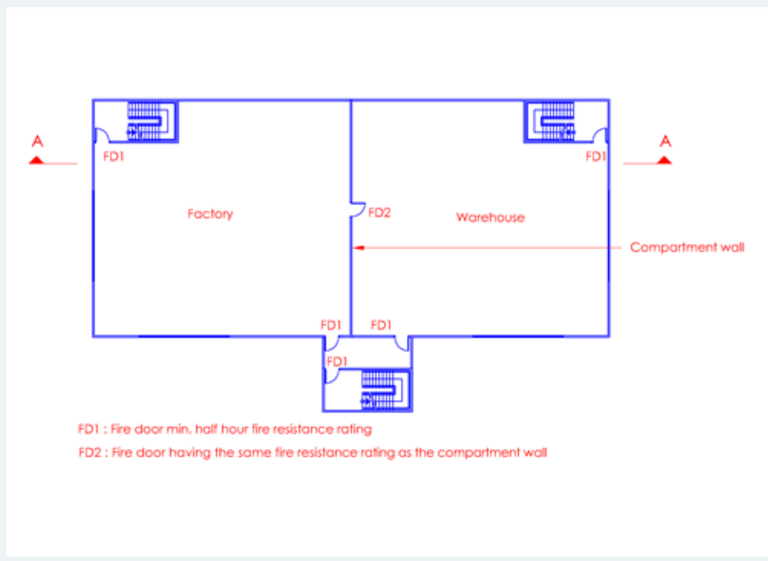


Figure 3.2.5b. – 2 : Compartment walls separating different PGs

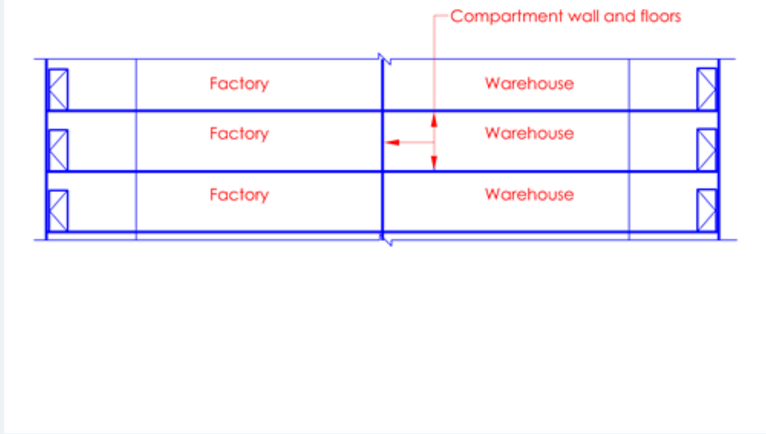


Figure 3.2.5b. - 3 : Compartment walls & floors separating different PGs

Compartment walls and floors shall be constructed of non-combustible materials to have minimum 1-hr fire resistance rating under *Table 3.3A* for any of the compartment.

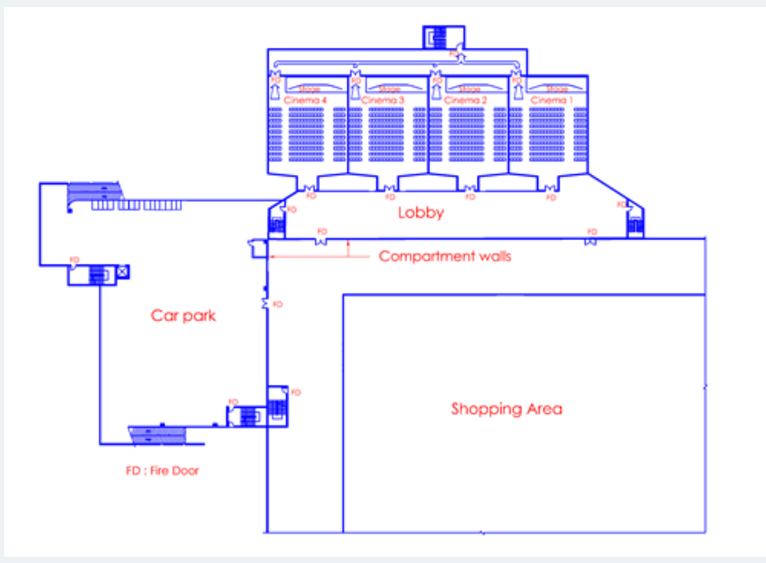


Figure 3.2.5b. - 4 : Compartment walls separating different PGs

In the above diagram, the car park (PG VIII) is fire compartmented from the shopping area. The car park has higher fire risks than shopping and cineplex. Fire separation between cineplex and shopping area is required. This is to safeguard the occupants in the cineplex from any fire occurrence in the shopping area.

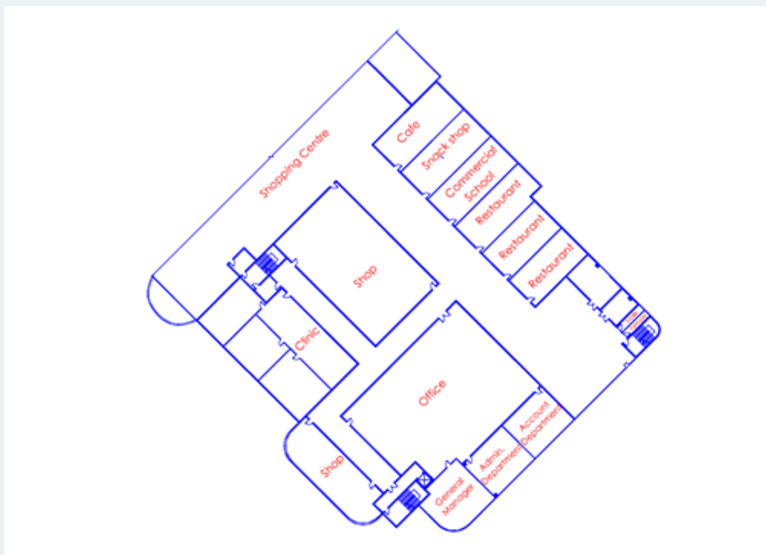


Figure 3.2.5b. - 5 : A mixture of different PGs without fire compartment

The above diagram shows a typical shopping floor, which has a mixture of different purpose groups without fire compartmentation.

Strictly interpreting the above subclause would mean that in a shopping centre, for example, shop (PG V), office (PG IV), place of public resort (PG VII), commercial school (PG III) would need to be separately compartmented from each other. This would not be practical. In practice, shopping or commercial buildings would have mixture of the uses of different purpose groups.

Under sub-clause (b)(i), an ancillary office which is located within the compartment or floor used as PG V is not required to be separately fire compartmented, provided the measurement of travel distance requirements of PG III shall apply to the ancillary office. Similarly, under sub-clause (b)(ii) , ancillary usage to PG III such as sick/first aid room, reception lobby/area, waiting area, staff lounge/staff recreation room, staff rest room/pantry, staff changing/locker room, meeting room, staff training room, etc. is not required to be separately fire compartmented.

c. Floor over a basement

Any floor immediately over a basement for PG II to VIII buildings shall be a compartment floor except for:

(1) a basement with floor area not exceeding 100m², or

(2) PG IV, V and VII buildings with basement floor area exceeding 100m^2, provided the following conditions are complied with:

(a) the building is fitted throughout with an automatic sprinkler system in compliance with the requirements in Chapter 6; and

(b) the first basement shall be compartmented from other basement storeys.

Note: For PG I buildings, refer to *Cl.9.1.1b.(2)* for compartmentation of floor over basement requirements.

Explanation and Illustrations

(No illustration)

To avoid providing fire compartmentation in building to comply with the cubical extent and floor area control under *Table 3.2A*, automatic sprinkler system would be proposed as an alternative. Where automatic sprinkler system is to be provided to a building, compliance with *Table 3.2A* on max 3 storeys per compartment is still required, unless atrium design is proposed subject to obtaining the SCDF 's prior approval before submission of building plan.

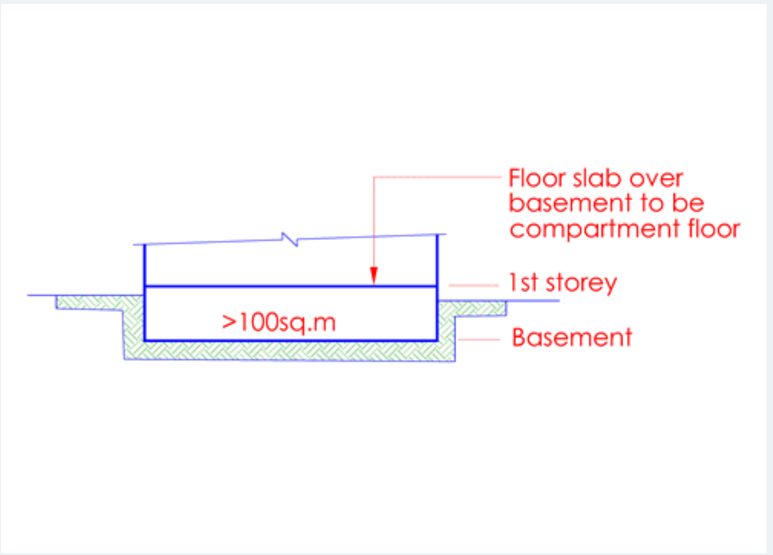


Figure 3.2.5c.(2) - 1 : Floor over basement

Where the floor area of the basement exceeds 100m^2 it shall be a compartment below ground level and shall not comprise more than one storey. The basement floor shall be provided with sprinkler system under *Cl.6.4.1d.(1)* and dry riser under *Cl.6.2.1b*.

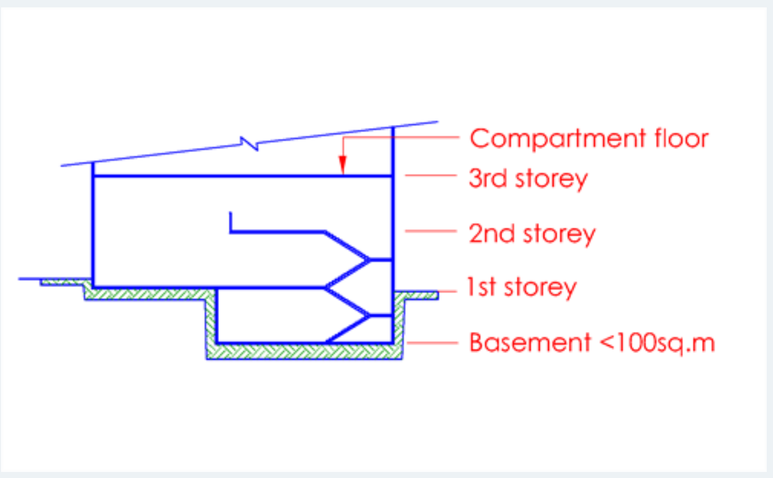


Figure 3.2.5c.(2) - 2 : Floor over basement

In situation where the basement floor area is not exceeding 100m², the basement and upper storeys may be allowed to be interconnected to form one compartment, subject to max. 3 storeys or levels in a single compartment. It should be noted that *Cl.3.2.5d.* prohibits more than one storey below ground level to be connected to form one compartment.

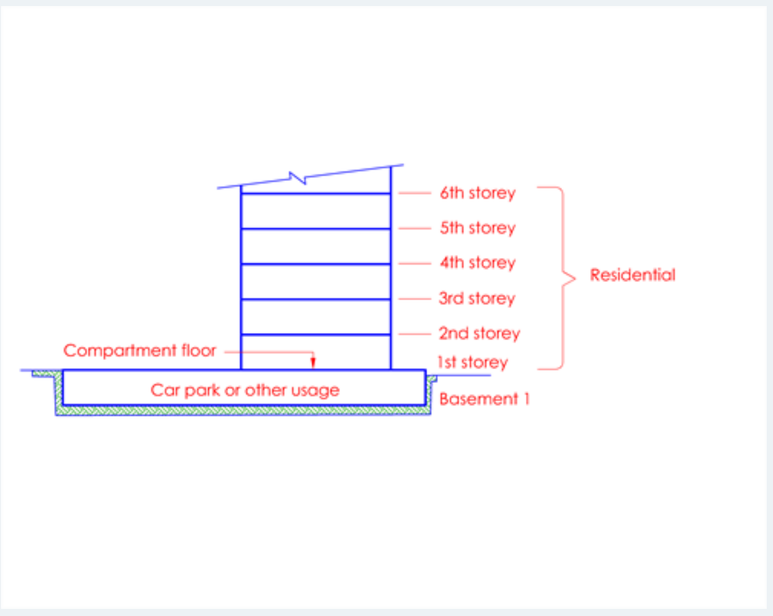


Figure 3.2.5c.(2) - 3 : Floor over basement

All basement floors, except those under PG I & II, are required to be provided with automatic sprinkler system under *Cl.6.4.1d.(1)*. Where basement floor, regardless of its area, is interconnected with upper storeys, the automatic sprinkler system required for the basement shall be extended to cover all the upper storeys.

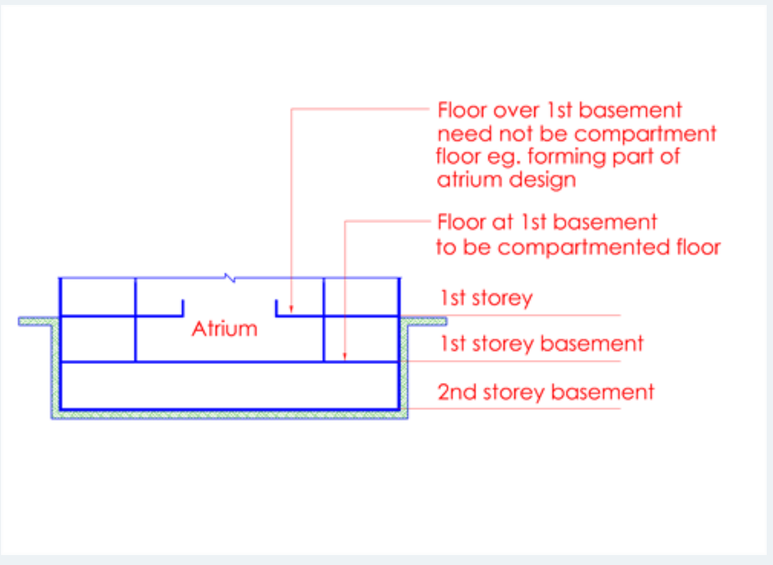


Figure 3.2.5c.(2) - 4 : Floor over basement

For buildings under PG IV, V and VII, the first basement floor can be inter-connected with the upper storeys regardless of whether or not it exceeds 100m^2, provided sprinkler system and smoke control system are provided. For atrium design, prior consent from the SCDF should be obtained before making Building Plan submission. See *Cl.3.2.4a.*.

Cl.3.2.5d. prohibits more than one basement floor to be connected to form one compartment, except in the case of basement used solely for car parking.

d. Basement floors

In any compartment below pavement level, no compartment shall comprise more than one storey, except in the case of PG IV, V and VII buildings as permitted under *Cl.3.2.5c.(2)* and in the case of basement used solely for car parking. No part of a basement storey shall be used for the bulk storage of highly inflammable liquids or substances of an explosive nature.

Explanation and Illustrations

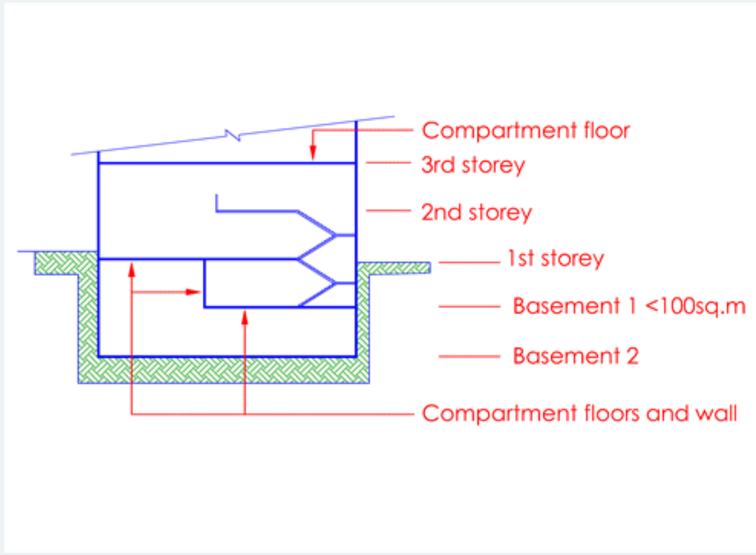


Figure 3.2.5d. - 1

Basement 1, which has a floor area of less than 100m² can be interconnected with 1st storey, provided it is compartmented from basement 2. Sprinkler system and rising mains are required to be provided to the building.

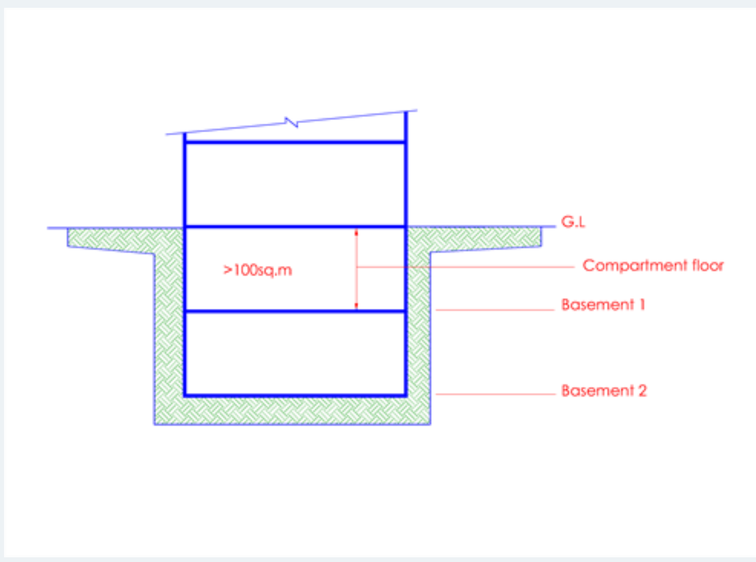


Figure 3.2.5d. - 2

Basement 1 having a floor area of more than 100m² is required to be compartmented from 1st storey. The above clause does not permit more than one basement storey per compartment unless solely used for car parking. Sprinkler system and rising main are required to be provided to basement.

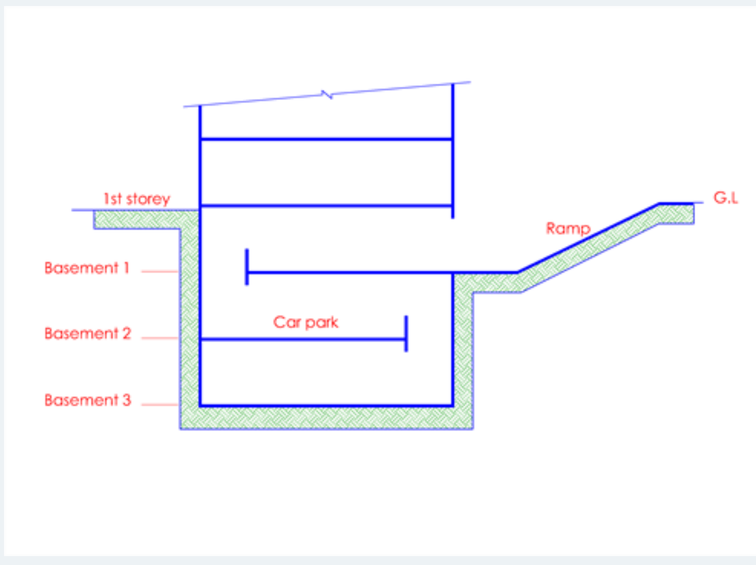


Figure 3.2.5d. - 3

Owing to the special use where ramps or car lifts are needed to connect all the floors, compartmentation is relaxed where sprinkler system and rising main are provided.

e. Fire Command Centre (FCC)

The FCC shall be separated from other parts of the same building by compartment walls and floors having at least 2-hr fire resistance rating.

Explanation and Illustrations

(No illustration)

The fire resistance rating of the walls and floors shall comply with the elements of structure and shall have minimum period of 2 hours. Any door opening into the Fire Command Centre from the occupancy area shall be minimum 2-hr fire-rated.

f. Kitchen

In room/ space where open-flame cooking activities are carried out, except for residential units in PG I and II buildings, the following requirements shall be complied with:

(1) The kitchen shall be separated from other parts of the same building by compartment wall and floor having at least 1-hr fire resistance rating. Separation requirement for kitchen can be exempted under the following conditions:

Rationale

The conditions for exemption of compartmentation for open-flame cooking area ensure that smoke could be readily dispersed via the openings to the external and fire can be contained within the cooking area so as not to affect the escape of occupants.

Explanation and Illustrations

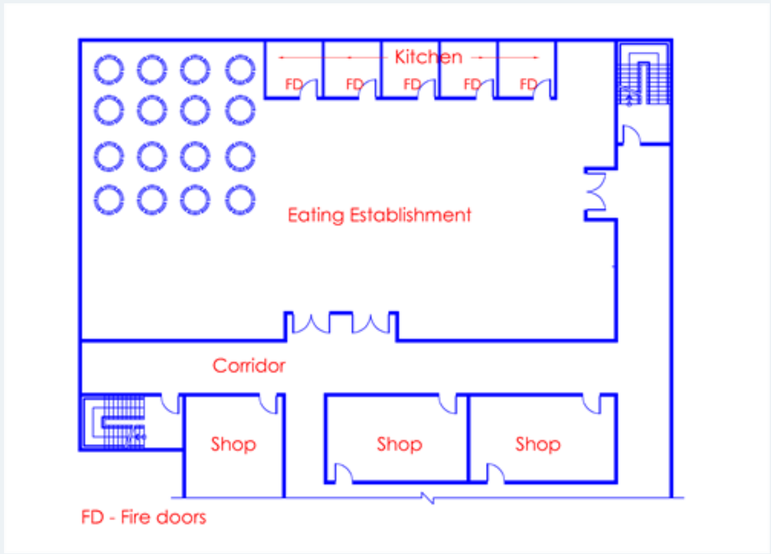


Figure 3.2.5f.(1) to (3) - 1

The above figure illustrates a eating establishment without kitchen fire-suppression system. The clause enables the QP to exercise the option of compartmenting kitchen with open-flame cooking.

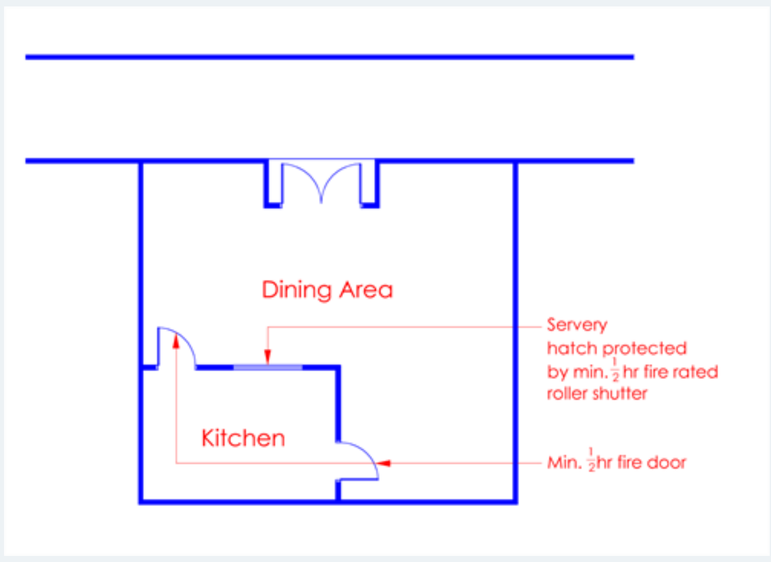
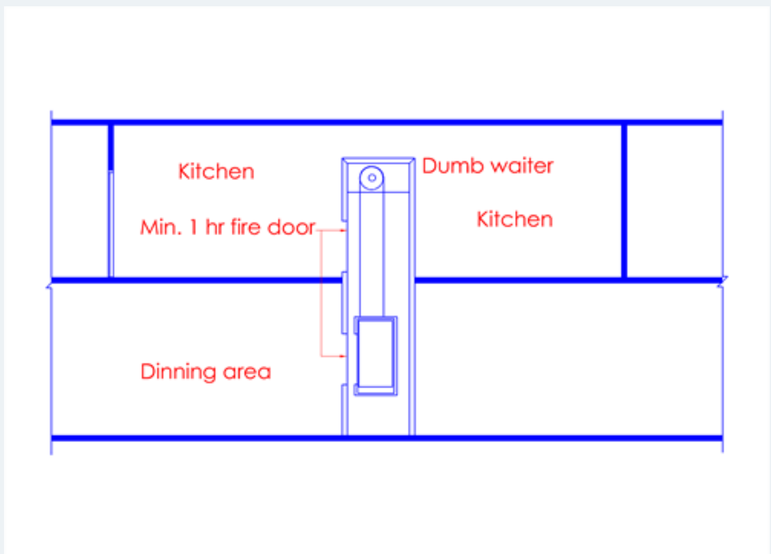


Figure 3.2.5f.(1) to (3) - 2

Kitchen is compartmented from dining area by 1-hr enclosures and ½-hr fire doors. Protection to servery hatch can be a fire-rated roller shutter held in the open position by fusible links.



Section

Figure 3.2.5f.(1) to (3) - 3

As the dumb waiter is connecting 2 storeys, it shall be enclosed in 2-hr protective enclosures with 1-hr fire-rated access door at each storey.

(a) when all the cooking facilities in the kitchen are fitted with approved extinguishing systems, or

Explanation and Illustrations

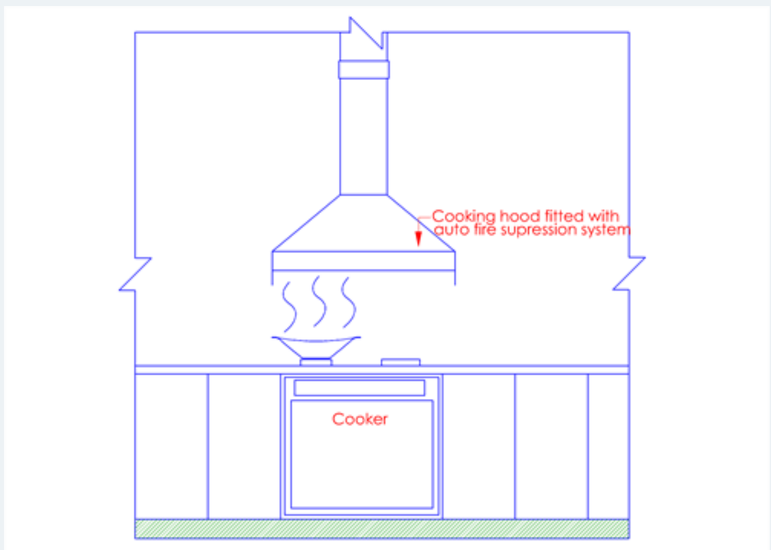


Figure 3.2.5f.(1)(a)

The above sub clause allows the kitchen not to be compartmented if the cooking hood or range is installed with an automatic fire suppression system. Automatic fire suppression system shall be of approved type based on international standards such as NFPA 17A. QPs are also reminded to ensure that the premise owners/ operators are aware of the stipulated maintenance regime in the standards.

With this arrangement, there is no need to seek waiver approval from the SCDF.

(b) when there are at least 25% of the perimeter walls (excluding air well and void) of an eating establishment open directly to the external of the building, and provided any part of the floor space is within 9m from the nearest opening, or

Explanation and Illustrations

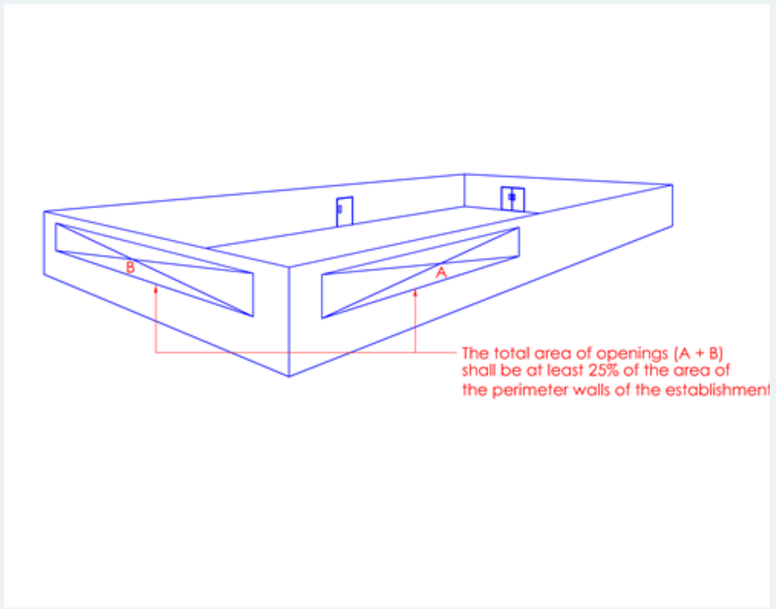


Figure 3.2.5f.(1)(b) – 1

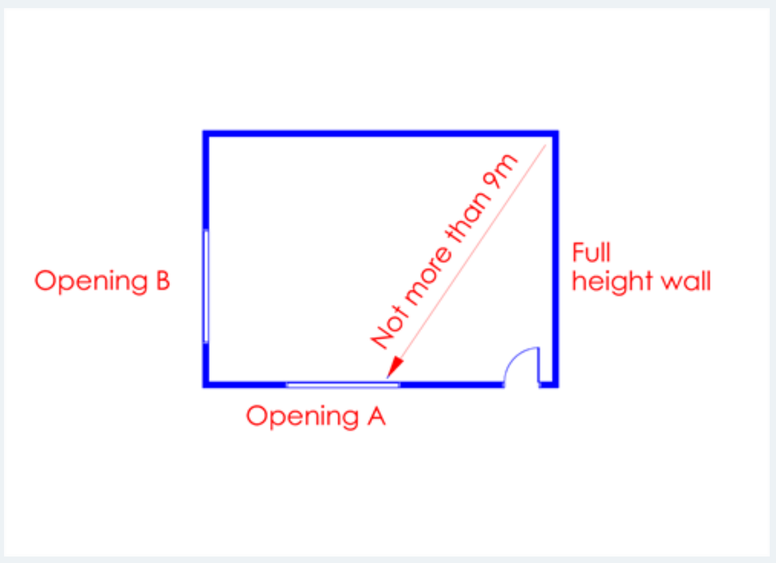


Figure 3.2.5f.(1)(b) – 2

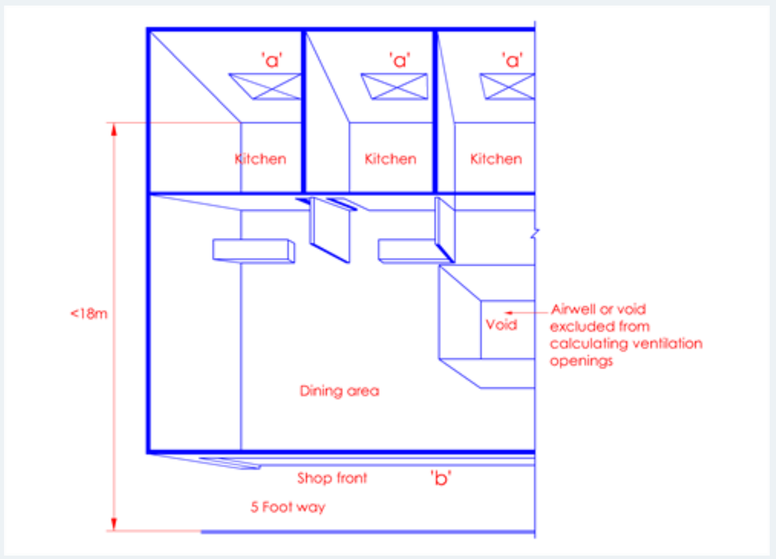


Figure 3.2.5f.(1)(b) – 3

(c) when there are at least 50% of the perimeter walls (excluding air well and void) of an eating establishment open directly to the external of the building, and provided any part of the floor space is within 12m from the nearest opening, or

Explanation and Illustrations

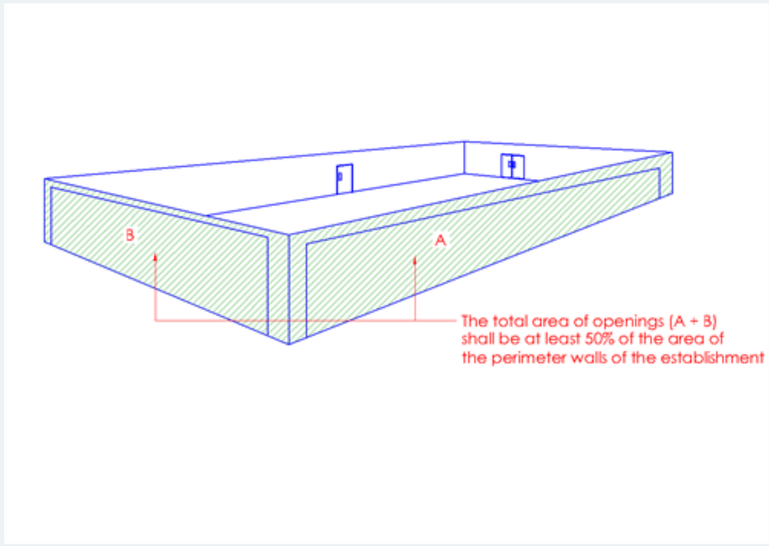


Figure 3.2.5f.(1)(c) – 1

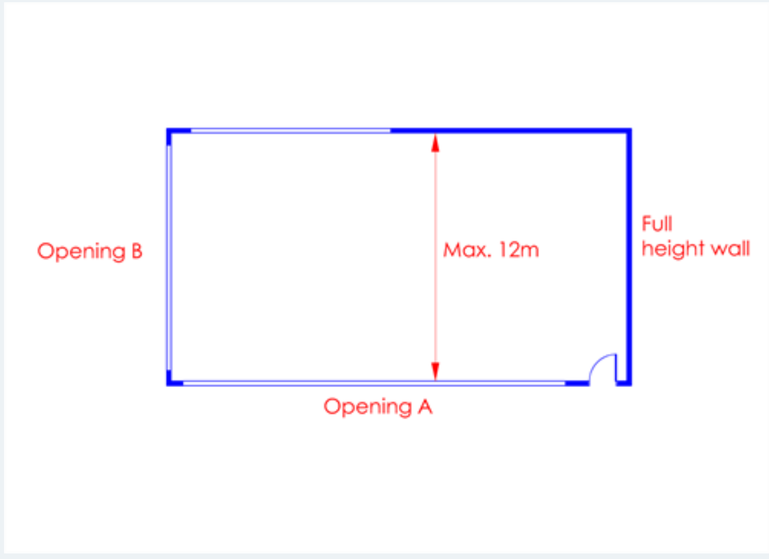


Figure 3.2.5f.(1)(c) – 2

The 25% and 50% ventilation openings are required for smoke venting and relief of accumulated heat from the area on fire. This exemption cannot be applied in an enclosed air-conditioned environment, where the peripheral walls are fitted with glass panel.

The 25% and 50% ventilation openings are absolute values. Extrapolation of percentage ventilation openings based on depth of the eating establishment is not permitted.

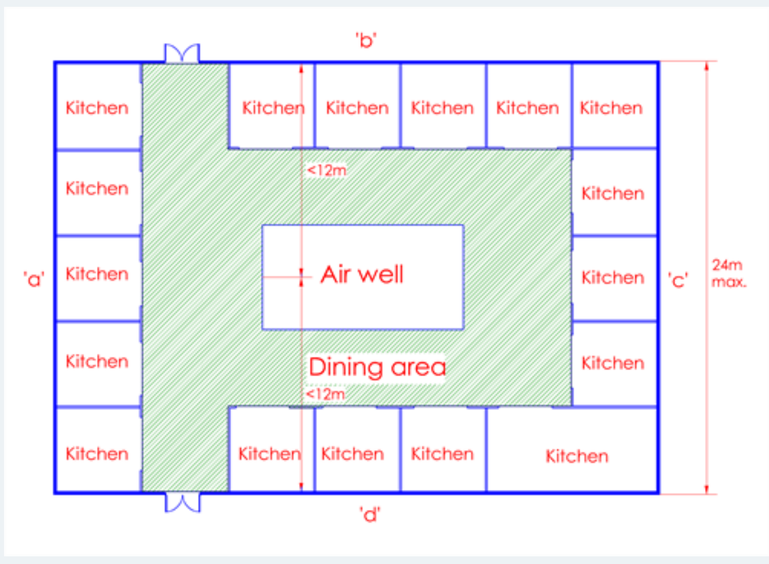


Figure 3.2.5f.(1)(c) – 3

In the above figure the kitchens are not required to be compartmented.

Ventilation openings along the external walls ‘a’, ‘b’, ‘c’ and ‘d’ shall be uninterrupted, having minimum 50% of the perimeter walls of the eating establishment. The openings to the air well shall not be included in this purpose.

The above requirement is more relevant to hawker centre type design.

(d) when an eating establishment is separated from other parts of the same building by walls and floors having 1-hr fire resistance rating and doors having at least ½-hr fire resistance rating; and provided:

(i) for a sprinkler-protected building, there is no restriction to the floor area of the compartment, or

(ii) for a non-sprinkler-protected building, the floor area of the compartment shall not exceed 150m^2.

(2) Openings in the compartment wall and floor shall comply with the relevant provisions of Cl.3.9 for protection of openings.

(3) Doors shall have at least ½-hr fire resistance rating and be fitted with an automatic self-closing device.

Explanation and Illustrations

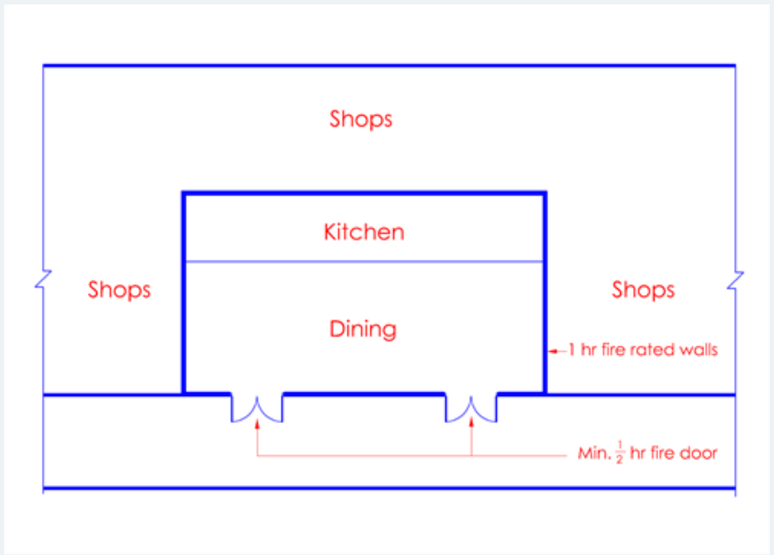


Figure 3.2.5f.(1)(d) - 1

Under *Cl.3.2.5f.(1)(d)(i)*, the kitchen and dining area can be in one compartment, provided the building is sprinkler-protected and there is no need restricting to the floor area of the compartment

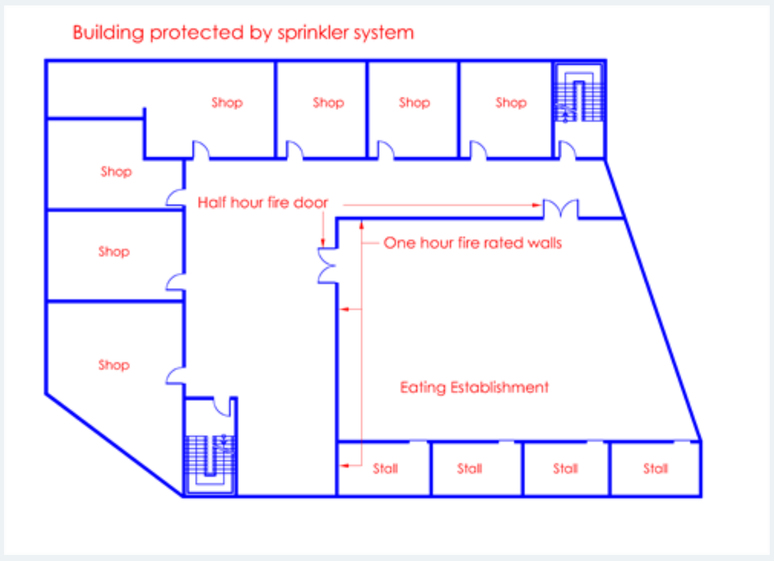


Figure 3.2.5f.(1)(d) - 2

With the provision of sprinkler system, further relaxation is allowed to permit the whole eating establishment to be enclosed with at least 1-hr fire-rated walls and ½-hr fire-rated door. There is no restriction to the accessible floor area of the eating establishments.

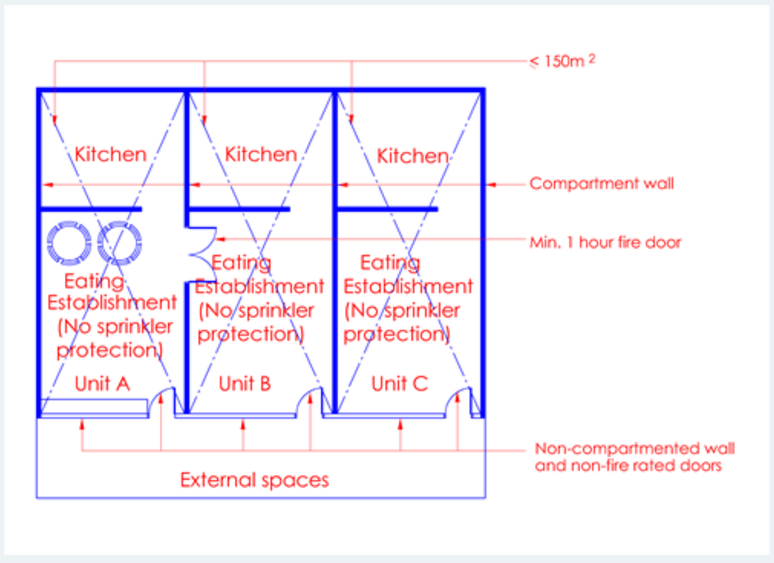


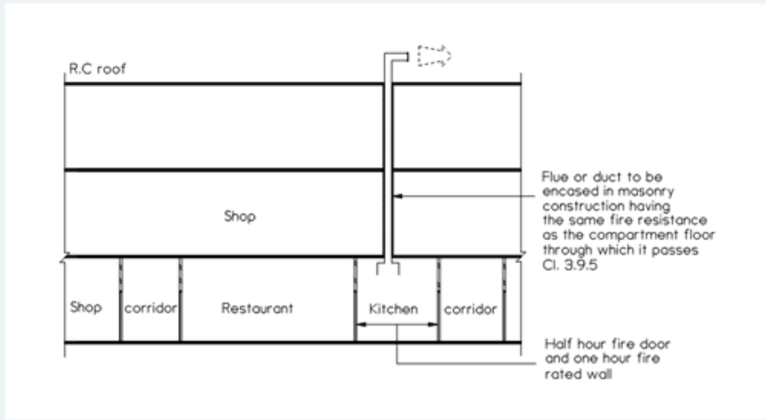
Figure 3.2.5f.(1)(d) - 3

Under *Cl.3.2.5f.(1)(d)(ii)*, where the building is not sprinkler-protected, the area of the compartment, kitchen and dining area e.g. (unit A) shall not exceed 150m^2.

(4) Where the flue or duct passes through the compartment wall or floor, the flue or duct shall be encased by non-combustible construction to comply with the requirements of Cl.3.9.5, and the installation of dampers in such flue or duct is prohibited.

(5) LPG cylinders provided for open-flame cooking activities shall not be located at the basement and the installation of LPG cylinders at other areas shall comply with the provisions in the Fire Safety (Petroleum) Regulations.

Explanation and Illustrations



Section

Figure 3.2.5f.(4)

Kitchen is required to be compartmented from other areas by 1-hr compartment walls and floors. Doors to the kitchen shall have minimum ½-hr fire resistance rating and shall open outward from the kitchen. Small fires which commonly occur in the kitchen are often caused by overheating of cooking oil on the stove or in a deep pan fryer or by grill. Exhaust ducts in kitchen are usually coated with grease internally over a period of time. Fire in the ducts could be started by sparks or by fire from the stove.

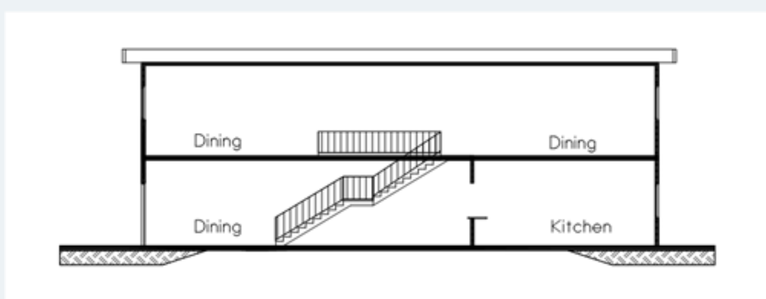
Cooking appliances include – open-flame gas fired oven, charcoal grill and appliances which have open flames located or protected from views.

Fire-rated door to kitchen shall not be wedged open for serving purpose. In circumstances where fire doors are to be kept open, the door shall be fitted with electromechanical device susceptible to smoke under *Cl.3.9.2c.*. See Cl.1.4.34 for further illustration.

To qualify for non-provision of fire compartment under *Cl.3.2.5f.(1)*, auto fire suppression equipment should be incorporated into the cooking range. This equipment may consist of fixed pipe carbon dioxide, dry chemical or foam- water sprinkler or spray system. Such auto suppression system to the cooking range shall be listed and approved by a certification body.

Notwithstanding all the above, the compartment where open-flame cooking activities is carried out shall not comprise more than one storey.

Explanation and Illustrations



Section

Figure 3.2.5f.

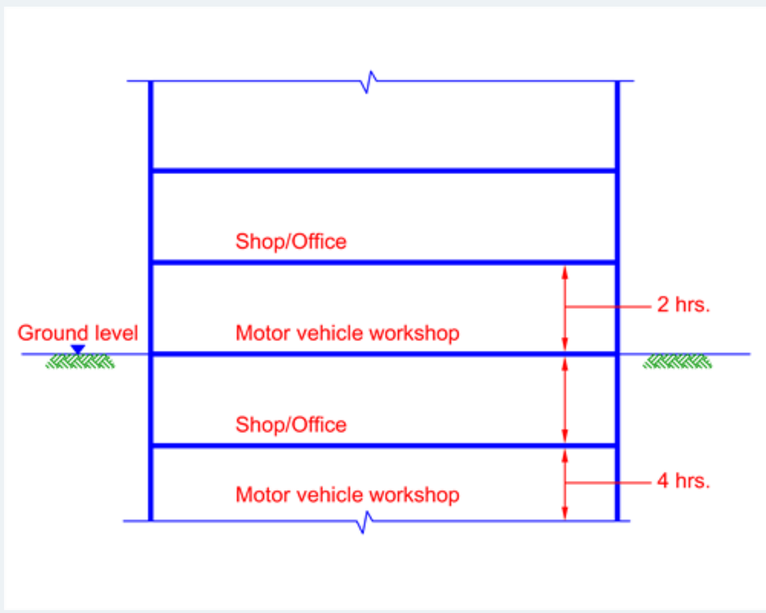
Where 'open-flame' cooking is used, the compartment comprising dining and kitchen areas shall not comprise more than one storey.

In the case of eating establishment which comprises 2 storeys, then each storey shall be a fire compartment by itself.

g. Motor vehicle workshop

A motor vehicle workshop shall be separated from any other part of the same building by compartment walls and floors having at least 2-hr fire resistance rating, and if located in a basement storey of a building, shall be separated from any other part of the same building by compartment walls and floors having at least 4-hr fire resistance rating.

Explanation and Illustrations



Section

Figure 3.2.5g.

h. Spray painting room

Areas in which spray painting or other related processes are performed or carried out, shall be separated from other parts of the same building by compartment walls and floors having at least 2-hr fire resistance rating. Where spray painting booths that have built-in vapour extraction system complying with NFPA 33, the fire resistance requirement is not applicable.

Where a spray painting room or booth is protected by an automatic sprinkler system but not complying with *NFPA 33*, the fire resistance rating for the fire compartment to the room or booth can be reduced from 2-hr to 1-hr.

Explanation and Illustrations

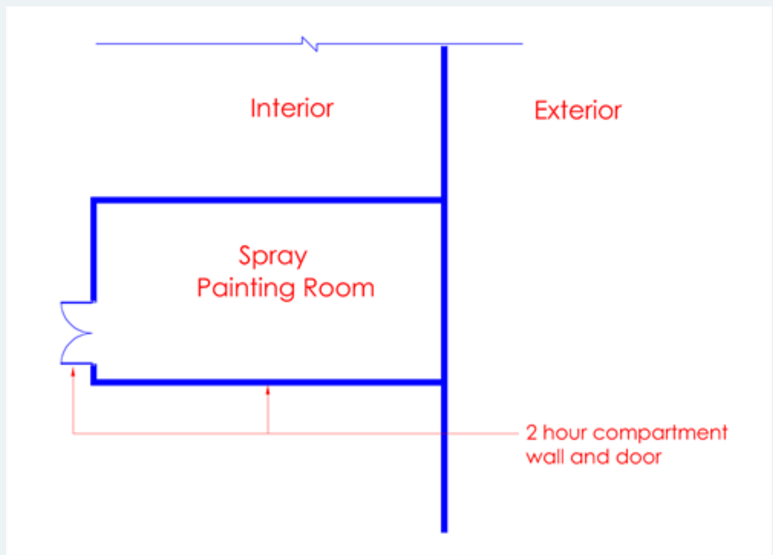


Figure 3.2.5h.

Spray painting booth or room shall be mechanically ventilated and enclosed in min. 2-hr fire-rated compartment to allow spraying of paint to be carried out. It shall be constructed to prevent the escape of spray and flammable vapour which shall be removed by the exhaust system.

The exhaust discharge point shall be not less than 5m from the inlet of any mechanical ventilation system.

i. Store room

For non-sprinkler-protected buildings, if the area of the store room exceeds 10m², it shall be compartmented from the other parts of the same building by compartment walls and floors having at least 1-hr fire resistance rating. No fire compartmentation is required for a store room which is housed within a sprinkler-protected building. However, store room exceeding 700m^2 and 100m^2 for above-ground and below-ground respectively are subject to the compartment size requirements stipulated under Cl.9.8.3.

Explanation and Illustrations

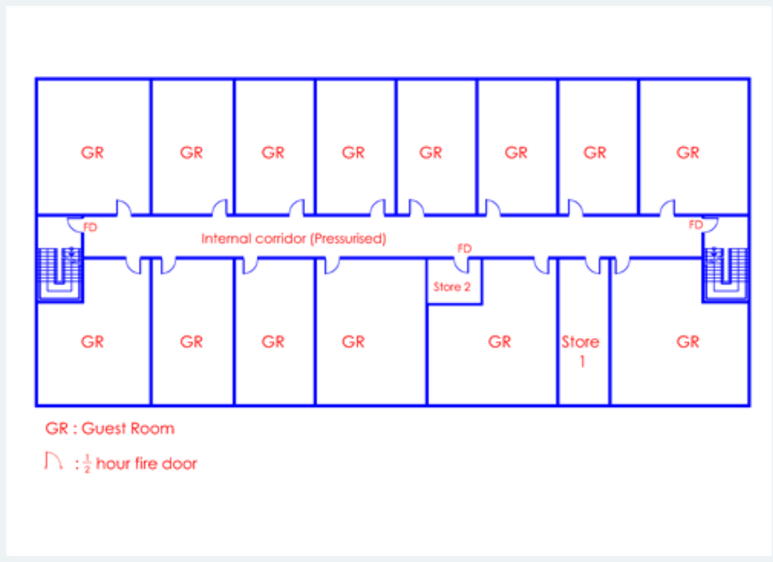


Figure 3.2.5i.

Store 1 exceeding 10m² inside a Hotel space will need to be compartmentalised with 1- hour fire rated enclosures.

Store 2 which is less than 10m² still required to be provided with fire door as the store opens into internal corridor, which is pressurised.

The main reason for compartmentation of storeroom is to prevent undetected fire in the storeroom from developing into a big fire.

Compactus

Compactus room which is more than 10m² shall be treated as a compartment under the above sub-clause. The enclosing walls/floor/ceiling/door shall have min. 1-hr fire resistance rating. Irrespective of the location of the compactus storage area, if it is not enclosed in a room, it shall be treated as open storage shelves and not as a store. The main reason is that a fire occurring in a room could be unnoticed, until it becomes too big to be put out by first aid firefighting equipment. An incipient fire occurring in an unenclosed compactus storage area could be easily spotted by occupants and immediate reaction could be taken to put out the fire.

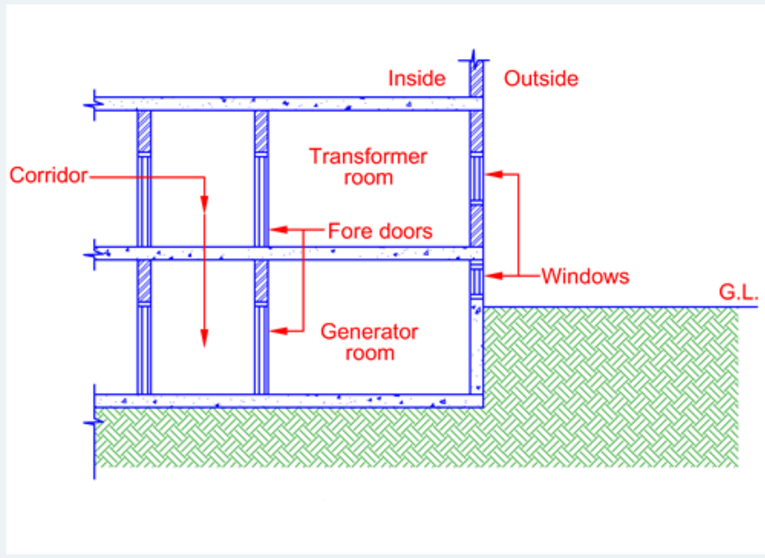
Any store, regardless of its size, shall be compartmented under the above sub-clause if it opens directly into exit passageways and designated protected escape routes, e.g. smoke-stop lobbies, protected staircases.

j. Areas of special hazard

(1) Areas of special high risk in a building

Boiler rooms, transformer rooms, generator rooms, storage areas of materials that are highly combustible or flammable, and any other areas of special high risk shall be separated from other parts of the building by compartment walls and floors having at least 2-hr fire resistance rating. If the building is protected by an automatic sprinkler system, the fire resistance rating of the compartment walls and floors can be reduced to one hour.

Explanation and Illustrations



Section

Figure 3.2.5j.

Transformer and generator rooms that contain flammable liquids should be located against an external wall for external ventilation and explosion relief.

Transformer room

Transformers could be dry type or oil cooled type. Oil cooled type is to be located against an external wall above ground level to allow for external ventilation and explosion relief. Adequate precautions should be taken by the provision of a suitable catch pit or other means to prevent the spread of fire resulting from leakage and ignition of oil.

Generator rooms

Generator sets shall be located in clean, dry locations within fire-rated compartments. They may be placed outdoors if they are of purpose built type, provided proper separation from unprotected openings of the building is maintained. Generator rooms shall be located against an external wall above ground level to allow for external ventilation and explosion relief.

Storage areas of highly combustible or flammable materials

Where possible, oil storage tanks should be installed in open air at ground level at least 6m from adjacent buildings and in accordance with CP 40. A max. capacity of 700 litres of diesel oil is permitted to be stored in the generator room. The oil drum(s) shall be located within a bunded area, capable of containing 100% spillage from the drum(s).

Prior approval is to be obtained from the SCDF for storage of combustible or flammable liquids, other than in the generator room, before building plan submission.

(2) Room housing transformer that uses flammable liquid shall be located at ground level against an external wall.

(3) Diesel fuel tank for generator need not be located against an external wall.

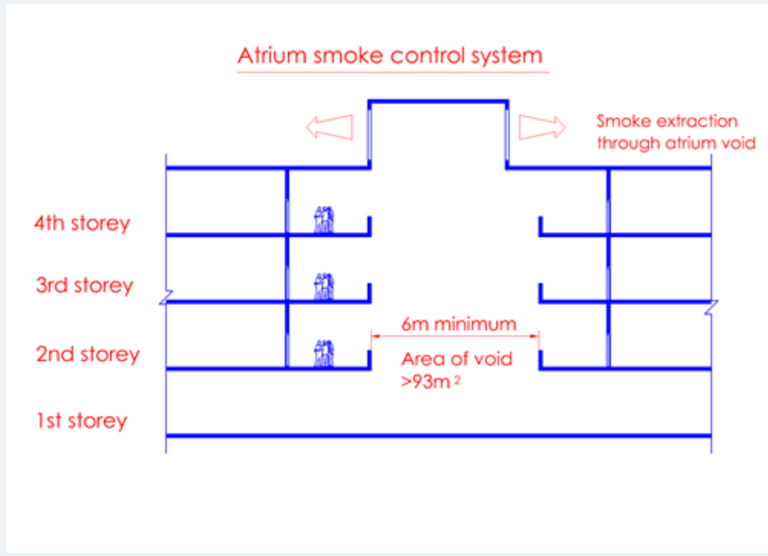
Rationale

Rooms for housing dry transformer, transformer using non-flammable liquids or generator needs not be located against an external wall.

Diesel fuel tank within a generator room is also not required to be placed against an external wall as the flash point of diesel fuel is high enough to be. non-flammable in most environments. However, it still required careful storage and safety precautions.

3.2.6 Provision for atrium spaces

Explanation and Illustrations



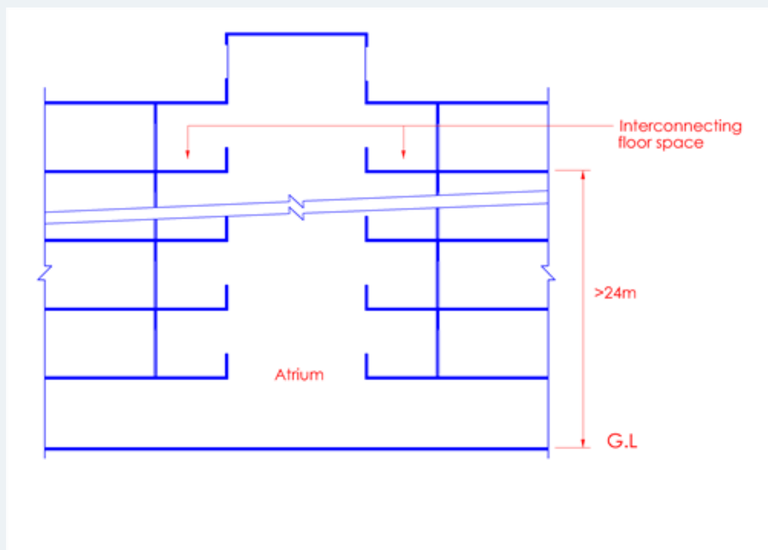
Section

Figure 3.2.6 - 1

1. The above clause allows the SCDF to vary the max. floor area/cubical extent of fire compartment to allow more than 3 storeys to be interconnected. The critical points for consideration would include the size and configuration of atrium void and the provision of sprinkler system and engineered smoke control system.

2. QPs should consult the SCDF in cases of all atrium designs before making building plan submission. The vetting will confine only to looking at the concept and the layout and profile of atrium void in the building proposal only. Calculations for the engineered smoke control system shall be submitted separately by M&E QPs.

3. Where a compartment in a building has a total floor area and cubical extent greater than that allowed under *Table 3.2A*, but the number of floor interconnected by void does not exceed 3 floors, QPs should consult the SCDF whether there is a need to provide engineered smoke control system, before making building plan submission. Similarly, if a compartment in a building has a total floor area and cubical extent greater than that allowed under *Table 3.2A* and the number of floor interconnected by void is more than 3 floors, QPs should consult the SCDF before making building plan submission. The consultation would confine to vetting of requirements mentioned in sub-clause 2. above.



Section

Figure 3.2.6 - 2

Atrium design allows multiple floors to be connected beyond 3 storeys per compartment but limit to a habitable height of 24m. The design would require the provision of engineered smoke control system and sprinkler system. The above clause allows atrium design in buildings, but prior approval from the SCDF must be obtained before building plan submission can be made. See *Cl.1.4.13*.

The requirements of Cl.3.2.1, *Cl.3.2.4a*, and *Cl.3.2.4b* of this Code are not applicable for atrium spaces provided the following conditions are complied with:

a. The minimum plan area of the atrium void shall be not less than 93m² and no horizontal dimension between opposite edges of the floor opening is less than 6m wide.

b. The atrium space is not of high hazard occupancy as stated in Cl.1.4.68.

c. The atrium is open and unobstructed in a manner such that it can be assumed that a fire in any part of the space will be readily obvious to the occupants before it becomes a hazard.

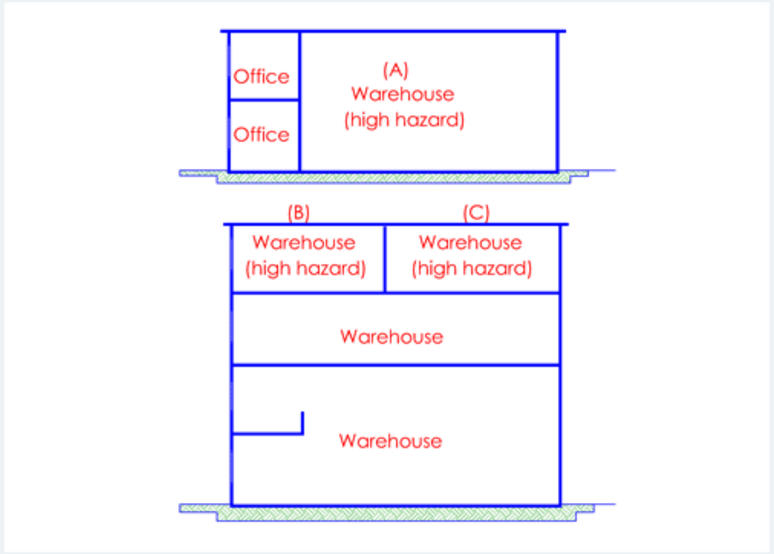
d. The building is fitted throughout with an automatic sprinkler system to comply with the requirements in Chapter 6.

e. The building is fitted with an engineered smoke control system in accordance with Cl.7.4.5.

f. Provision of openings and enclosures, and the planning of means of escape shall be subject to the approval of the SCDF.

3.2.7 Buildings of high hazard occupancy

Explanation and Illustrations



Section

Figure 3.2.7

1. Warehouse compartments A, B & C, as shown in above figure, shall not exceed 2000m² and 7500m³. Each compartment shall comprise one storey only. The materials to be stored in the warehouses shall exclude those listed under *Cl.3.2.7c.(1)* & *(2)*.

2. Buildings with habitable height not exceeding 24m are allowed to be used for bulk storage of goods or substances of highly combustible nature, except those listed under *Cl.3.2.7c.(1)* & *(2)*. However, if the above mentioned warehouse buildings exceed the habitable height of 24m, the whole building must be protected with automatic sprinkler system. Irrespective of the building height, *Cl.3.2.7a.* shall be complied with.

3. Materials as listed under *Cl.3.2.7c.(1)* & *(2)* are not allowed to be stored in any multi-storey building, regardless of the habitable height.

a. The compartment of buildings of high hazard occupancy shall not exceed one half of the sizes given in *Table 3.2A* and each compartment shall comprise one storey only.

b. No storey of a building, the habitable height of which is more than 24m, shall be used for the bulk storage of goods or substances of highly combustible nature unless the building is provided with a sprinkler system to comply with Chapter 6.

c. The type of storage materials or substances shall not include the following:

(1) materials with an auto-ignition temperature lower than 200°C; and

(2) combustible/ highly flammable materials which include those highlighted in sub-clauses *a.*, *b.*, *c.* and *d.* of *Cl.1.4.68.*

d. For buildings not listed in *Table 1.4A*, including but not limited to buildings used for the manufacture and/ or storage of highly combustible substances and/ or flammable liquids, etc., the requirements shall be consulted with the SCDF.

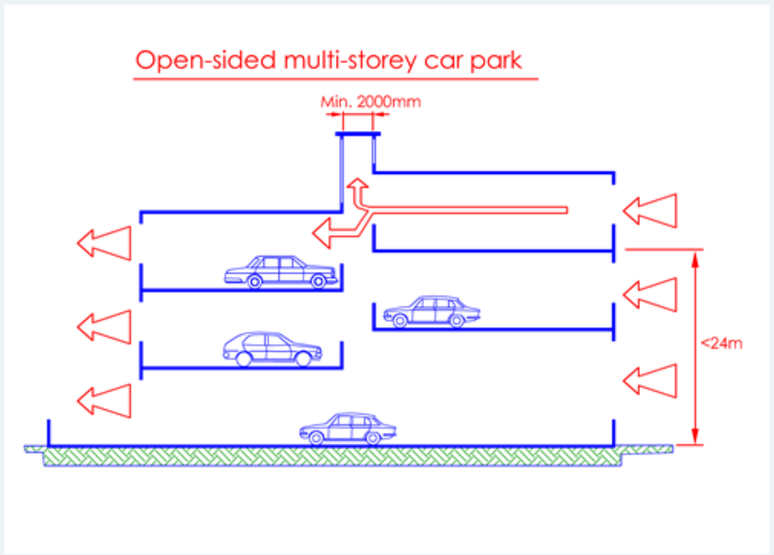
3.2.8 Exemption on size limitation of compartment

Rationale

The minimum ventilation requirements stipulated for open-sided carpark are to ensure effective cross ventilation so as to minimise smoke logging in the event of a fire in the car park. The dimensions have been validated through a fire engineering study.

With effective ventilation, the compartment size limitation for a non-sprinkler protected car park can be exempted.

Explanation and Illustrations

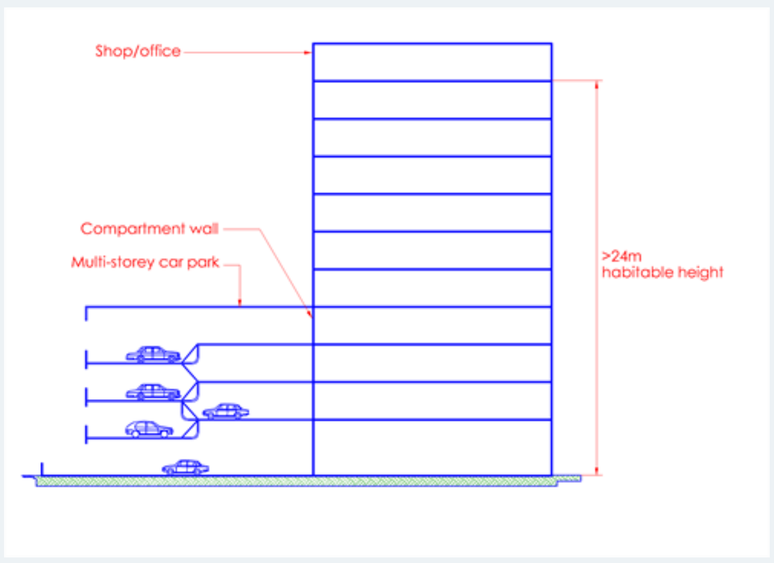


Section

Figure 3.2.8 - 1

As the habitable height is less than 24m, automatic sprinkler system is not required. The clear width of the air well shall not be less than 2000mm to prevent fire from a car from spreading vertically between split levels. Provision of fire alarm system shall be in accordance with *Table 6.3A* of the Fire Code.

Openings such as grille, fixed louvre types are considered acceptable. In determining the openings for the grille, obstacle should be deducted to obtain the nett openings. As for fixed louvres, only free area should be taking into account. Provision of sliding windows is not acceptable. The minimum 50% openings in the external walls shall be permanently open and such openings shall be evenly distributed to provide cross ventilation so as to prevent smoke logging.



Section

Figure 3.2.8 - 2

Situation 1 – Car park is integrated with office/shop building

The attached multi-storey car park is required to be protected by sprinkler system. *Cl.3.2.8a.* would not apply as there is free access between car park area and the shop/office floor area. There could be sharing of common escape staircases by occupants in the car park area and the shop/office floor area.

Situation 2 – Attached multi-storey car park is an independent building

Attached multi-storey car park would qualify for exemption on size limitation of compartment under *Cl.3.2.8a.*, provided there is no access opening in the continuous vertical compartment wall that separates car park building from shop/office building and no sharing of escape staircases. Each building is self-sufficient in its provision of means of escape. Multi-storey car park shall comply fully with *Cl.3.2.8a.* on the provision of permanent ventilation openings for cross-ventilation.

The requirements of Cl.3.2.1 for car parking decks can be exempted if both the following are complied with:

a. The car parking decks shall be open-sided with not less than 50% of the sides permanently open and unobstructed. Such openings shall be evenly distributed along each of the perimeter walls and on every individual floor/deck, excluding perimeter walls to air well, so as to provide cross ventilation to all parts of the car parking decks.

b. No part of the floor space shall be more than 12m from the openings on the perimeter walls of the building or air well. Air well where provided for this purpose shall have a superficial plan area of not less than 10m², or 0.1m² for every 300mm of height, whichever is greater, and have a minimum dimension on plan of 2m, open vertically to the sky for its full height.

3.2.9 Separation of area undergoing addition & alteration works

Explanation and Illustrations

(No illustration)

For the benefit of clarification, the Code has introduced this clause to clarify that the separation material for spaces undergoing additions and other occupied spaces need not be fire-rated construction. Instead, non-combustible partition used for separation between the undergoing A&A works and other occupied areas shall suffice.

For additions and alterations to existing buildings, the areas undergoing such works shall be separated from other occupied areas of the building in accordance with Cl.3.15.16.

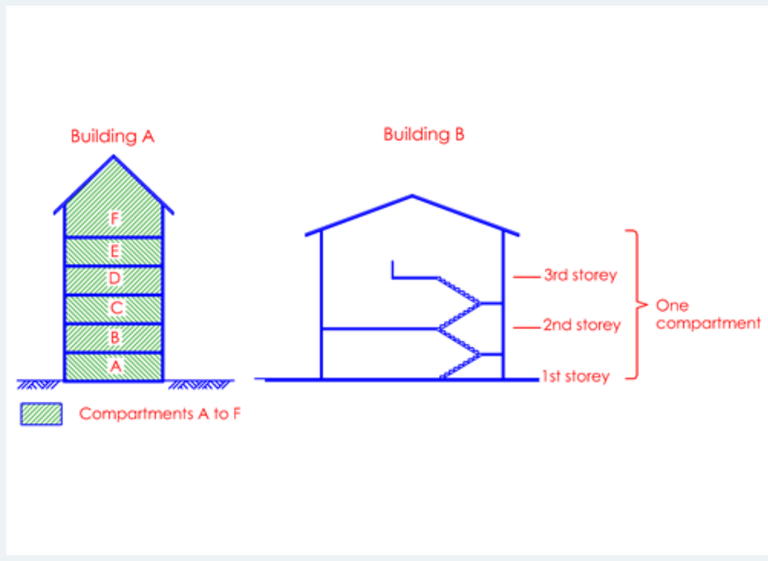
CLAUSE 3.3 FIRE RESISTANCE OF ELEMENTS OF STRUCTURE

3.3.1 Interpretation and application

The interpretation and application of Cl.3.3 shall be as follows:

a. Subject to the provisions of *Cl.3.3.1b.* and any other expressed provision to the contrary, any reference to a building of which an element of structure forms a part means the building or (if the building is divided into compartments) any compartment of the building, for which the element forms a part.

Explanation and Illustrations



Section

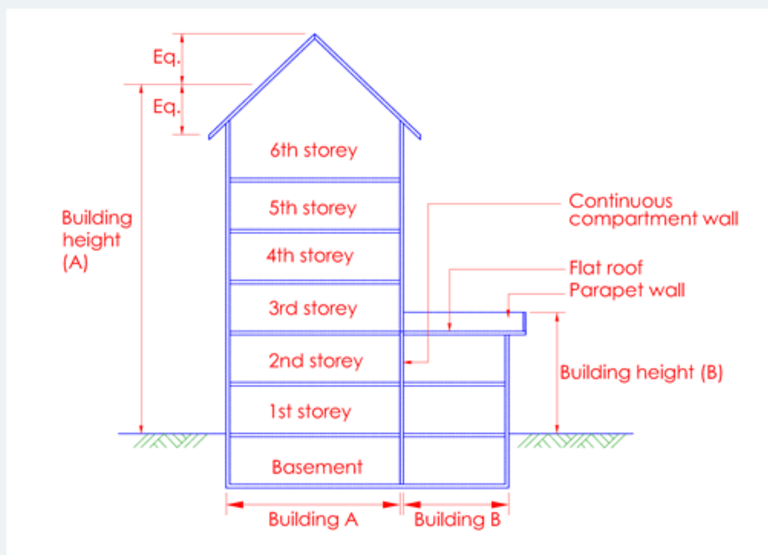
Figure 3.3.1a.

Any reference to a building, which is divided into compartments, of which an element of structure forms a part, means that compartment of the building (Building A).

Any reference to a building of which an element of structure forms a part means the building (Building B). It is important to note that any element carrying another element of structure must have at least the same fire resistance as the element it is supporting.

b. Any reference to height means the height of a building, but if any part of the building is completely separated throughout its height both above and below ground from all other parts by a compartment wall or compartment walls in the same continuous vertical plane, any reference to height in relation to that part means the height solely of that part.

Explanation and Illustrations



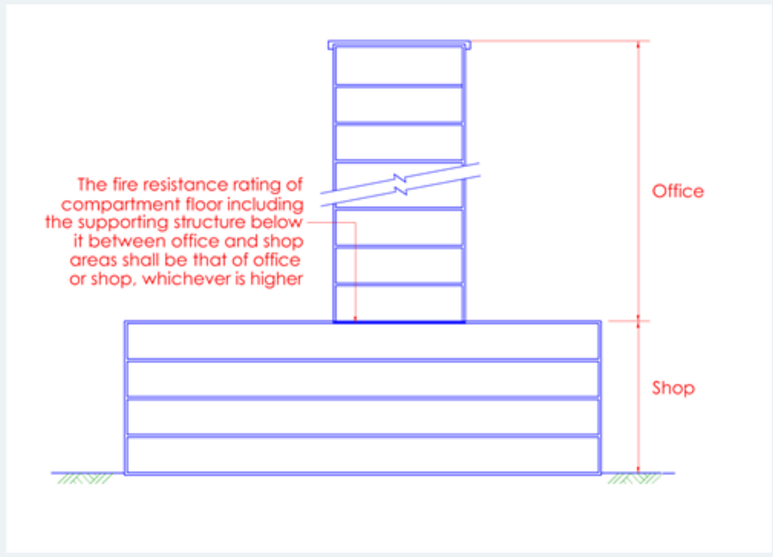
Section

Figure 3.3.1b.

The continuous vertical compartment wall divides the building into 2 parts. For building A, any reference to height means the building height (A). For building B, any reference to height means the building height (B).

c. If any element of structure forms part of more than one building or compartment and the requirements of fire resistance specified in *Table 3.3A*, in respect of one building or compartment, and differs from those specified in respect of any other building or compartment of which the element forms a part, such element shall be so constructed as to comply with the greater or greatest of the requirements specified.

Explanation and Illustrations

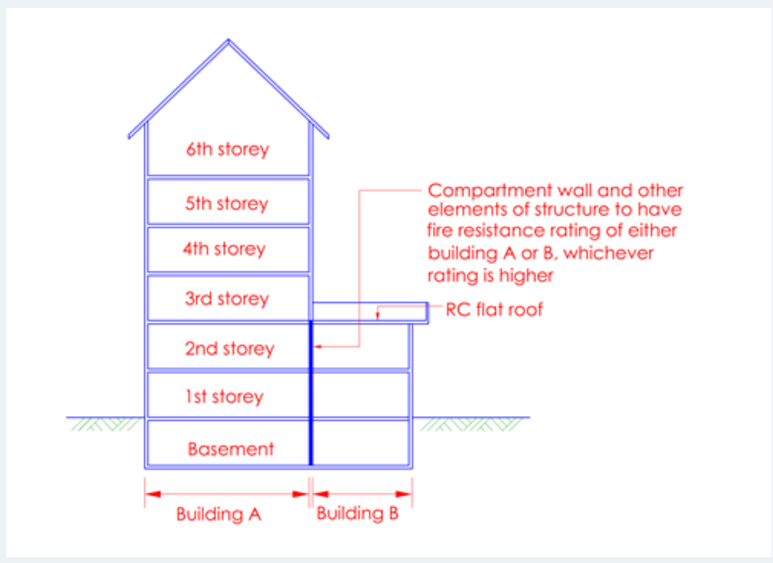


Section

Figure 3.3.1c. - 1

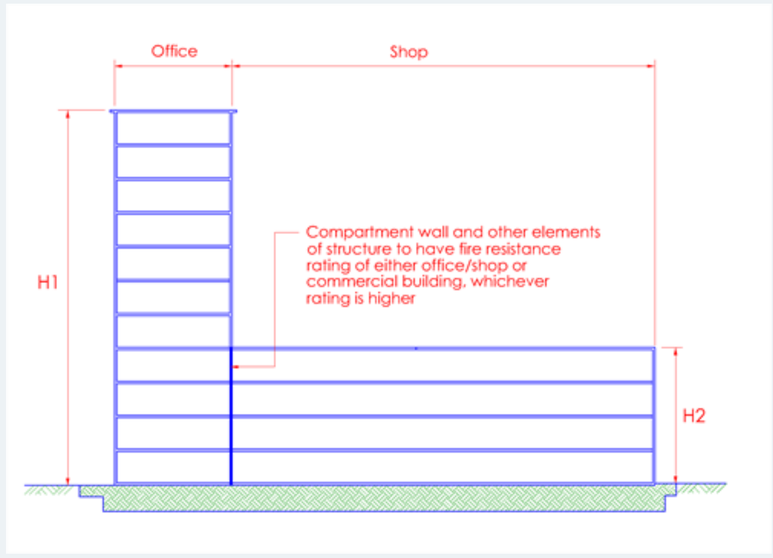
The diagram above shows a shopping podium and an office tower. The fire resistance of the elements of structure at the interface between the podium and tower shall be the higher of the two purpose groups (shops or offices).

The elements of structure referred to include compartment floor and also the columns going through the podium to support the structural frame of the office tower.



Section

Figure 3.3.1c. - 2



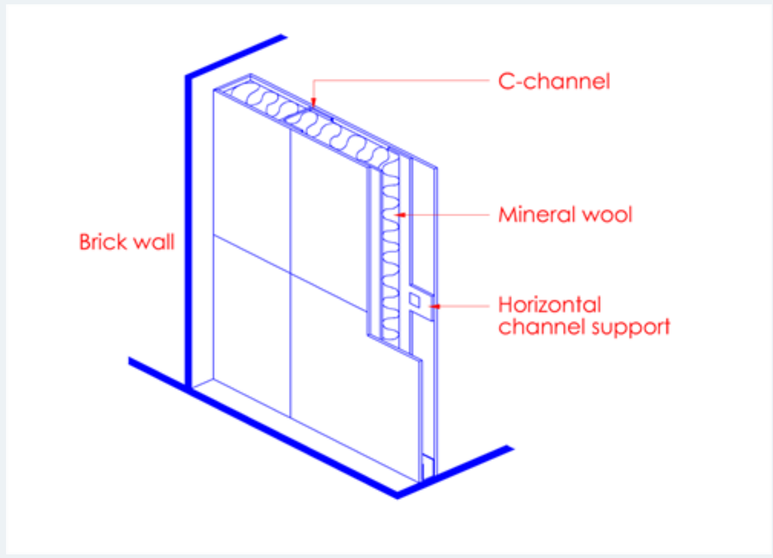
Section

Figure 3.3.1c. - 3

In the above figures, the continuous vertical compartment wall forms part of more than one building or compartment. The compartment wall shall be constructed to have higher fire resistance rating of the two buildings or compartments.

d. If any element of structure is required to be of non-combustible construction, the measure of fire resistance rating shall be determined by the part which is constructed wholly of non-combustible materials. (With the exception of fire protecting suspended ceilings, surface materials for walls and ceilings and floor finishes can be combustible, if they are not relied on to contribute to the fire resistance of the wall or floor).

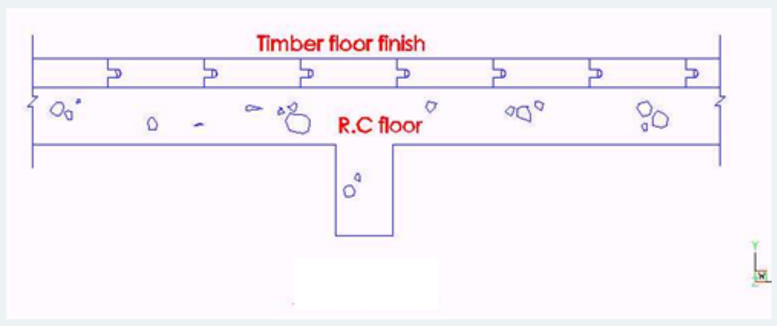
Explanation and Illustrations



Axonometric Section

Figure 3.3.1d. - 1

The above figure shows the construction of a non-load-bearing fire-rated compartment wall. If the C-channel or horizontal channel supports are replaced with timber members, the construction would not meet the requirement of the above subclause, as timber members are combustible. However, combustible finish if added to the surface of the wall would be considered as acceptable, provided it complies with Cl.3.13.



Section

Figure 3.3.1d. - 2

The above figure shows the addition of timber floor finish to the R.C floor. The combustible floor finish is not to be considered as contributing to the fire resistance of the floor.

For fire protection to suspended ceilings see Cl.3.3.5. The above clause is also not applicable to buildings under preservation or conservation where structural timber members are required to be retained. See also *Cl.9.1.1b.* and Cl.9.9.1.

3.3.2 Minimum periods of fire resistance

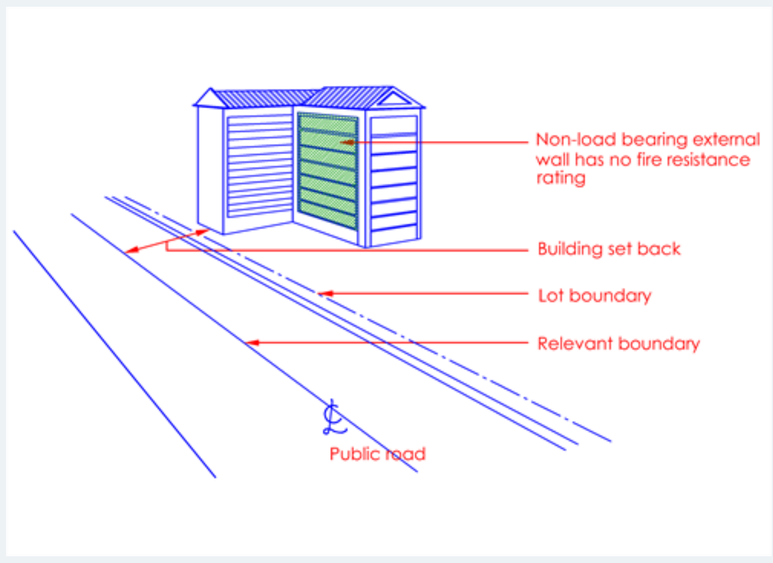
Subject to any expressed provision to the contrary, any element of structure shall be constructed of non-combustible materials and is required to have fire resistance for not less than the relevant period specified in *Table 3.3A*, with regards to the purpose group of the building of which it forms a part and the dimensions specified in that table, provided that:

a. any separating wall shall have at least 1-hr fire resistance rating; and

b. any compartment wall or compartment floor which separates a part of a PG II or III buildings, from any other part of the building of a purpose group other than PG II or III shall have at least 1-hr fire resistance rating.

3.3.3 Exemption for non-load-bearing external walls

Explanation and Illustrations



Axonometric view

Figure 3.3.3

Any part of a non-load-bearing external wall which constitute the unprotected opening in pursuance to Cl.3.5, is not required to have any fire resistance. In the above diagram, the non-load-bearing external wall facing the public road need not have fire resistance as it meets Cl.3.5 on set-back requirement, measured from the centre of the public road to the external wall.

The requirement on fire resistance in Cl.3.3.2 for non-load-bearing external walls shall not apply to:

a. any part of any external wall which is non-load-bearing and can, in accordance with Cl.3.5 be an unprotected area, or

b. steel structures of a standalone car park for passenger vehicles of Class 3 and below (unladen weight not exceeding 2500kg) provided the following conditions are fulfilled:

(1) Each storey shall be provided with cross ventilation by the provision of uninterrupted openings evenly distributed around the perimeter walls, excluding perimeter walls to air well. The area of the openings shall not be less than 50% of all external walls or 15% of the footprint per storey, whichever is greater. This condition is not applicable if a sprinkler system is installed throughout the car park.

(2) No point on any storey shall be more than 12m from the external air or air well. An air well, where provided for this purpose, shall have a superficial plan area of not less than 10m², or 0.1m² for every 300mm of height, whichever is greater, and have a minimum dimension on plan of 2m, open vertically to the sky for its full height. This condition is not applicable if a sprinkler system is installed throughout the car park.

(3) All floor beams shall be designed as a composite structure with the floor slab.

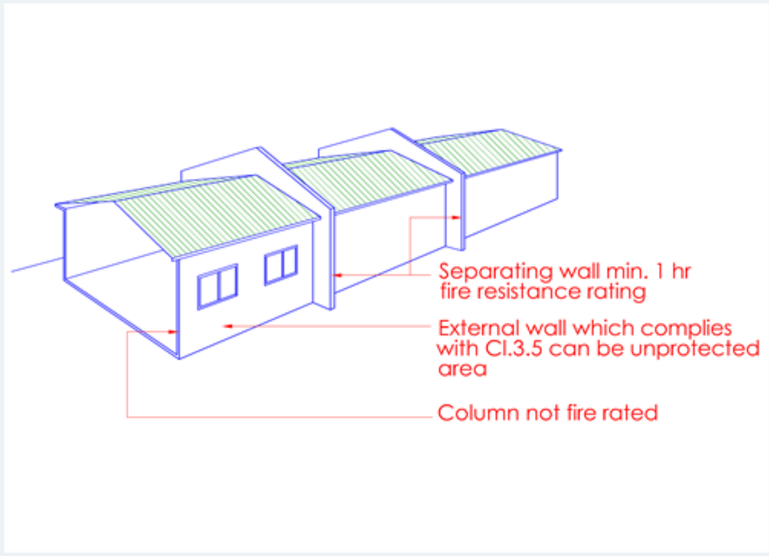
(4) The building is not more than 24m in habitable height, and there shall not be any basement storeys;

(5) No other usages, other than the electrical services that serve only the car park, are permitted;

(6) Steel structures shall meet the specifications of *SS EN 1993-1-2* and *SS EN 1994-1-2*.

3.3.4 Exemption for single storey buildings

Explanation and Illustrations



Axonometric Section

Figure 3.3.4 : Single-storey building with or without basement

Exemption for Single Storey Buildings

Irrespective of floor area, the minimum period of fire resistance rating for elements of structures is 1 hour. However, Cl.3.3.4 of the current Fire Code provides exemption for single storey buildings which need not comply with 1 hour fire resistance rating for the structural frame or beam or column subject to:

a. the beams or columns are not supporting a wall or gallery;

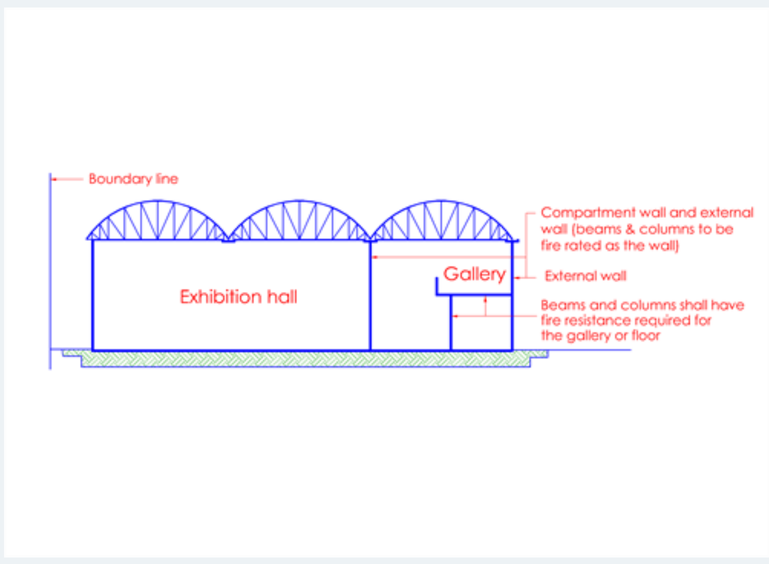
b. the beams or columns are not forming part of the separating wall between houses;

c. the external walls including the supporting beams or columns which are not supporting a gallery or in accordance with Cl.3.5 be an unprotected area.

In the case of a single storey building or a building consisting of a first storey and one or more basement storeys, the requirement on fire resistance in Cl.3.3.2 shall not apply to any element of structure which forms part of the first storey and consists of:

a. a structural frame or a beam or column, provided that any beam or column (whether or not it forms part of a structural frame) which is within or forms part of a wall, and any column which gives support to a wall or gallery, shall have fire resistance of not less than the minimum period, if any, required by this Code for that wall or gallery, or

Explanation and Illustrations



Section

Figure 3.3.4a.

The above exemption applies to all single storey buildings. However, in cases where the floor area of the building exceeds 4000m², prior consultation with the SCDF is required.

a. The structural frame or beams and columns of a single storey building need not have fire resistance under Table 3.3A, unless otherwise specified by the SCDF. The QPs shall, before making building plan submission, consult the SCDF as to the need for protection of beams and columns in the following situations :

(1) Single storey factory or warehouse involving high hazard materials;

(2) Single storey factory or warehouse having an extensive footprint; and

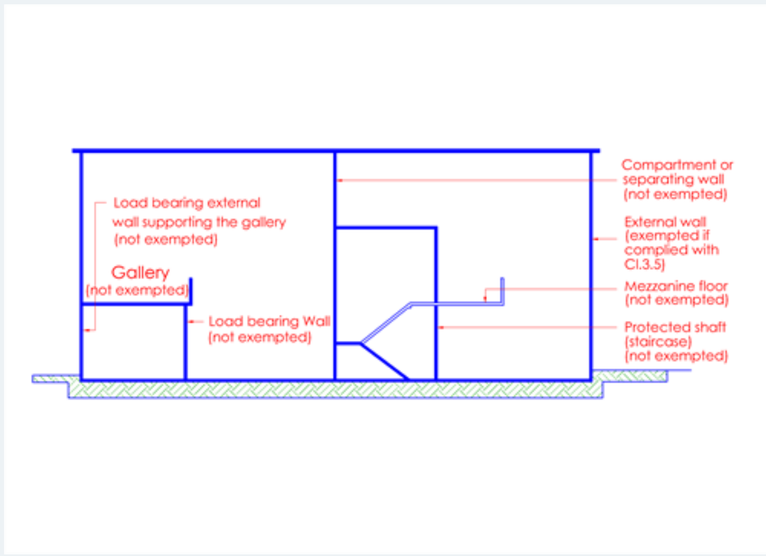
(3) Single storey warehouse exceeding a building height of 10m.

b. However, any beam or column which is within or forms part of a compartment wall, separating wall or external wall (which requires fire resistance under Cl.3.5) shall be required to have the same fire resistance rating as the wall in which such beam or column forms part of.

c. Any column or beam which gives support to a wall or gallery, shall have the same fire resistance as that required for the wall or gallery, e.g. column and beam supporting the external wall or mezzanine floor shall have the necessary fire resistance rating.

b. an internal load-bearing wall or a load-bearing part of a wall, unless that wall or part of it forms part of a compartment wall or a separating wall, or forms part of the structure enclosing a protected shaft or supports a gallery, or

Explanation and Illustrations



Section

Figure 3.3.4b.

An internal load-bearing wall or a load-bearing part of a wall is not required to have fire resistance under *Table 3.3A*, provided the wall is not:

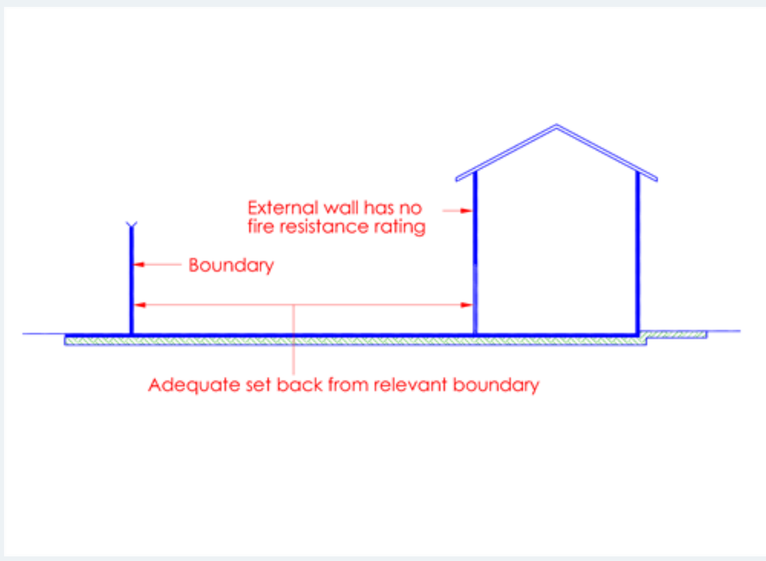
a. forming part of or a compartment or separating wall,

b. forming part of the structure enclosing a protected shaft e.g. exit staircase, or

c. supporting a gallery.

c. part of an external wall which does not support a gallery and which may, in accordance with Cl.3.5 be an unprotected area.

Explanation and Illustrations



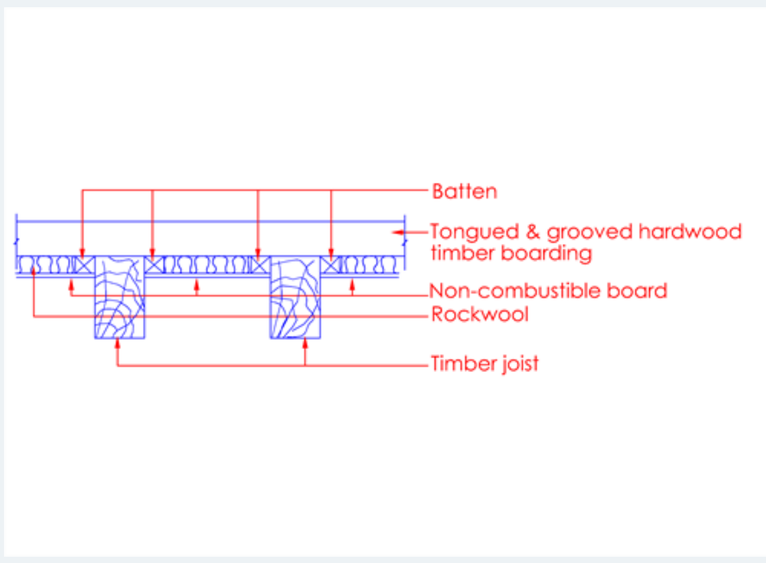
Section

Figure 3.3.4c.

External wall which does not support a gallery and has adequate setback from the boundary in accordance with Cl.3.5 to be an unprotected area need not have fire resistance under *Table 3.3A*.

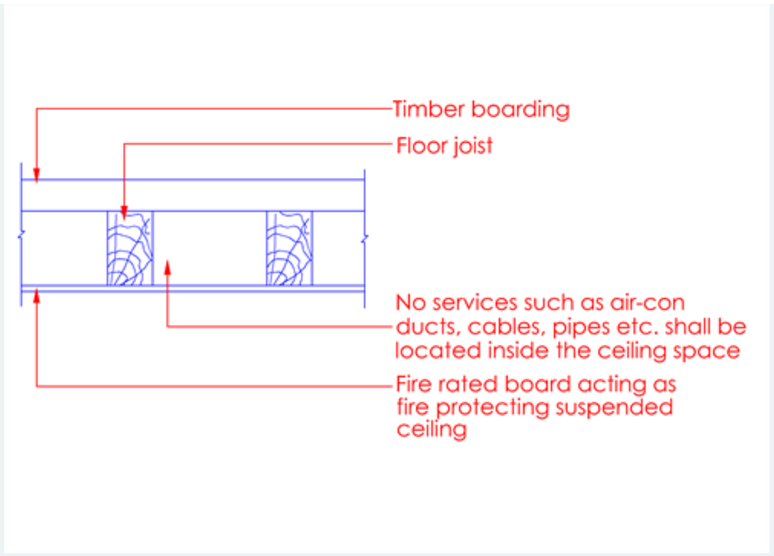
3.3.5 Suspended ceiling

Explanation and Illustrations



Section

Figure 3.3.5 – 1

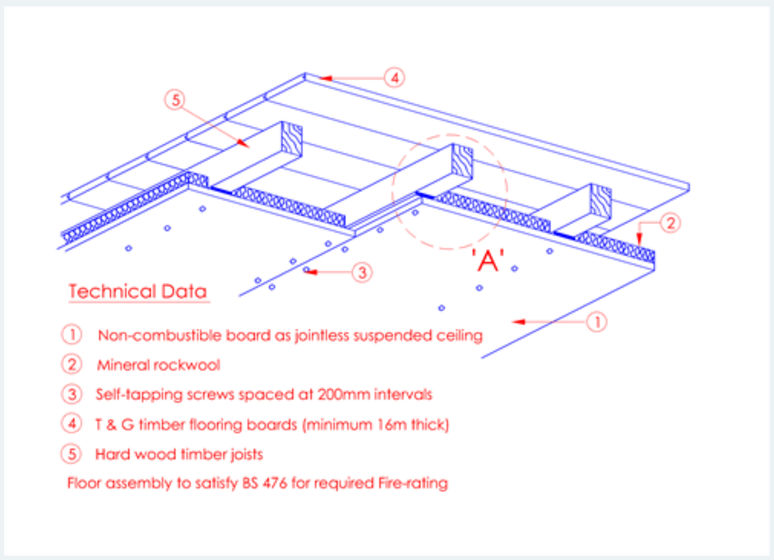


Section

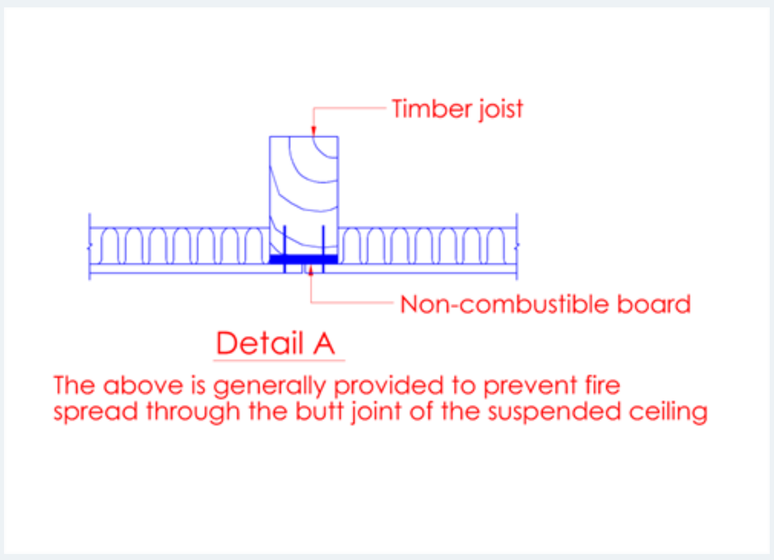
Figure 3.3.5 - 2

The suspended ceiling is to be treated as the soffit as the floor system or assembly consists of the timber boarding, joists and the suspended ceiling to achieve the necessary fire resistance rating.

Therefore the concealed space in the floor system or assembly is to be treated differently from concealed spaces mentioned under Cl.3.11. The main different is that concealed spaces in floor system or assembly are not permitted to have services such as air-con ducts, cables, pipes etc.; even if these services are housed in fire-rated enclosures.



Axonometric Section



Section

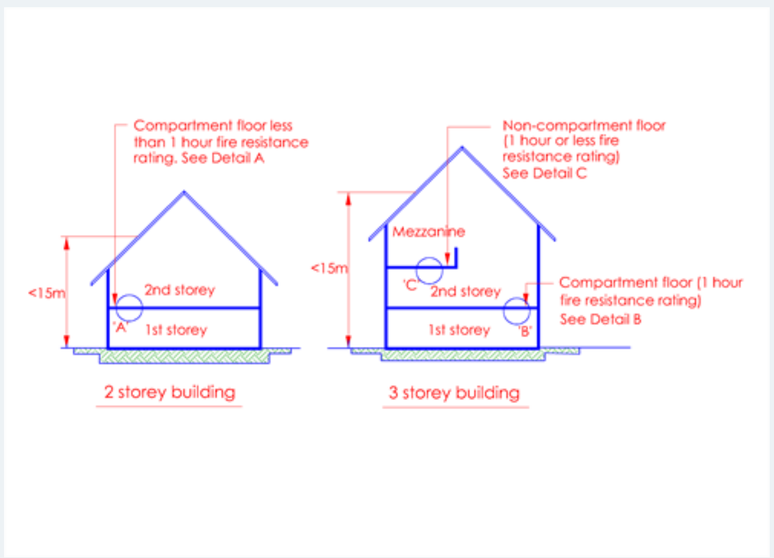
Figure 3.3.5 - 3

The implications of Cl.3.3.5 are that the normal type of suspended ceiling consisting of separate tiles cannot be counted as contributing to the fire resistance of the floor in buildings over 15m high where the period required is 1 hour; or in buildings of any height where the period required is more than one hour. In these circumstances only jointless ceilings can be considered as contributing

The above figure shows a protective ceiling being added to the underside of a timber floor, shall apply only to buildings under conservation where retention of the timber floor is required, and in buildings under PG I & II for the construction of attic. In addition to the four grades of ceiling given in *Table 3.3B*, other ceiling construction to tested prototype listed in the product listing scheme would be considered as acceptable.

The ceiling shown in Figure 3.3.5 - 1, shall be constructed specifically as a fire protecting membrane and comply with Table 3.3B on limitation of fire protecting suspended ceiling. As the ceiling is intended as a protecting membrane, the concealed ceiling space shall not be used for recessed lighting and other service, such as air-con ducts, cables, pipes etc., even if these services are housed in fire-rated enclosures.

Suspended ceilings which are contributing to the fire resistance rating of the floor under *Table 3.3B*.



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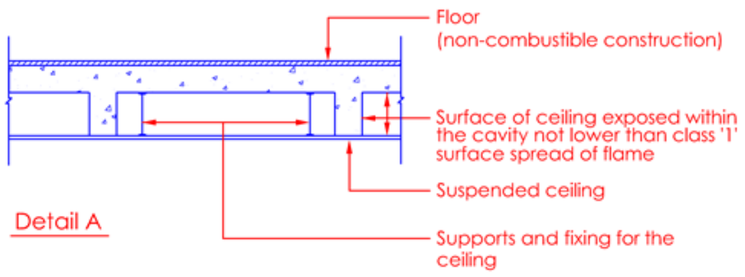
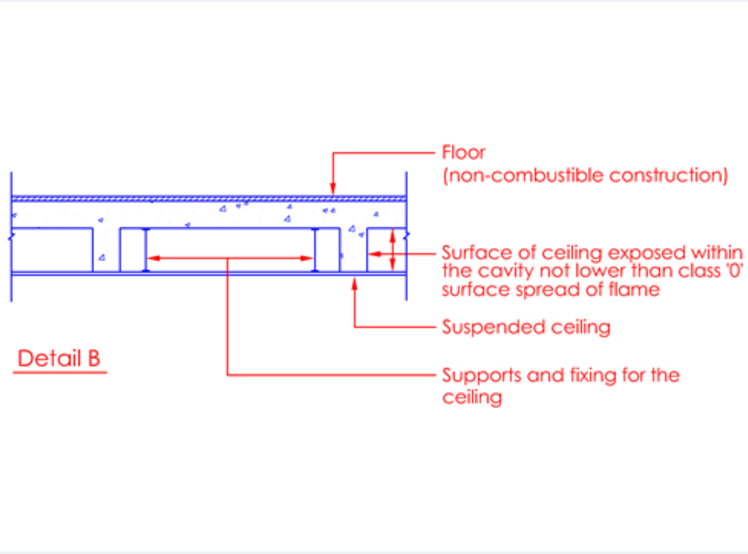


Compartment floor requiring less than 1 hour fire resistance rating



Compartment floor requiring 1 hour fire resistance rating

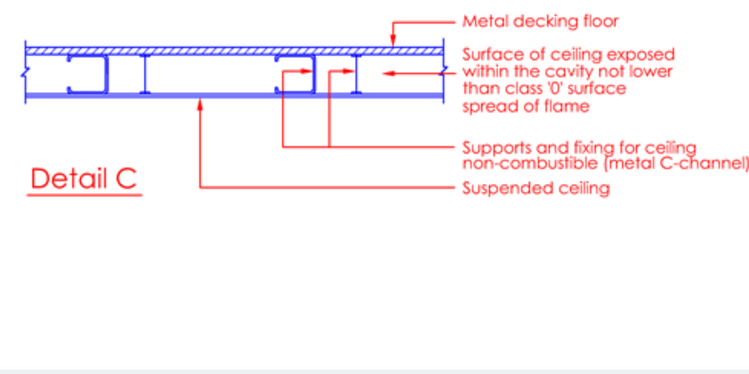
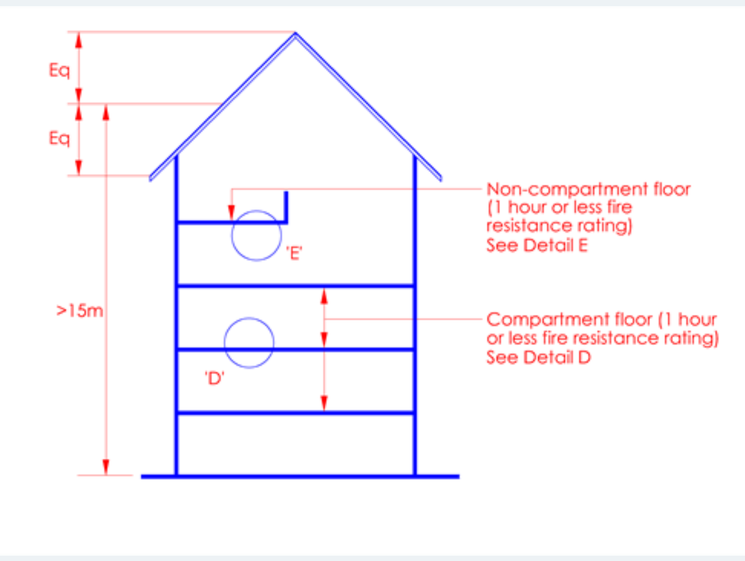


Figure 3.3.5 – 4 : Height of building less than 15m



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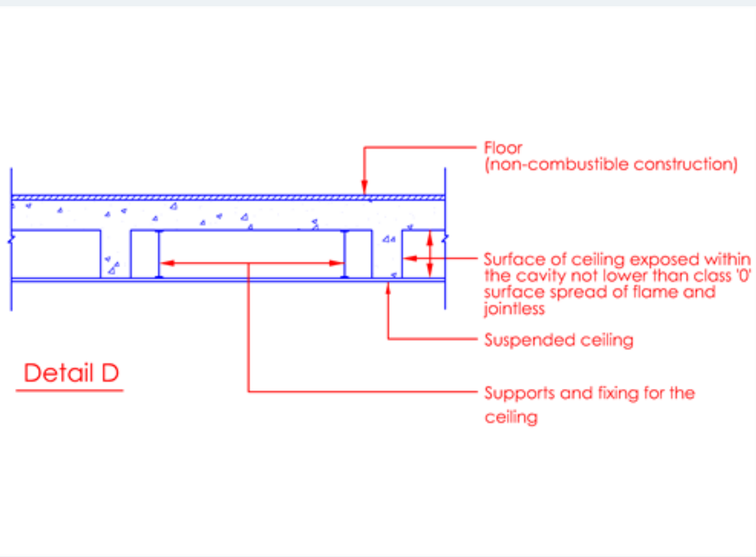
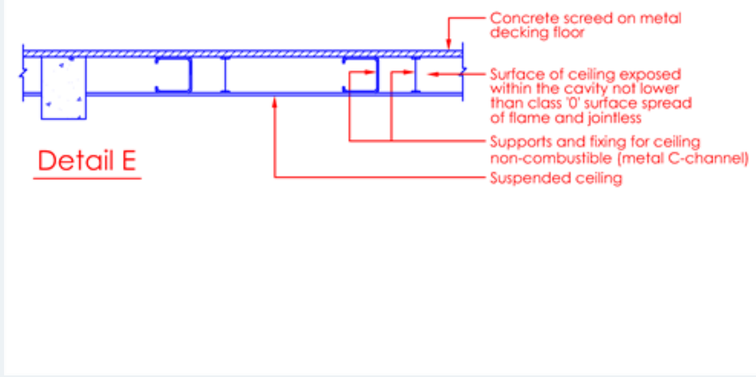
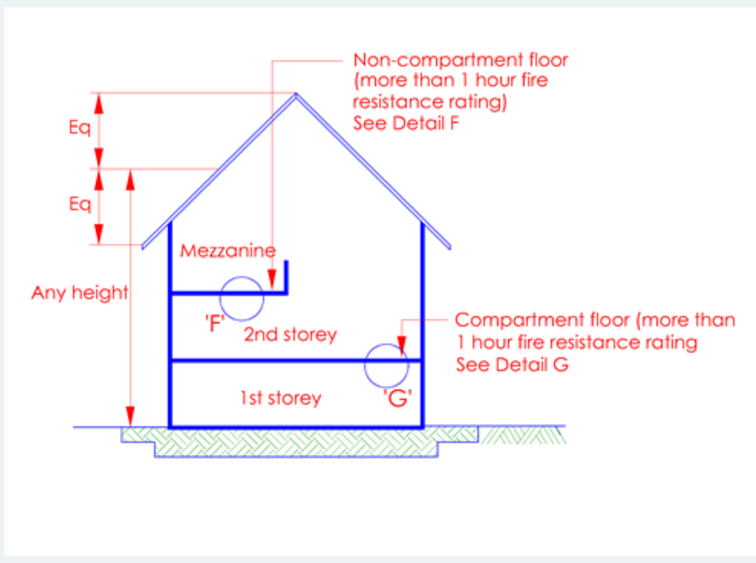


Compartment floor requiring 1 hour or less fire resistance rating



Non-compartment floor requiring 1 hour or less fire resistance rating

Figure 3.3.5 - 5 : Height of building - 15m or more



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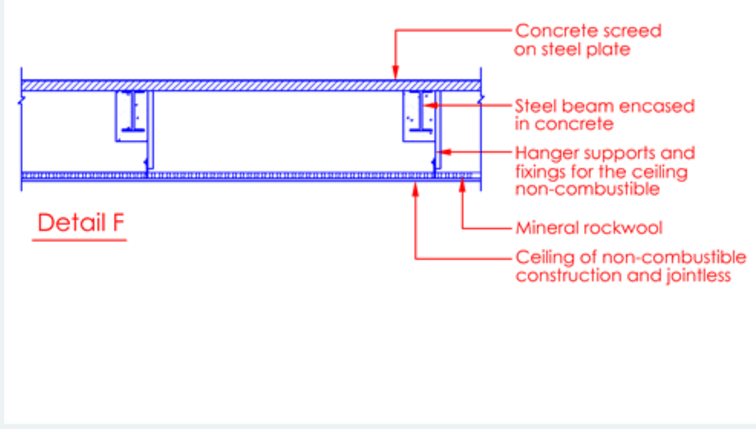
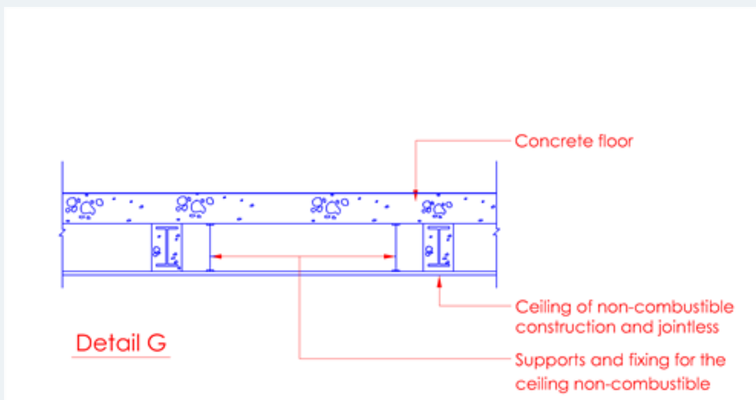


Non-compartment floor requiring 1 hour or less fire resistance rating



Compartment floor requiring more than 1 hour fire resistance rating

Figure 3.3.5 - 6 : Height of building - any height

The foregoing figures illustrate the intent of the clause which basically deals with the contribution by suspended ceilings to the fire resistance of floors. The provision of suspended ceilings for the protection of the floors shall be treated differently from that provided for the protection of structural steel works in the ceiling space.

Where the space above a suspended ceiling is protected by an automatic sprinkler system it shall be exempted from the requirements for non-combustibility and surface spread of flame classification as specified in the above Table, provided the ceiling is not situated over an exit passageway, protected lobby or other required protected means of escape, and that the ceiling space is not used as an air plenum.

In determining the fire resistance of floors, no account shall be taken of any fire resistance attributable to any suspended ceiling unless the ceiling is constructed specifically as a fire protecting suspended ceiling, and the construction complies with the requirements under *Table 3.3B* for Limitations on Fire Protecting Suspended Ceilings.

3.3.6 Fire-rated board

Explanation and Illustrations

(No illustration)

Running of services in the space between the steel structure and fire-rated boards should be discouraged, unless it is unavoidable.

Services shall be limited to cables only and shall not include duct, gas pipes, fuel oil pipes, etc..

a. Fire-rated boards are permitted to be used for protection to structural steel beams, columns and as wall construction in building if all of the following are complied with:

(1) The fire-rated boards shall be non-combustible (*BS 476 Part 4 or Part 11*).

(2) They shall have fire resistance for not less than the relevant period specified in *Table 3.3A*, with regards to the purpose group of the building of which it forms a part and the dimensions specified in that table.

(3) They shall meet the criteria, in terms of water absorption and bending strength performance, when subject to the test standards of *BS EN 520* (for gypsum plaster board) or *ISO 1896* (for calcium silicate or cement board).

(4) Fire-rated boards used to make dry walls shall, in terms of impact & deflection performance, meet the partition grade specified under *BS 9999* (Test for partitions) in accordance with *BS 5234-2*.

(5) They shall not be used to protect structural steel in areas which are subject to explosion risk, as the boards may be displaced by the force of the blast.

(6) In buildings under PG VI and VIII, where the presence of corrosive atmosphere may affect the effectiveness of fire-rated boards for protection to structural steel members of buildings, such proposals shall be subject to evaluation of the SCDF.

b. Incorporation of services within fire-rated drywall construction shall comply with the following:

(1) The installations shall meet the fire performance test requirements set out in *BS 476 Part 22* and shall not incorporate services beyond the case scenario for which it has been successfully tested.

(2) Electrical cables shall be housed in metal conduits within the dry construction.

(3) Gas pipe installation are prohibited in fire-rated dry construction.

Note

1. Design stage

Individual supplier shall conduct fire tests for their entire product ranges, i.e. different fire ratings for similar types of dry construction material, same fire rating for different types of dry construction material, etc.. However, it would be acceptable for the Test Laboratory to carry out an assessment for similar product ranges with the same fire rating for the dry construction assembly (with services within) with one that had been tested subject to product assessment requirements of Test Laboratory. However, where a dry wall construction differs in terms of fire rating, services layout and configuration etc., separate fire test(s) need to be conducted.

2. Commissioning stage

Under the Product Listing Scheme (PLS), it is a requirement for supplier to submit DoC for the project to a Certification Body (CB) for audit purposes. However, DoC shall now also be included as a mandatory document for QP to submit to SCDF for issuance of TFP. The requirement will mandate QP to check on the quality of fire-rated dry construction on site and ensure that the supplier diligently checks the quality of work before submitting the DoC for the project.

3. Post installation stage

Addition & Alteration (A&A) works which were carried out on fire-rated dry construction may contravene design criteria such as puncturing the board for mounting of additional services and thereby undermining its fire integrity and insulation. Therefore, the QP shall comply with the following administrative requirements for subsequent A&A works on fire-rated dry construction:

a. The building owner shall endorse on plans that where any subsequent A&A works involving fire-rated dry construction are to be carried out, a QP shall be engaged.

b. For easy identification of fire-rated dry construction within the building, the QP shall indicate the locations of fire-rated dry construction on

(i) a zone chart in accordance with the requirements stipulated in SS CP 10; and

(ii) the A&A building plan for approval by the SCDF.

CLAUSE 3.4 TESTS OF FIRE RESISTANCE

3.4.1 Fire resistance

Explanation and Illustrations

In conjunction with Part 20, methods of test are provided for – Beams, columns, floors, flat roofs and walls (Part 21); Partitions, door sets and vertical shutter assemblies, ceiling membranes and glazed elements (Part 22); and Suspended ceilings protecting steel beams and intumescent seals for use in conjunction with single acting latched timber fire-resisting door assemblies (Part 23).

Part 20 specifies standard heating conditions based on a temperature/time curve (*Figure 3.4.1 - 2*) which furnaces are required to follow; the temperature at defined locations close to the exposed face of the specimen under test rising to 821°C after 30 minutes and 1133°C after four hours.

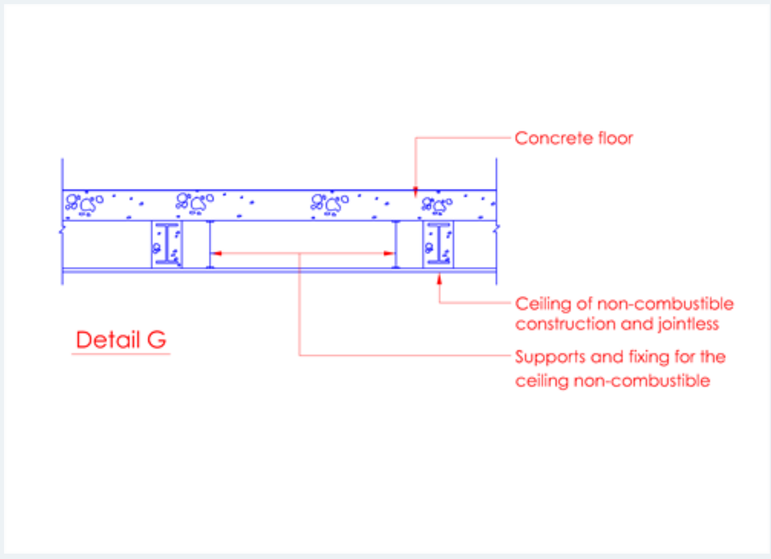


Figure 3.4.1 - 1

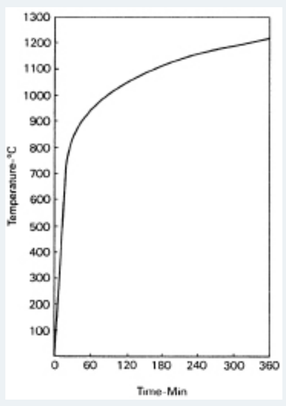


Figure 3.4.1 – 2 : Standard temperature vs Time curve

The specimen to be tested should be either full size or, where the element exceeds the size that can be accommodated by the furnace, it must have the following minimum dimensions.

Non-separating elements: Vertical 3m high Horizontal 4m span

Separating elements: Vertical 3m high X 3m wide Horizontal 4m high X 3m wide

Specimens are normally heated to simulate their exposure in a fire, e.g. walls from one side, floors from beneath and columns from all sides.

Elements of building construction are required to satisfy various criteria according to their designed function in the event of fire. These are:

a. “Stability” or “Load-bearing capacity”: the ability of a load-bearing element to support its test load without excessive deflection.

b. “Integrity”: the ability of a separating element to resist collapse, the formation of holes, gaps or fissures through which flames and/or hot gases could pass, and the occurrence of sustained flaming on the unexposed face (the side of the specimen remote from the furnace).

c. “Insulation”: the ability of a separating element to resist an excessive rise in temperature on its unexposed face.

The criterion of “stability” or “load-bearing capacity” is applied only to load-bearing elements. For floors, flat roofs and beams, allowable vertical deflection is limited to 1/20 clear span.

Loss of “integrity” in the context of the formation of holes, gaps or fissures is judged by ignition of a cotton fibre pad. Where this test is not suitable, failure is deemed to have occurred if either a 25mm diameter gauge can penetrate into the furnace through a gap at any point, or a 6mm diameter gauge can penetrate into the furnace through an opening and can be moved for a distance of at least 150mm.

Loss of “insulation” occurs when the temperature on the unexposed face (the side of the specimen remote from the furnace) increases by more than 140°C (mean) or by more than 180°C at any point. Loss of “integrity” also constitutes loss of “insulation”.

Columns and beams have to satisfy only the criterion of “load-bearing capacity”; glazed elements are normally required to satisfy only “integrity”; and floors and walls have to satisfy all three criteria. It is pertinent to note that under *Table 3.4A*, doors are only required to satisfy “integrity”, leaving aside “insulation” as it is assumed unlikely that combustible materials would be stored against them. However, doors to protected lobbies, exit staircases and exit passageways should be provided with insulation against transmission of heat by radiation from the fire floor into the protected enclosures which occupants use for evacuation.

It is important to note that fire-rated glass door shall not be used in fire lift shaft, exit staircases and exit passageways. In other areas such as protected lobbies, separating and compartment walls, the use of fire-rated glass is permitted, provided the building is sprinkler-protected. See Cl.3.15.13 for more details.

Performance for the fire resistance of elements of structure and other forms of construction shall be determined by reference to the methods specified in *BS 476: Part 20 to 23*, which specify tests for stability, integrity and insulation.

Specific requirements for each element in terms of the three performance criteria of stability, integrity and insulation are given in *Table 3.4A*.

3.4.2 “Deem to satisfy” provisions

Explanation and Illustrations

(No illustration)

Cl.3.4.2b. provides the alternative to complying with the specification of tested prototype under BS 476 Part 20 to 23. Specification set out in *Annex 3A* to Cl.3.4 could be used and there is no need to obtain separate testing. However, on completion of the building works, the QP concerned is to forward to the RIs his/her certificate of supervision that the relevant *specification* listed in *Annex 3A* to Cl.3.4 had been complied with on site when applying for TFP or FSC.

An element of structure or other part of a building shall be deemed to have the requisite fire resistance if:

a. it is constructed to the same specification as that of a specimen exposed to test by fire in accordance with the method and procedure under *BS 476: Part 20 to 23*, and satisfied the requirements of that test for the three performance criteria of stability, integrity and insulation for not less than the specified period, or

b. in the case of a wall, beam, column, stanchion or floor to which *Annex 3A* to Cl.3.4 relates, it is constructed in accordance with one of the specification set out in that Annex and the notional period of fire resistance given in that Annex as being appropriate to that type of construction and other relevant factors is not less than the specified period.

CLAUSE 3.5 EXTERNAL WALL

3.5.1 Requirements of external walls

The requirements of external walls are as follows:

a. Any external wall of a building or a separated part of a building which constitutes or is situated within a distance of 1m from any point on the relevant boundary, or is a wall of a building or a separated part of a building which exceeds 15m in height shall:

(1) be constructed wholly of non-combustible materials apart from any external wall finishes which complies with Cl.3.5.4 or any internal lining which complies with Cl.3.13.4

(2) be so constructed as to attain the fire resistance required by this chapter; and

Explanation and Illustrations

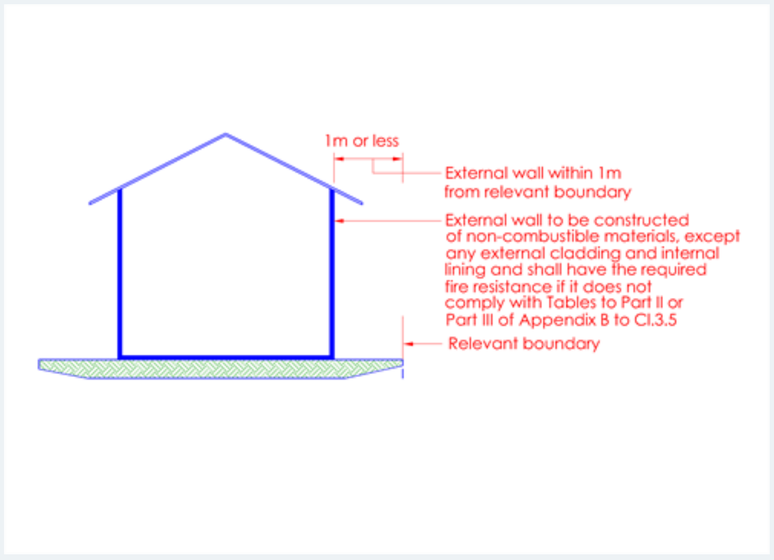


Figure 3.5.1a. - 1: Buildings of any height situated at 1m or less from relevant boundary

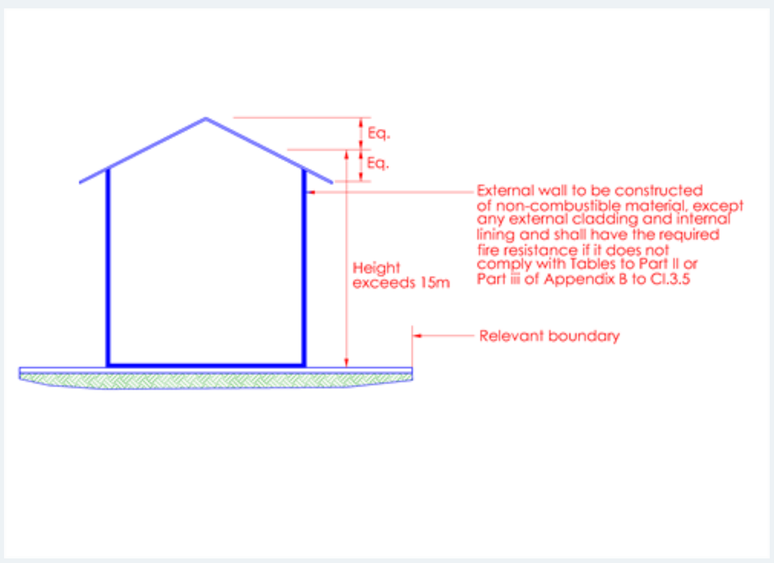


Figure 3.5.1a. - 2

Where the external wall of a building which exceeds 15m in building height or is within 1m of the relevant boundary, the entire external wall shall be constructed wholly of non-combustible materials, apart from any external combustible cladding under Cl.3.5.4 or internal combustible lining under Cl.3.13.4.

The external wall of building which is sited less than 1m from the relevant boundary, shall be imperforate, free of any unprotected area and have the necessary fire resistance rating, both inside and outside. The required fire resistance shall be achieved by the non-combustible part alone.

The external wall shall have the necessary fire resistance rating as required of the elements of structure of the building or compartment, in which the wall is located, in accordance with *Table 3.3A*, Part 1.

Any part of the external wall which is to be treated as unprotected area in accordance with Tables to Part II of *Annex 3B* to Cl.3.5, need not have fire resistance.

If the entire external wall is to be treated as unprotected area, the separation distance between the external wall and the relevant boundary shall comply with Tables to Part II of *Annex 3B* to Cl.3.5.

External walls, which are more than 1m from the boundary, need to resist the effect of fire from the inside only.

In cases where the external walls of buildings are situated less than 1m from relevant boundary, the external walls shall be treated as separating walls. The requirements under Cl.3.6 shall be fully complied with.

b. any beam or column forming part of an external wall, and any structure carrying an external wall which is required to be constructed of non-combustible material, shall comply with the provisions of *Cl.3.5.1a.*.

Explanation and Illustrations

(No illustration)

Any beam or column forming part of an external wall and any structure carrying an external wall shall be constructed of non-combustible materials and have the necessary fire resistance rating of elements of structure, apart from any external cladding which complies with Cl.3.5.4 or any internal lining which complies with *Cl.3.13.4.* The required fire resistance shall be achieved by the non-combustible part alone.

3.5.2 Exceptions on external wall construction

a. The requirements of *Cl.3.5.1a.(1)* for non-combustibility of external walls need not apply to the external wall of a building or part of a building separated as described in *Cl.3.3.2b.*, if that wall is situated 1m or more from the relevant boundary and it is:

(1) of PG I or II building of not more than three storeys, or

Explanation and Illustrations

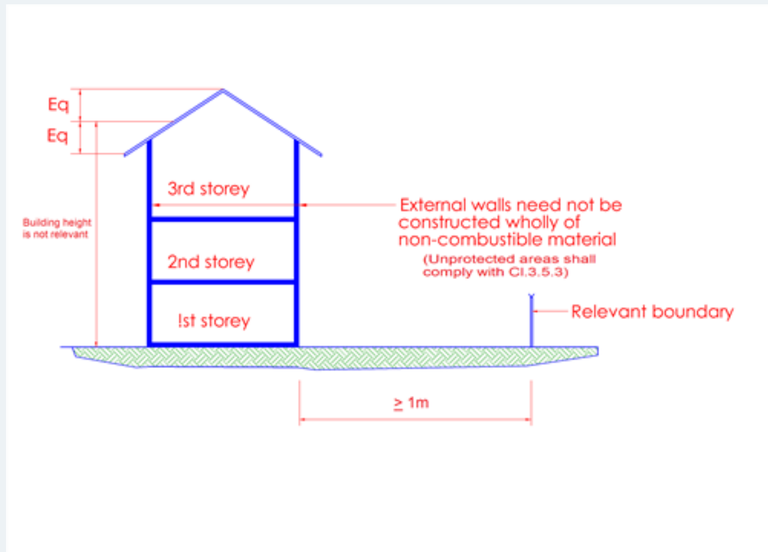


Figure 3.5.2a.(1) – 1 : PG I / PG II building

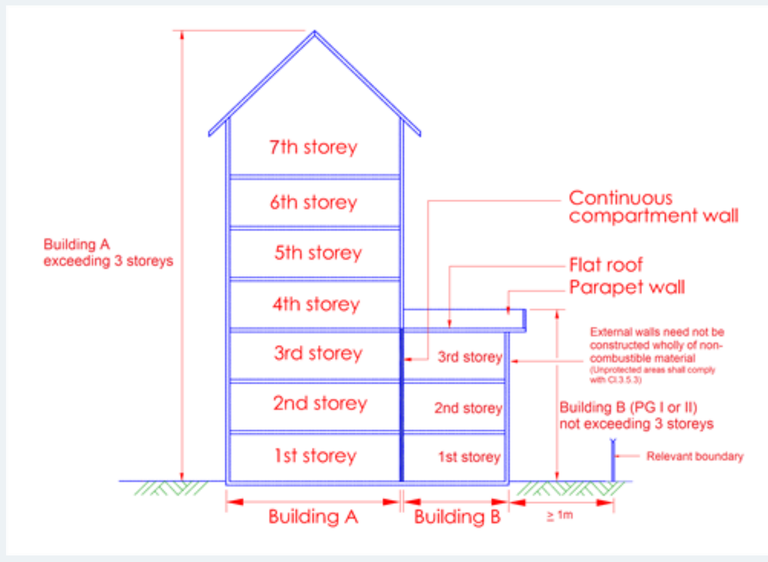


Figure 3.5.2a.(1) - 2 : Separated part of PG I / PG II building

Part of a PG II building (not exceeding 3 storeys – building B in Figure 3.5.2a.(1) - 2, separated from the other parts (building A) by vertical compartment wall. Exemption would also apply to the building in Figure 3.5.2a.(1) - 1 which shall not exceed 3 storeys in height and be situated 1m or more from the relevant boundary.

(2) of single storey construction and not exceeding 15m in height and floor area not exceeding:

(a) 3000m^2 for PG III, IV, VII buildings, or

(b) 2000m^2 for PG V, VI buildings, or

(c) 500m^2 for PG VIII buildings, or

Explanation and Illustrations

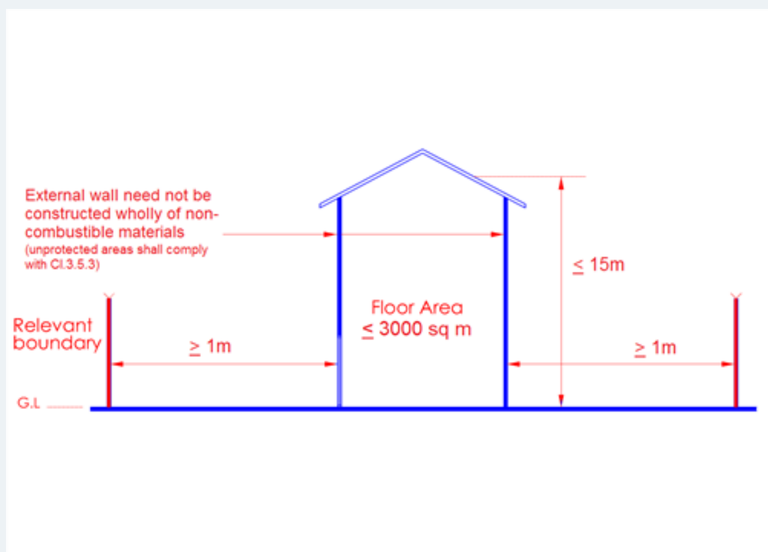


Figure 3.5.2a.(2)

Single storey health care occupancy, schools, old folk's home, etc. (PG III) need not comply with non-combustibility of external wall, if it complies with the requirements under *Cl.3.5.2a.(2)*.

(3) of other than single storey buildings, but not exceeding 7.5m in height and the compartmented floor area not exceeding:

(a) 250m^2 for PG IV, V, VII buildings, or

(b) 150m^2 for PG VI, VIII buildings.

b. The requirements of *Cl.3.5.1a.(2)* for fire resistance of external walls need not apply to the external wall of a building or part of a building separated as described in *Cl.3.3.2b.*, if that wall is situated 1m or more from the relevant boundary and it is:

(1) of a single storey building of a purpose group other than PG VI and VIII and not exceeding 15m in height, or

(2) of a single storey PG VI or VIII building not exceeding 15m in height and floor area not exceeding 2000m² or 500m² respectively.

Explanation and Illustrations

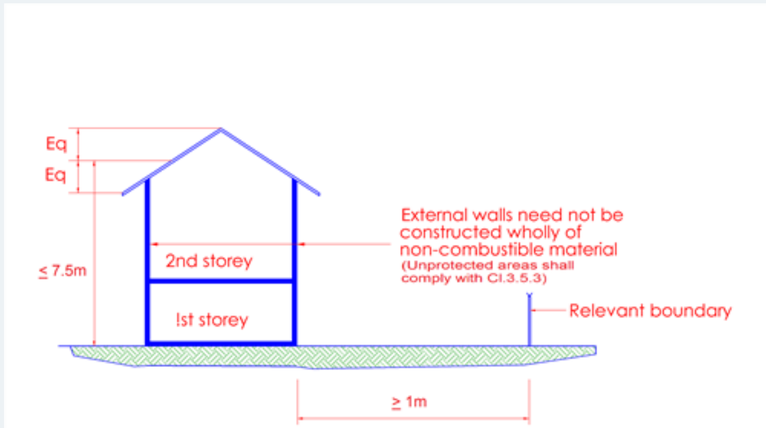


Figure 3.5.2a.(3) – 1

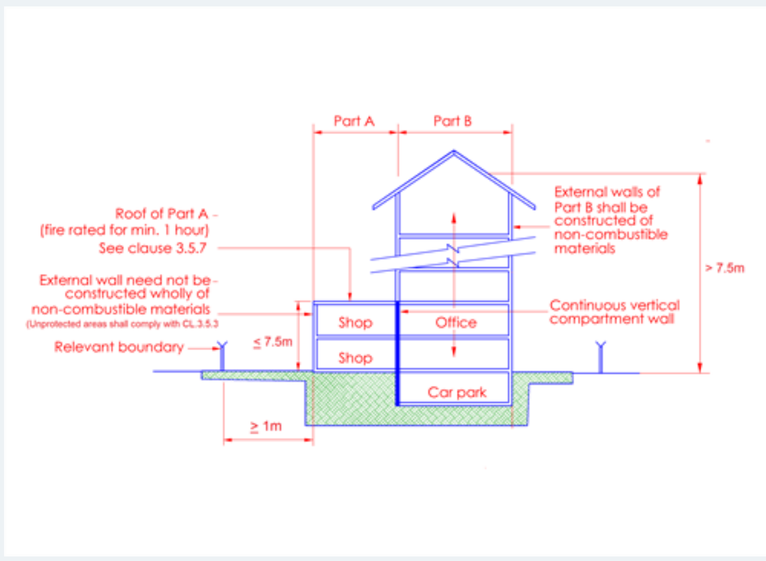


Figure 3.5.2a.(3) - 2

Cl.3.5.2a.(3) is applicable to separated part of building as described in *Cl.3.3.4b.*, which is illustrated in Figure 3.5.2a.(3) - 2.

Part A of the building comprising shops which is separated from other parts of the same building by a continuous vertical compartment wall would qualify for exemption of non-combustibility of external construction if:

a. the entire external wall does not exceed 7.5m in height, measured from the outside ground; and

b. the external wall is situated 1m or more from the relevant boundary.

3.5.3 Unprotected areas in any side of a building

Unprotected areas in any side of a building shall comply with all of the following:

a. Any relevant requirements relating to the permitted limits of unprotected areas specified in *Annex 3B*, unless the building is so situated that such side can in accordance with *Annex 3B*, consist entirely of any unprotected area.

b. The extent of unprotected openings in an external wall of a building/compartment, in relation to its distance from the lot boundary, can be doubled that of *Annex 3B*, provided the building/ compartment is fitted throughout with an automatic sprinkler system in compliance with the requirements in Chapter 6.

Explanation and Illustrations

(No illustration)

Unprotected areas in relation to a side or external wall of a building means:

a. a window, door or other opening, and

b. any part of the external wall which has less than the relevant fire resistance required in Cl.3.5, and

c. any part of the external wall which has combustible material more than 1mm thick attached or applied to its external face whether for cladding or any other purpose

The extent of unprotected areas in the external wall in relation to the setback from relevant boundary or lot boundary shall be in accordance with *Annex 3B* to Cl.3.5. The further the building is setback from the relevant boundary, the greater the amount of unprotected areas would be permitted.

An example on calculations of unprotected openings/setback from relevant boundary is given in page 56. The intensity of the heat produced by a fire within a building which can reach the relevant boundary will depend upon the extent of the “unprotected areas” in the external walls and the distance between these walls and the relevant boundary. The heat flux at the relevant boundary shall be less than that normally required for pilot ignition of combustible material after a period of exposure.

In situations where the extent of unprotected areas in external walls do not comply with *Annex 3B*, the QP has 4 alternatives. These are:

a. reduce the total unprotected area, or

b. increase the distance from the relevant boundary, or

c. introduce compartmentation within the building to break up the size of enclosing rectangle, or

d. introduce automatic sprinkler system so that the unprotected areas can be doubled or the distance from the relevant boundary can be reduced by half.

c. As an alternative to *Cl.3.5.3b.* above, the distance between the external wall of a building and the relevant boundary can be half that specified in *Annex 3B*, if the building is fitted throughout with an automatic sprinkler system in compliance with the requirements in *Chapter 6*.

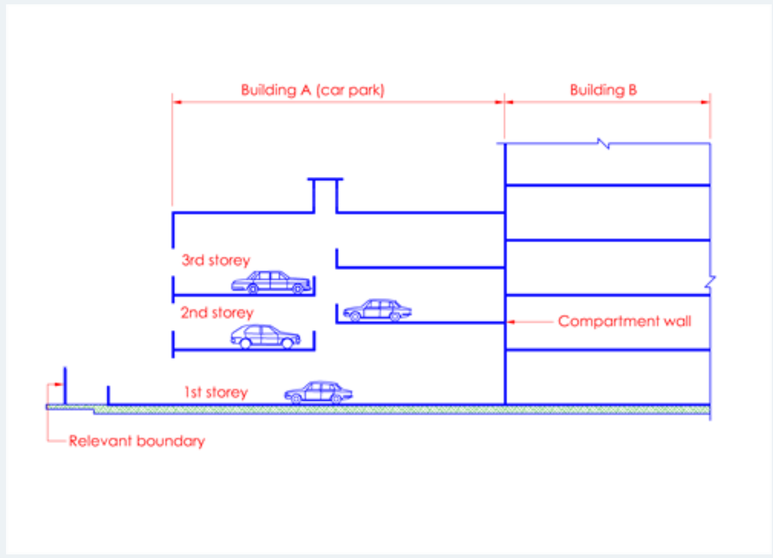
Explanation and Illustrations

(No illustration)

The above clause is to provide an alternative for buildings protected with sprinkler system. QP/Building owner shall decide which option, *Cl.3.5.3b.* or *c.* i.e. either double the unprotected openings or half the separation distance between the building and the relevant boundary, whichever is relevant to the building.

d. The extent of unprotected openings in an external wall of a building/ part of building used for car parking in relation to its distance from the lot boundary/ relevant boundary can be based on the floor having the largest extent of unprotected openings to comply with Table 1 of *Annex 3B*.

Explanation and Illustrations

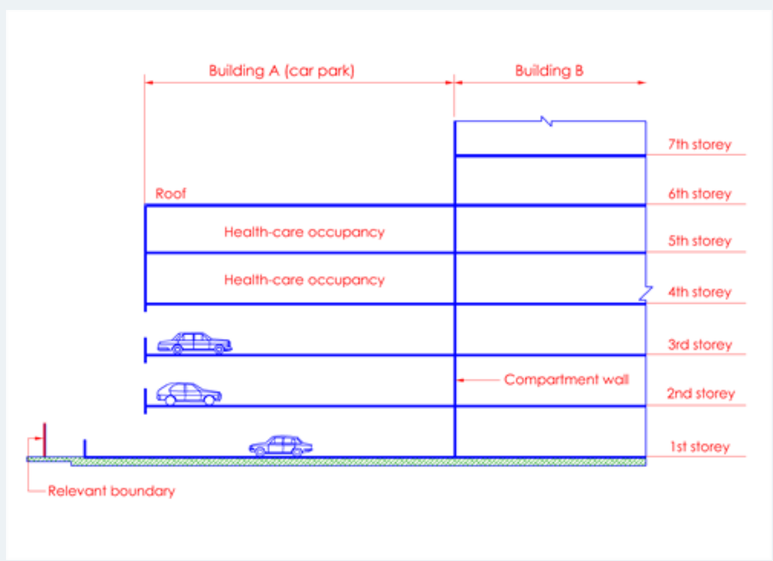


Section

Figure 3.5.3d. - 1

The above clause treats car park building differently by allowing the floor having the largest extent of unprotected openings to be used for the purpose of complying with Table 1 of *Annex 3B*. This clause grants special relaxation in relation to its distance from the lot boundary for the purpose of complying with Table 1 of *Annex 3B*.

In the above figure, the enclosing rectangle would apply to 1st storey elevation facing the relevant boundary, instead of the whole building, which forms one compartment.



Section

Figure 3.5.3d. - 2

The above clause treats car park building differently by allowing the floor having the largest extent of unprotected openings to be used for the purpose of complying with Table 1 of *Annex 3B*. This clause grants special relaxation in relation to its distance from the lot boundary for the purpose of complying with Table 1 of *Annex 3B*.

In the above figure, the enclosing rectangle would apply to 1st storey elevation facing the relevant boundary, instead of the whole building, which forms one compartment.

3.5.4 External wall finishes

Rationale

This clause stipulates the requirements for cladding materials on the exterior of buildings. It also provides clarity on the rating and classification of that part of the building below 15m in height, and on the use of composite panels as cladding material.

Finishes on external walls shall comply with the following:

a. Homogenous cladding on external walls shall be constructed of material of at least limited combustibility tested in accordance with *BS 476 Part 11* or approved equivalent. For buildings not within PG VI and VIII, any part of such cladding below a height of 15m from the ground, and situated at least 1m away from the relevant boundary can consist of:

(1) timber of not less than 9mm finished thickness, or

(2) a material having a surface which achieves at least:

(a) Class 0 flame-spread rating tested in accordance with *BS 476 Part 6 & 7*, or

(b) Class B rating classified under *EN 13501-1*.

b. Composite panels used as cladding on external walls shall comply with *Cl.3.15.13.*

3.5.5 Reference to Part I & II of Annex 3B

Any reference to *Annex 3B* shall be construed as referring to the provisions of Part I of that Annex together with the provisions of Part II.

3.5.6 Buildings on land in common occupation

Explanation and Illustrations

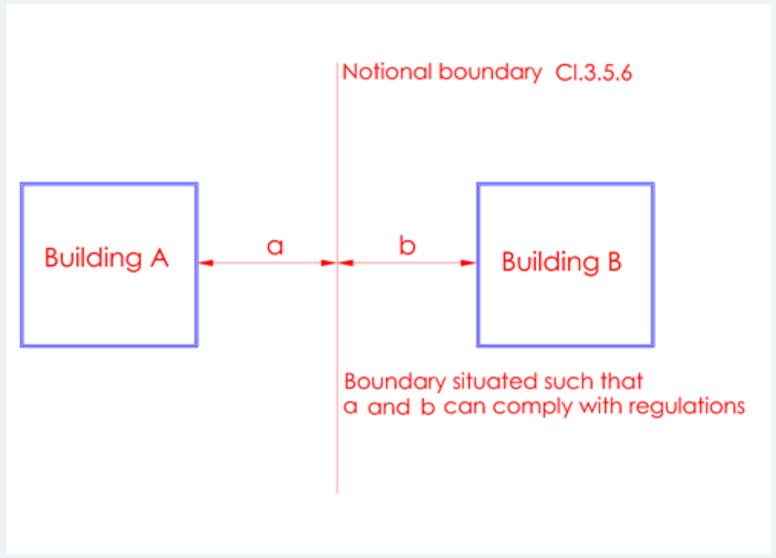


Figure 3.5.6

1. It is necessary to assume a notional boundary when two or more detached buildings are erected on land in common occupation.

2. The notional boundary is taken to exist in space between the buildings and is positioned so that the external walls of building A and B facing the notional boundary comply with the separation distance requirement in accordance with Tables of *Annex 3B*, based on the percentage of unprotected area and the purpose group of the compartment/floor.

3. Unprotected openings shall be assessed for each building separately. The separation distance between the two buildings shall be not less than the sum of the distance each building would require to a relevant boundary i.e. “a” is equal to or greater than the separation distance to the boundary for building A and “b” is equal to or greater than the separation distance to the relevant boundary for building B.

4. The notional boundary can be shifted next to external wall of building A or B, if the external wall has no unprotected areas and is constructed of non-combustible materials having the requisite period of fire resistance rating as the elements of structure of the storey compartment.

If two or more detached buildings are erected on land in common occupation, for any external wall of such a building facing the external wall of an adjacent building, the relevant boundary shall be a notional boundary passing between those buildings. This notional boundary shall be positioned to enable the external walls of those buildings to comply with the requirements of *Cl.3.5.3.*

3.5.7 Vertical fire spread

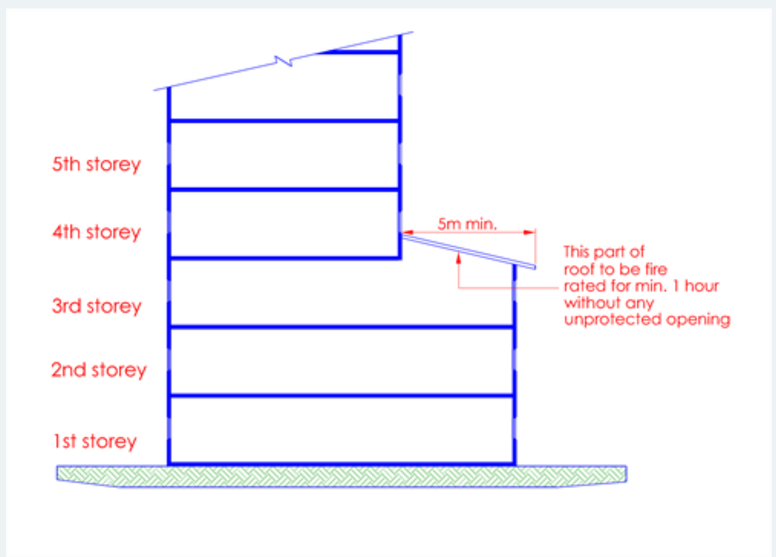
Rationale

The purpose of providing high/low separation is to ensure fire will not spread from the lower compartment to the abutting higher different compartment of the building.

a. For high and low parts of different compartments of a building abutting each other, either one of the following requirements shall be complied with to prevent spread of fire between the distinct parts:

(1) the roof-over of the lower part of the building shall be fire-rated in accordance with the element of structure for minimum 1 hr for a distance of 5m measured horizontally from the external wall of the higher part of building; or

Explanation and Illustrations



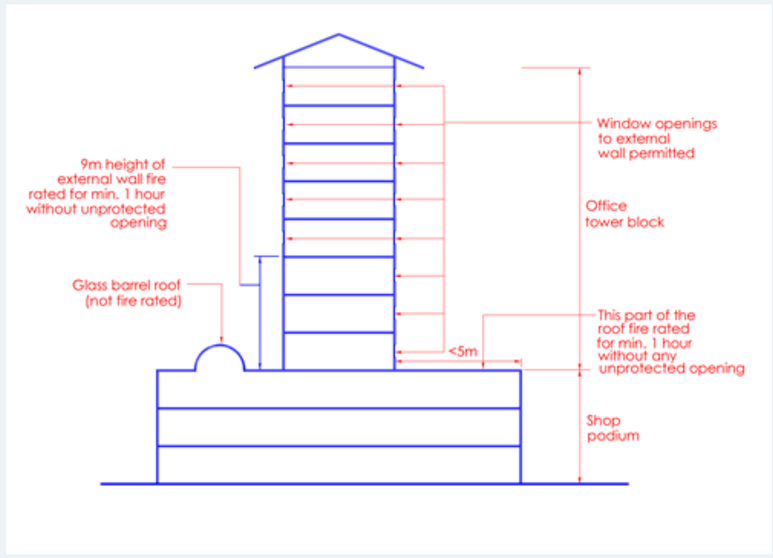
Section

Figure 3.5.7a.(1)

The entire roof projection over the lower part of the building if less than 5m, then the entire roof projection shall be fire-rated with minimum 1-hr fire resistance rating. A fire occurring in the 3rd storey would spread vertically to 4th storey via the roof and windows. To prevent the fire spread vertically, the roof of 3rd storey should be fire-rated for minimum. 1 hour for a distance of 5m measured horizontally from the external wall of 4th storey abutting the roof of 3rd storey. The above requirement to fire rate the roof of 3rd storey will not be applicable if the building or lower part of the building is sprinkler-protected.

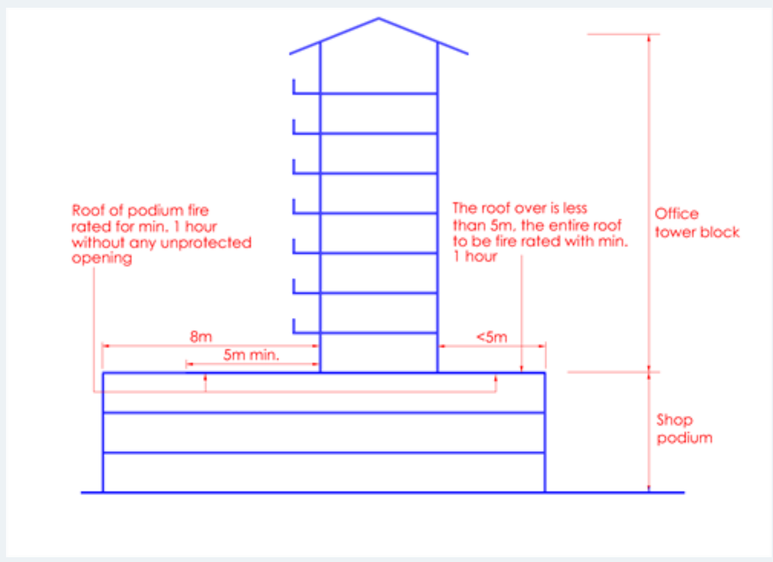
(2) the external wall of the higher part of the building overlooking the roof below shall have the necessary fire resistance rating in accordance with the element of structure for minimum 1 hr for a vertical height of not less than 9m measured from the roof of the lower part of the building.

Explanation and Illustrations



Section

Figure 3.5.7a.(2) – 1



Section

Figure 3.5.7a.(2). - 2

Providing fire rated wall with unprotected opening is an alternative to fire rating the roof under *Cl.3.5.7a.*.

The above 2 figures show the 2 ways of preventing fire spread vertically from the lower floor to the upper floors.

b. The above requirements shall not be applicable to:

(1) buildings or lower parts of the building which are sprinkler-protected;

(2) the buildings under the conservation programme of the authority having jurisdiction, or buildings built before 1969;

(3) covered car porches intended solely for the purpose of the boarding and alighting of passengers;

(4) open-sided/ covered walkways/ linkways not exceeding 5m in width with no commercial activities or storage; and

(5) canopies of depth not exceeding 2m over private enclosed spaces or balconies in PG II buildings, provided that the canopy is constructed of non-combustible material.

3.5.8 Non-sprinkler-protected roof

Rationale

This fire safety requirement is to prevent fire from spreading through an unprotected roof to an adjacent building located outside the boundary.

The 4m setback stipulated is consistent with the minimum horizontal 5m protection required under Cl.3.5.7a.(1) to prevent vertical fire spread, taking into consideration a minimum 1m setback of the adjacent building from the boundary.

For non-sprinkler-protected roof within 4m from the boundary (excluding boundary abutting public street, canal or river), the portion of the roof within this 4m zone shall be 1-hr fire-rated. This requirement is exempted for areas stated under *Cl.3.5.7b.*.

3.5.9 Separation of residential floor facade

Rationale

The fire-rated spandrel and horizontal projection from building facade are to serve as an effective fire barrier to slow down or prevent vertical fire spread. The dimensions have been validated through a fire engineering study.

Separation of PG II residential floor façade shall be in accordance with *Cl.9.2.1b.(3)*.

3.5.10 External sun-breakers/ weather features

External sun-breakers or weather features which will result in the channelling of flame upwards during a fire are not permitted.

CLAUSE 3.6 SEPARATING WALLS

3.6.1 Requirements of separating walls

a. Every separating wall shall:

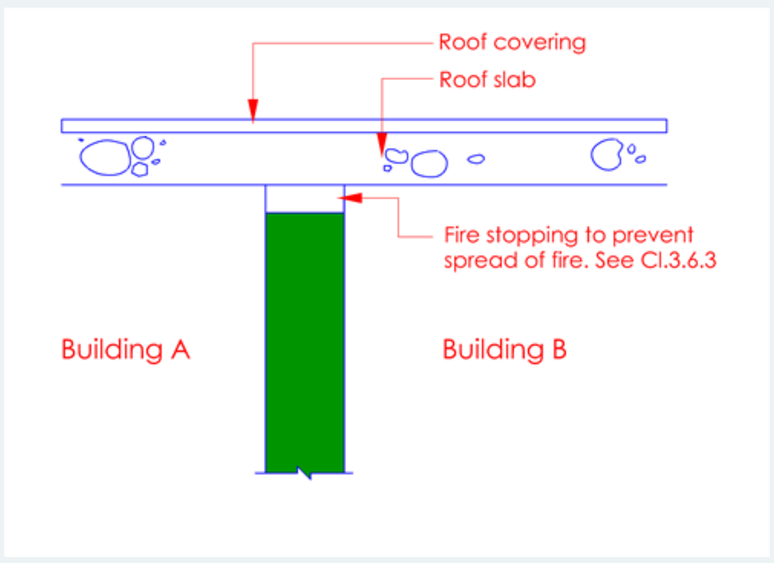
(1) form a complete barrier in the same continuous vertical plane through the full height between the buildings it separates, including roofs, basements, air-con ledges and balconies, and shall be without openings except where permitted Cl.3.6.2;

(2) have the appropriate fire resistance to comply with the requirements of Cl.3.3;

(3) be constructed of non-combustible materials, together with any beam and column which form part of the wall and any structure which it carries; and

(4) not include glass fire-resisting walls.

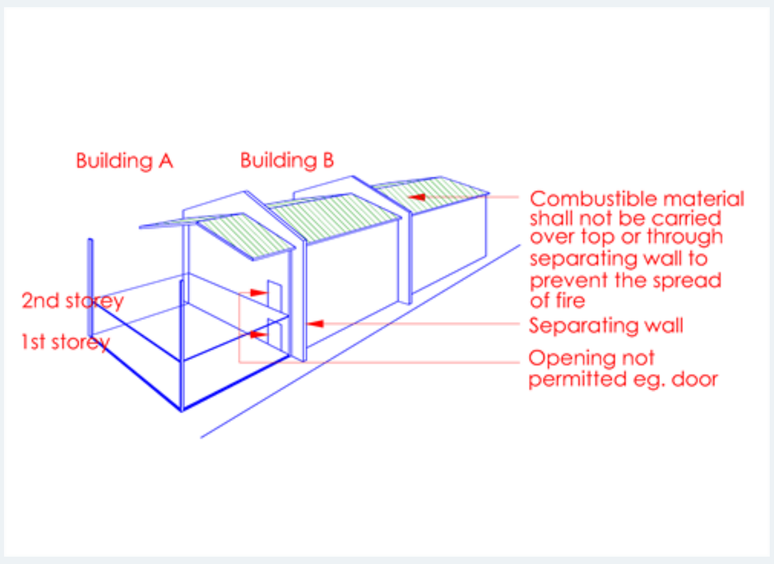
Explanation and Illustrations



Section

Figure 3.6.1a(1) - 1 : Separating wall with flat roof

Separating wall is the common wall that separates one house from another, as in the case of semi-detached or terraced houses. It is to prevent the spread of fire from house to house. The separating wall shall have the appropriate fire resistance rating as the elements of structure of the adjoining house having the larger floor area or cubical extent as the case may be. It shall not include fire-resisting glass.



Axonometric view

Figure 3.6.1a(1) - 2 : Separating wall with pitched roof

Door opening in the separating wall is to provide communication between 2 houses is not acceptable, unless the 2 houses are under single ownership and occupied by a single family. Owner is required to furnish an undertaking to the SCDF that should one of the houses is to be sold, the door opening in the separating wall shall be bricked-up to have the necessary fire resistance as the adjoining wall.

b. Exception

(1) *Cl.3.6.1a(1)* shall not apply to wall between car porches of PG I buildings or wall between canopies over private enclosed spaces located on the grade level of PG II buildings. This exception shall not apply if the unprotected opening of the car porches/ canopies fails to comply with the setback distance requirements from the other lot boundary.

(2) *Cl.3.6.1a(1)* shall not apply to any sun screen or ledge that protrude from edge of the floor level.

Explanation and Illustrations

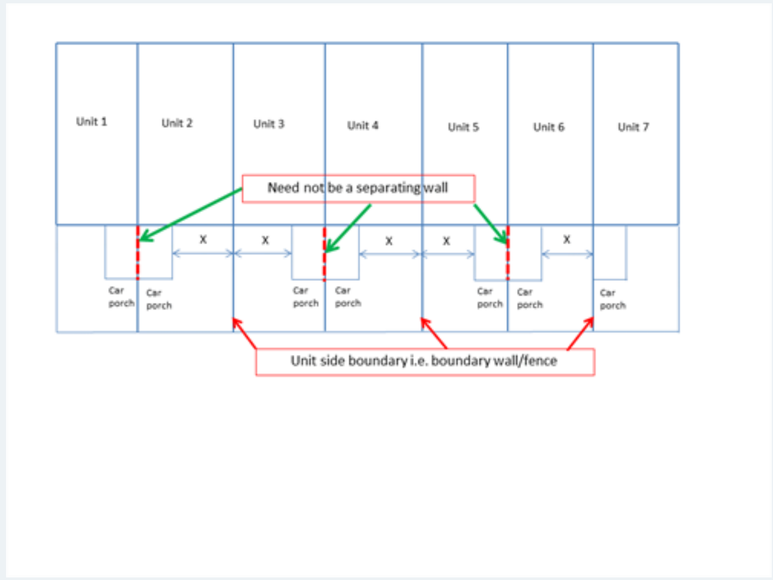


Figure 3.6.1b. – 1 : Scenario 1

Walls between car porches (annotated by dash line) need not be separating walls provided the car porches are set back (annotated as 'x' above) adequately from their respective unit side boundaries.

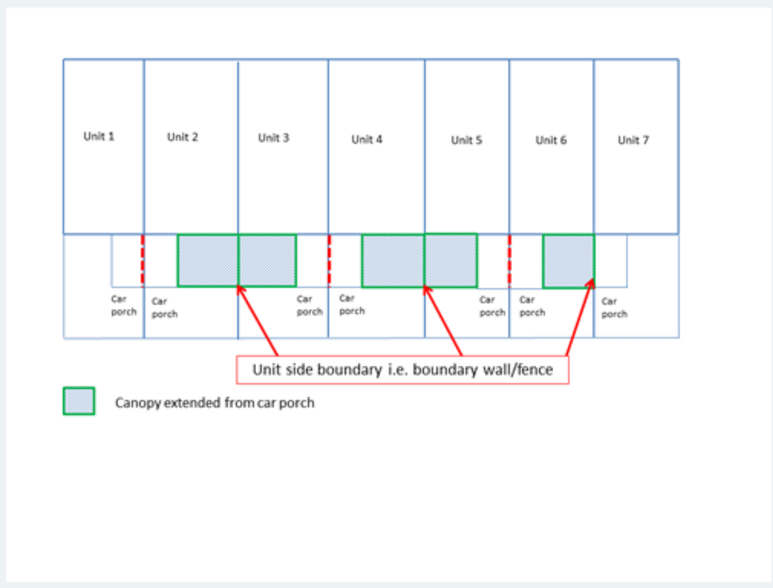


Figure 3.6.1b. – 2 : Scenario 2

Walls between car porches need to be separating walls (annotated by dash line) if the canopies span across the car porches and unit side boundaries.

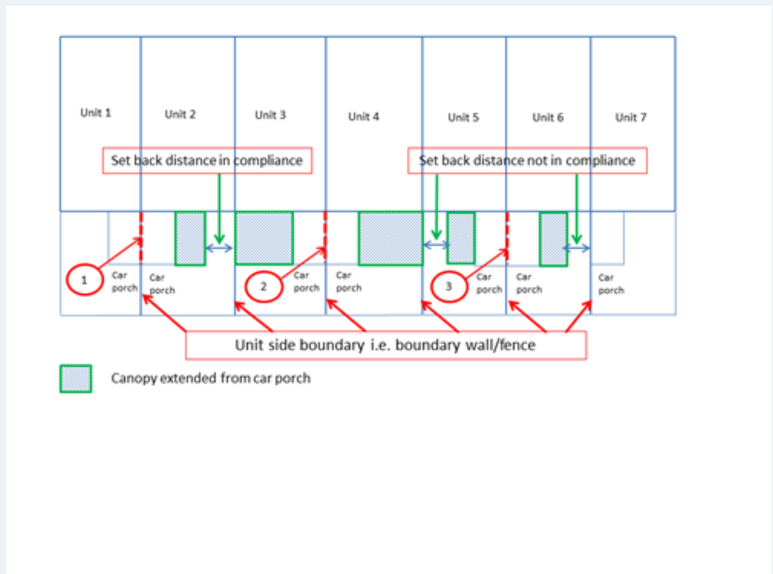


Figure 3.6.1b. – 3 : Scenario 3

Boundary no. 1 need not be a separating wall if the extended canopy can comply with set back to the unit side boundary as reflected above. Conversely, boundary nos. 2 & 3 need to have separating walls since the extended canopies cannot comply with set back from their respective side boundaries.

3.6.2 Openings in separating walls

Explanation and Illustrations

(No illustration)

1. Opening in the separating wall shall comply with the following conditions:

   a. QPs shall obtain prior approval from the SCDF before submission of building plan.

   b. If the adjoining unit or building is under different ownership; written consent from the owner shall be obtained for submission to the SCDF.

   c. Owners are to submit a written undertaking to the SCDF that should the opening in the separating wall is no longer required, it shall be restored to its original imperforate state.

2. *Cl.3.6.2b.* is not applicable to PG VI & VIII buildings.

Door opening between 2 industrial units is not acceptable, unless the units are owned by one owner and occupied by a single company. In such a case the door opening in the separating wall shall be used solely for providing communication between the units and shall not be taken as means of escape during fire emergency, unless otherwise allowed. The owner is to furnish an undertaking to the SCDF that should one of the units be sold, the door opening in the separating wall shall be bricked-up to have the necessary fire resistance as the adjoining wall.

A separating wall shall have no openings except for:

a. a door required to provide a means of escape in the event of a fire, having the same fire resistance as that required for the wall and complying with Cl.3.9.2, or

b. a door provided for the purpose of public circulation and permitted by the SCDF, having the same fire resistance as that required for the wall and complying with Cl.3.9.2, or

c. an opening for the passage of a pipe complying with the relevant provisions of Cl.3.9.3.

Explanation and Illustrations

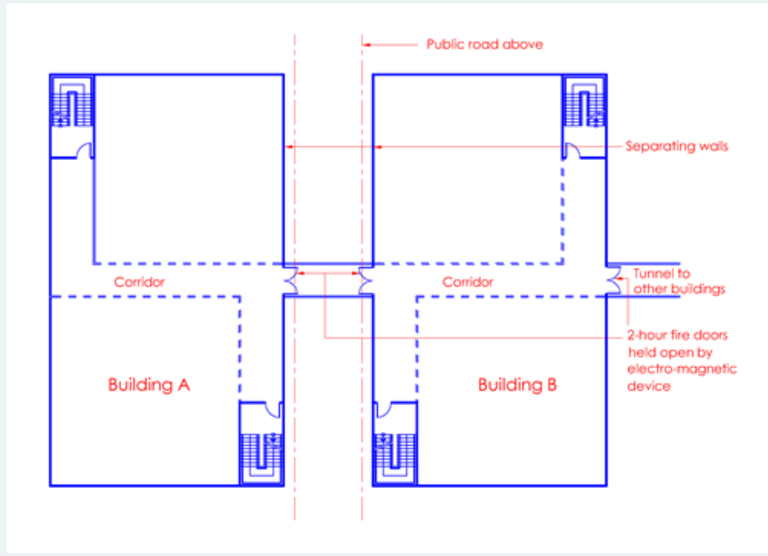


Figure 3.6.2b. - 1 : Basement plan 1

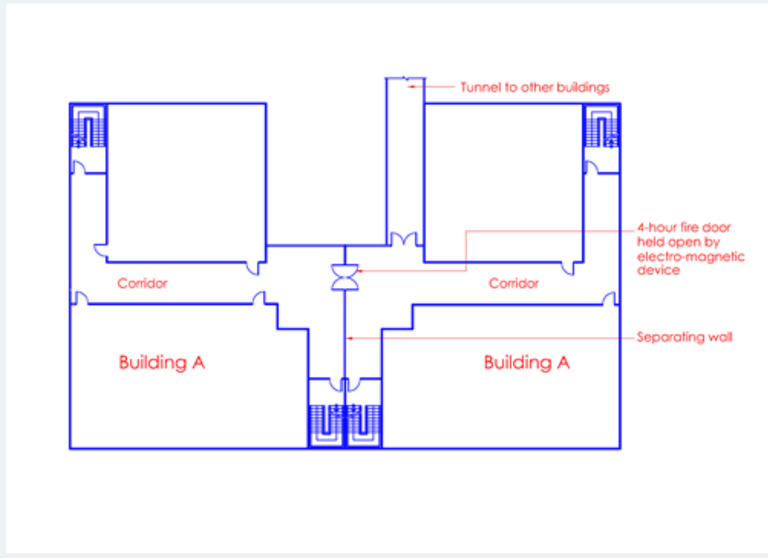
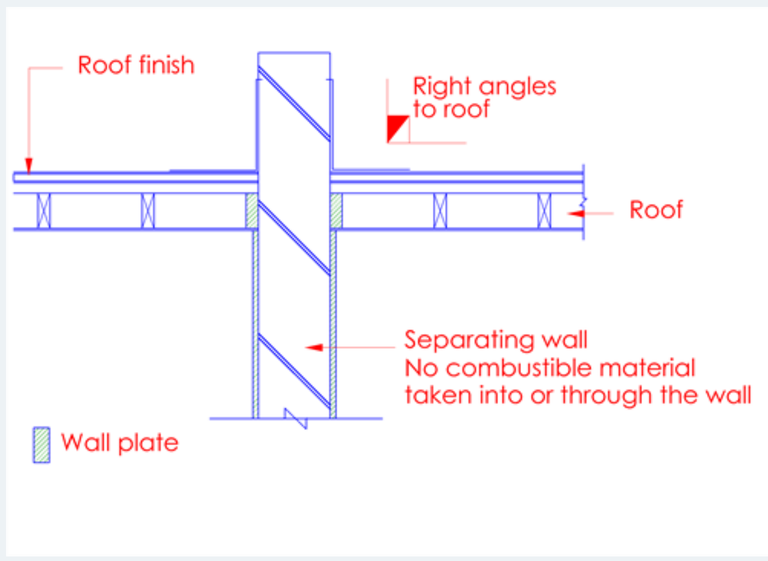


Figure 3.6.2b. - 2 : Basement plan 2

Doors are provided in separating walls to connect 2 buildings for public circulation. Prior approval shall be obtained before building plans are submitted for approval. The above provision for the purpose of public circulation shall not be taken to qualify for the requirements for the provision of area of refuge.

3.6.3 Roof junction

Explanation and Illustrations



Section

Figure 3.6.3

Separating wall is carried right up above the roof coverings to act as a barrier to prevent fire spread over the roof level. The above clause addresses the concern at the junction of separating walls with roofs and other elements of structure to prevent fire from spreading through cracks and gaps at such junctions.

A separating wall shall be either extended up to form a close joint with the underside of a pitched roof of non-combustible covering or extended up above the level of such roof covering. The junction between such separating wall and roof shall be properly fire-stopped so as not to render ineffective the resistance of such separating wall to prevent the spread of fire.

3.6.4 External wall junction

Explanation and Illustrations

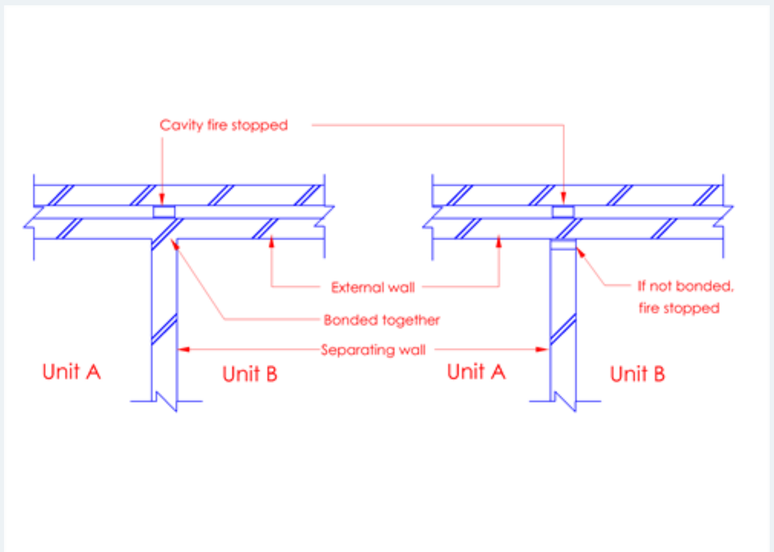
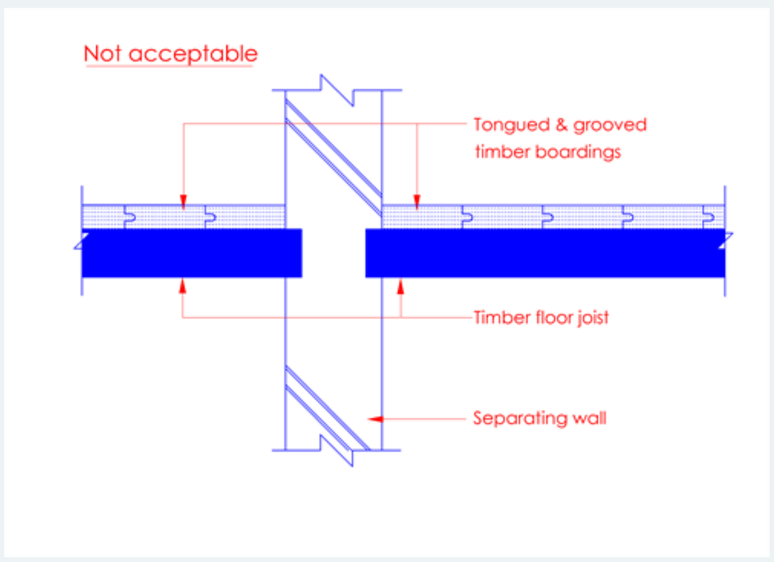


Figure 3.6.4

If any external wall is extended across the end of a separating wall, such external wall and separating wall shall be bonded together or the junction of such walls shall be fire-stopped to comply with the requirements of Cl.3.12.

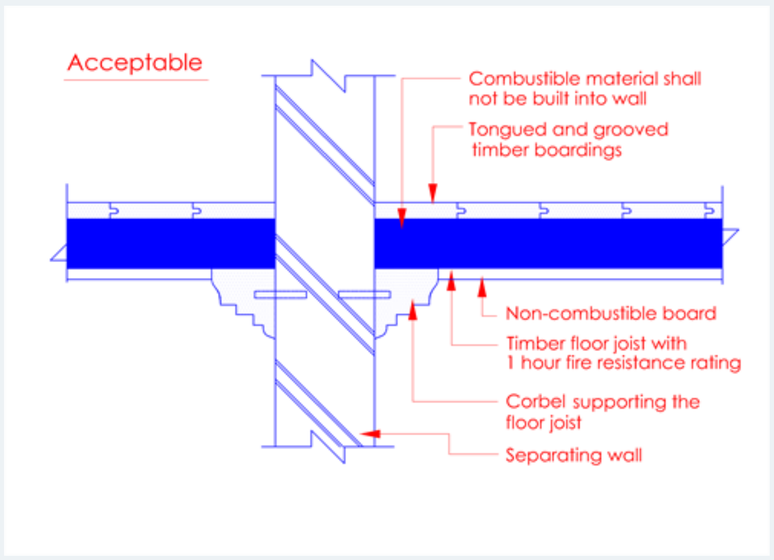
3.6.5 Prohibition of combustible materials in separating walls

Explanation and Illustrations



Section

Figure 3.6.5 - 1



Section

Figure 3.6.5 - 2

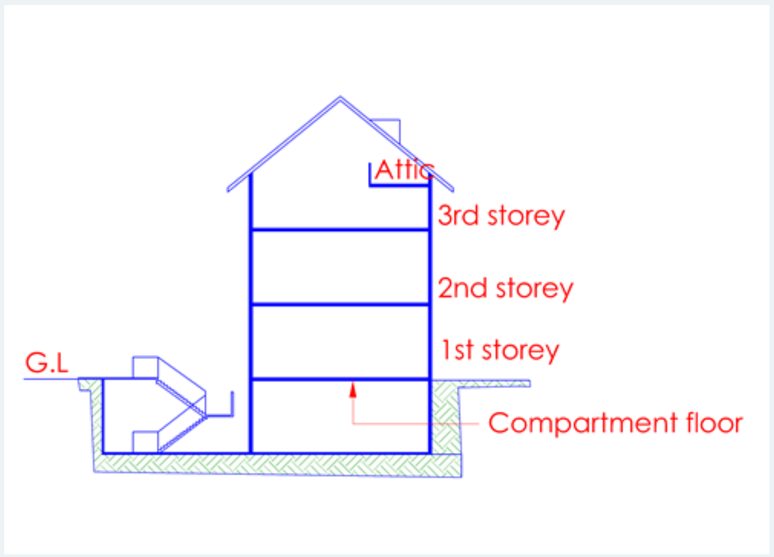
Combustible materials built into separating wall would weaken the fire resistance integrity of the wall. Separating wall must be constructed of wholly non-combustible materials, including the beam, column or other structure carrying the wall. Exception is allowed for internal linings under Cl.3.13. However, for building under conservation, it would be acceptable if the original method of construction of floor is required to be retained.

No combustible material shall be built into, extended through, across the ends of, or over the top of separating walls in such a way as to render ineffective the resistance of such separating walls to prevent the spread of fire.

CLAUSE 3.7 COMPARTMENT WALLS AND COMPARTMENT FLOORS

3.7.1 Requirements of compartment walls or compartment floors

Explanation and Illustrations



Section

Figure 3.7.1

The provision of compartment floor would apply to separate basement from upper storeys in the case where the building has 4 or more upper storeys or levels and a basement. Under such situation, *Cl.3.2.5d.* shall be complied with i.e. the compartmentation between basement and 1st storey shall not be penetrated by any openings or services even if:

a. such openings are provided with fire doors; and

b. the services are in protected shafts.

Compartment walls and floors are to be totally imperforate except for the following permitted openings:

a. doors

b. protected shafts

c. ventilation ducts

d. pipes

e. chutes e.g. refuse, linen

Compartment walls and floors are to be constructed wholly of non-combustible materials, including any beam or column which forms part of the wall or floor and any structure which it carries. The walls and floors shall be constructed to have the necessary fire resistance of min. 1 hour to comply with the requirements of Cl.3.3. See Cl.3.2.5 on the provision of compartment walls and floors to apartment/maisonette unit. Provision of fire resisting glass in compartment wall or floor separating residential units is not allowed.

Every compartment wall or compartment floor shall be required to:

a. form a complete barrier to fire between the compartments it separates;

b. have the appropriate fire resistance to comply with the requirements of Cl.3.3, except for compartment which is abutting a common circulation space and not more than 3m from the eaves of the building;

c. be constructed of non-combustible materials (together with any beam or column which forms part of the wall or floor, and any structure which it carries); and

d. shall not have fire-resisting glass components, unless permitted under Cl.3.15.14.

3.7.2 Openings in compartment wall or compartment floor

Explanation and Illustrations

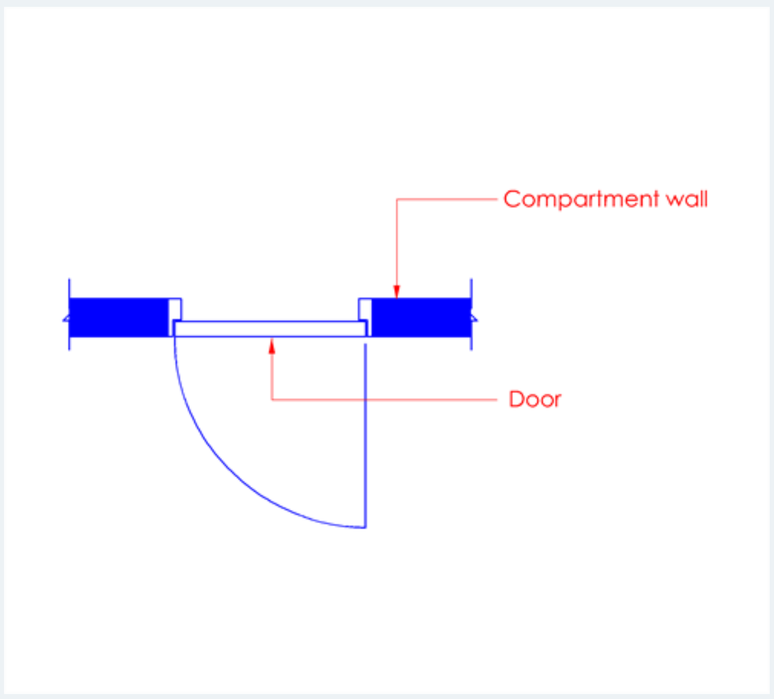
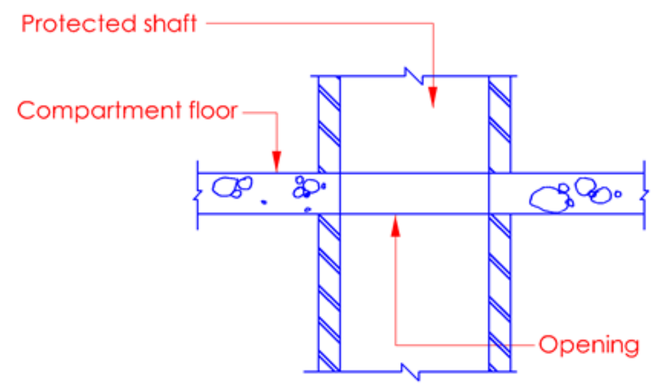


Figure 3.7.2 – 1: Door opening in compartment wall



Section

Figure 3.7.2 – 2 : Protected shaft opening in compartment floor

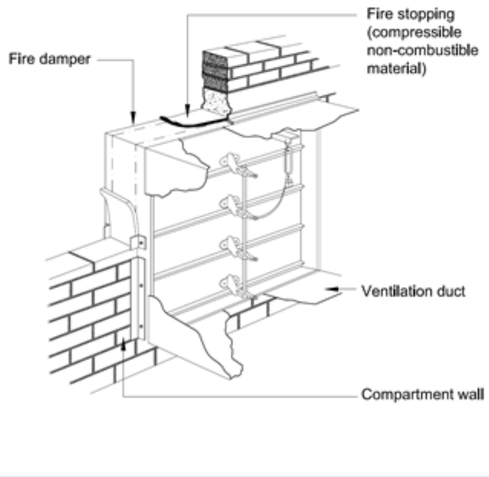


Figure 3.7.2 – 3 : Fire damper opening in compartment wall

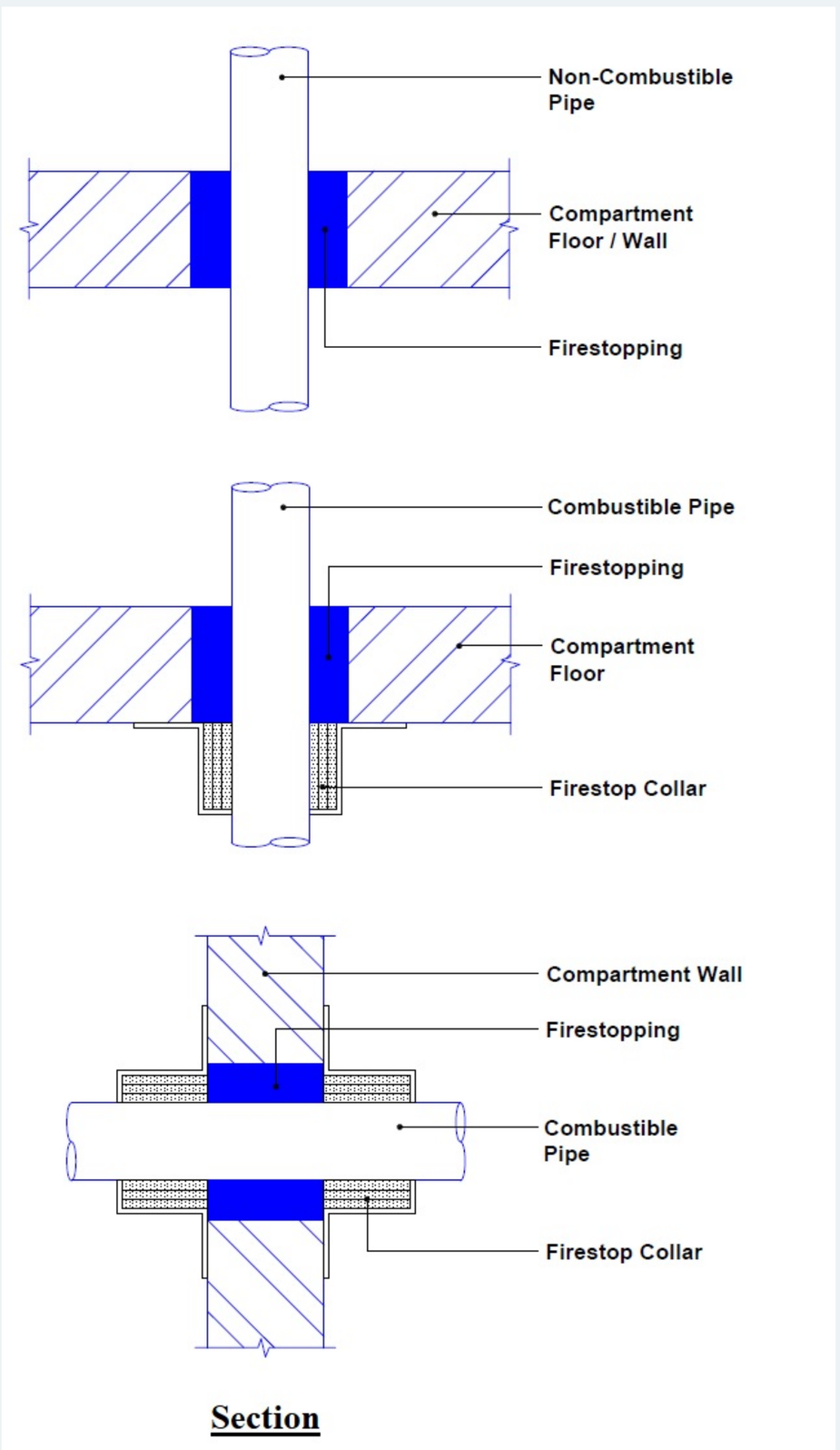


Figure 3.7.2 - 4 : Pipe penetration in compartment wall

It is a common practice to provide ½-hr fire resistance entrance door to flat or maisonette from common space, e.g. lobby. The fundamental reasons are that entrance doors are subject to normal everyday usage and that it is generally accepted that no combustible materials would be placed behind the doors.

In other situation, the door within compartment wall shall have the same fire resistance as the compartment wall. This is applicable to trap doors in floors.

Compartment walls and floors are required to be totally imperforate except for the above-mentioned openings to permit movement of people, air, services etc. in the building.

Other provisions in the code which allow fire door to have ½ the fire resistance rating of the adjoining compartment wall are:

a. doors to protecting structure under Cl.3.8.6;

b. exit doors opening into an internal and external exit passageway under *Cl.2.3.2b.(3)* and *Cl.2.3.2c.(2)* respectively; and

c. exit doors opening into protected lobby under *Cl.2.2.13b.*.

Doors to protected shafts are required to have ½ the period of the fire resistance rating of the protecting structure surrounding the opening. The main reasons for the above relaxation are:

a. Exit doors if required to have the same period of fire resistance rating as the surrounding wall would be quite heavy. Occupants escaping into the protected staircase would need to push hard to open the doors. Besides having to overcome the weight of the doors, additional force would be required to deal with the self-closing device fitted to the doors and in certain cases, the force imposed by the staircase pressurisation system. This would slow down the evacuation process;

b. A fire that breaks into the shaft at one level would need to break out again at another level. The aggregate rating of the 2 doors, each at different level, would be considered as acceptable.

c. Door openings in protecting structures would be limited in size, hence the potential source of weakness in the overall integrity of the shaft is limited.

In other situation, the door within compartment wall shall have the same fire resistance as the compartment wall. This is applicable to trap doors in floors.

A compartment wall or compartment floor shall have no openings in it, except for

a. a door which has the same fire resistance rating as the compartment wall and complies with the relevant requirements of Cl.3.4, unless permitted by other provisions of the Code, or

b. a protected shaft which complies with the requirements of Cl.3.8, or

c. the passage of a pipe or ventilation duct.

Such openings in the compartment wall or compartment floor shall be protected to comply with the relevant provisions of Cl.3.9.

3.7.3 Openings

a. Junction with other structures

Where a compartment wall or compartment floor forms a junction with any structure comprising any other compartment wall, or any external wall, separating wall or structure enclosing a protected shaft, such structures shall be bonded together at the junctions or the junctions shall be fire-stopped to comply with the requirements of *Cl.3.12.*

Explanation and Illustrations

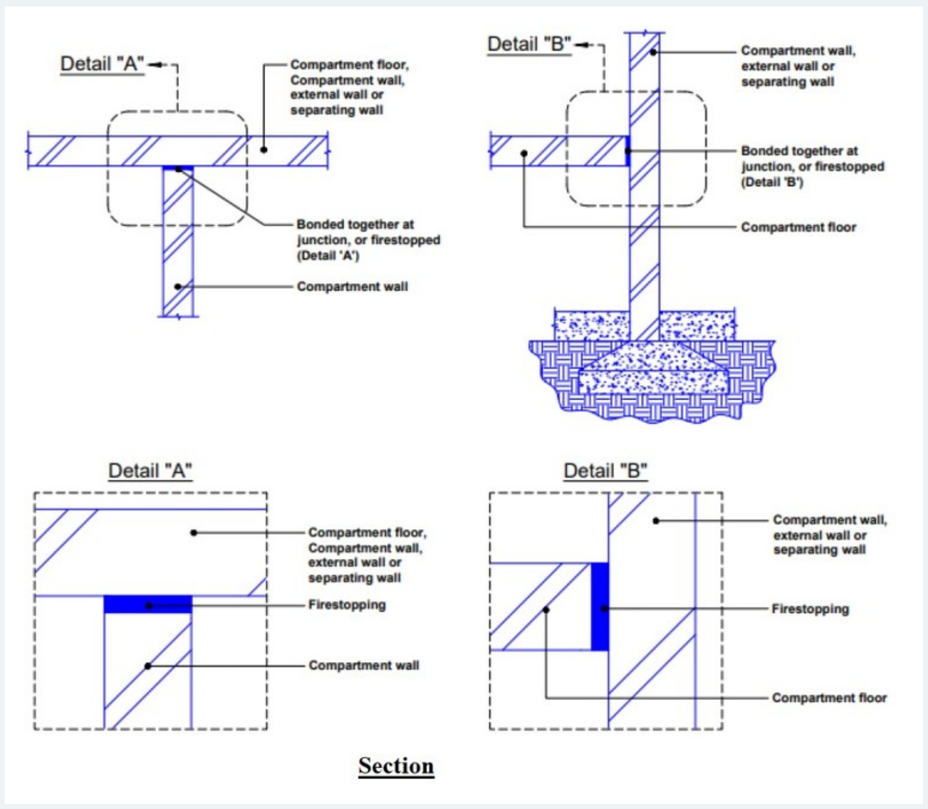


Figure 3.7.3a

b. Opening in curtain walling

The opening occurring at the junction between the edge of a structural floor and the curtain walling shall be sealed to prevent the spread of smoke and flame from the lower floor to the upper floor via the opening. Materials to be used for sealing the opening shall have the requisite fire resistance rating as the elements of structure.

Explanation and Illustrations

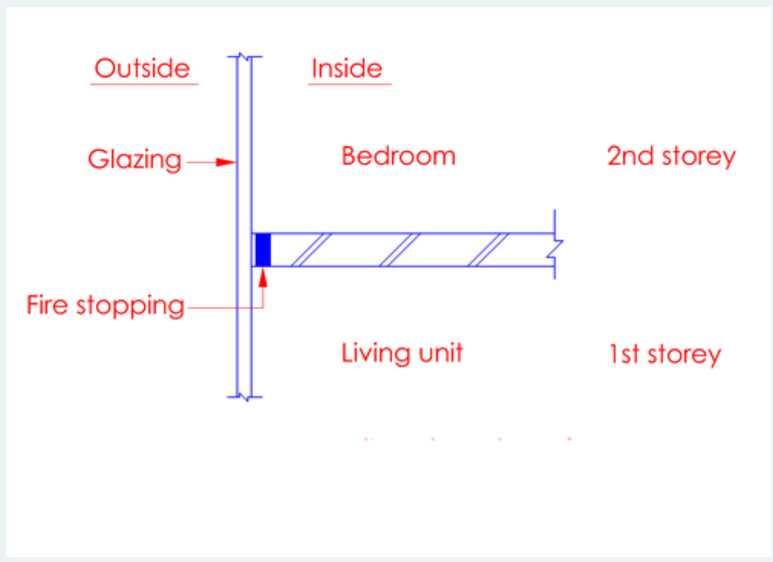


Figure 3.7.3b. – 1 : Details at junction of curtain walling at floor

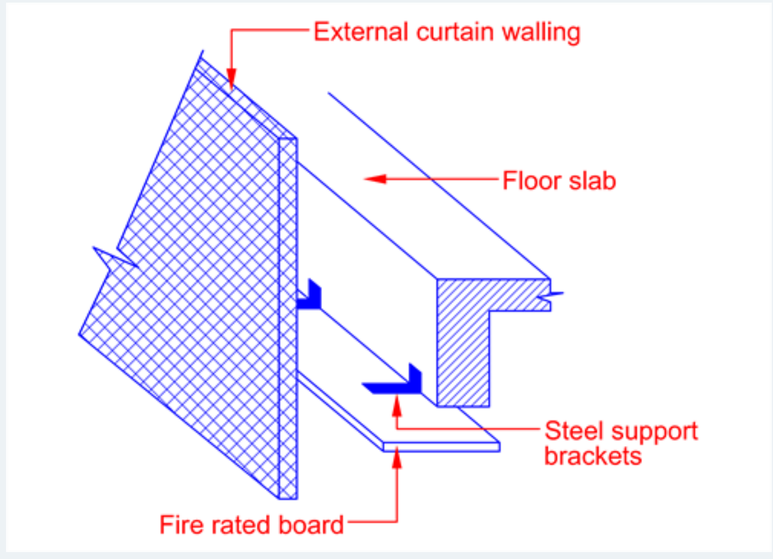
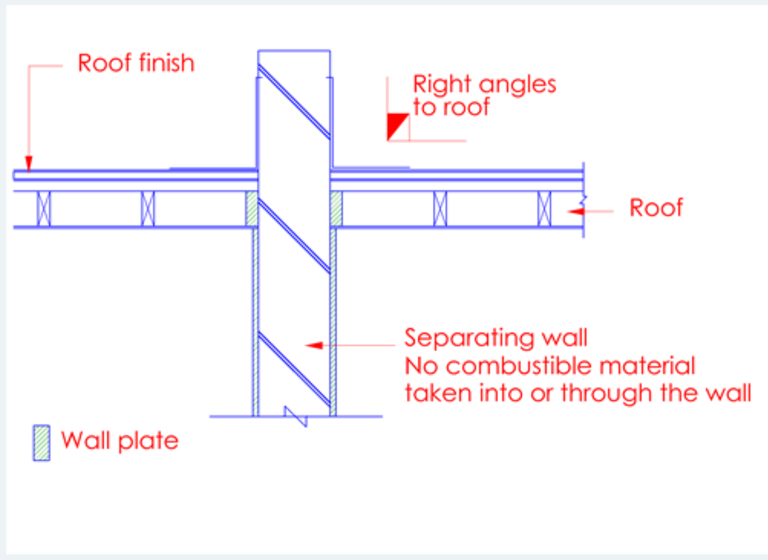


Figure 3.7.3b. – 2

3.7.4 Compartment wall - roof junctions

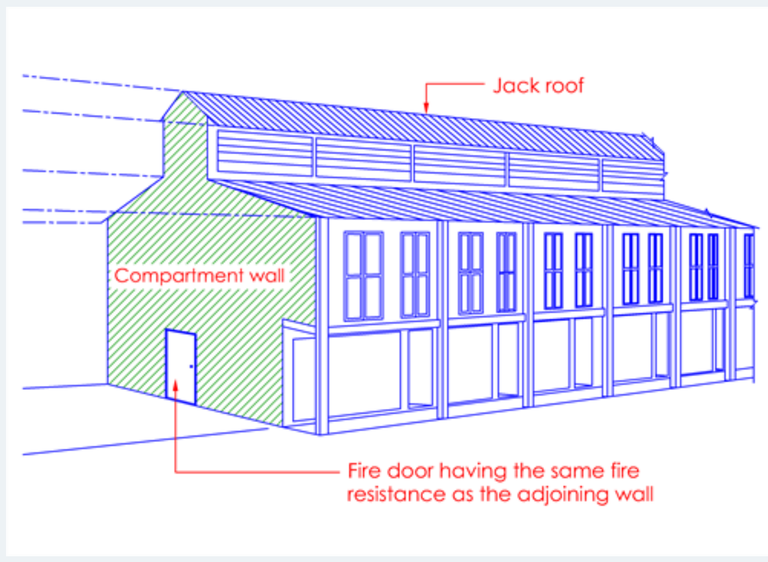
Explanation and Illustrations



Section

Figure 3.7.4 - 1

Compartment wall is carried right up above the roof coverings to act as a barrier to prevent fire spread over the roof level. The above clause addresses the concern at the junction of compartment walls with roofs and other elements of structure to prevent fire spreading through cracks and gaps at such junctions.



Axonometric view

Figure 3.7.4 - 2

Compartment wall shall be brought up to the underside of the roof coverings, including jack roof to complete the fire separation and to prevent fire spread from compartment to compartment. See also Cl.3.6.3 (separating wall – roof junction)

Where a compartment wall forms a junction with a roof, such compartment wall shall be extended up to form a close joint with the underside of the roof and shall be properly fire-stopped or shall be extended up above the level of the roof covering and the junction between such compartment wall and roof shall be properly fire-stopped so as not to render ineffective the resistance of such compartment wall to the effects of the spread of fire.

3.7.5 Prohibition of combustible materials

No combustible material shall be built into, extended through or extended across the ends of any compartment wall or compartment floor or extended over the top of any compartment wall in such a manner as to render ineffective the resistance of such wall or floor to the effects of the spread of fire.

3.7.6 Non-combustibility of compartment walls or floors

Explanation and Illustrations

(No illustration)

Construction of compartment walls and floors is to be entirely of non-combustible material, except for compartment walls or floors in buildings which are required to be retained by URA under the conservation programme. The exemption was an understanding between the SCDF and URA. As a general guide, QPs are required to seek prior consultation with the SCDF before making BP submission. There are also certain other exceptions:

a. floor finishes

b. wall or ceiling linings complying with Cl.3.13

c. suspended ceilings under Cl.3.3.6

Any structural members carrying compartment walls or floors must also comply with the requirement of non-combustibility. Apart from the contribution made by suspended ceilings under Cl.3.3.6, the fire resistance of the structural members must be attained without assistance from any combustible material (with the exception of buildings designated for conservation).

Every compartment wall or compartment floor shall be constructed of non-combustible materials, unless permitted by the SCDF.

3.7.7 Use of fire shutter

a. General

A fire shutter is permitted to be used as compartment wall, except for the fire compartmentation to comply with the requirements of *Cl.3.2.4b.*, Fire Command Centre (FCC) and means of escape, which include exit staircases, smoke-free lobbies/ fire lift lobbies, internal exit passageways, etc.

Explanation and Illustrations

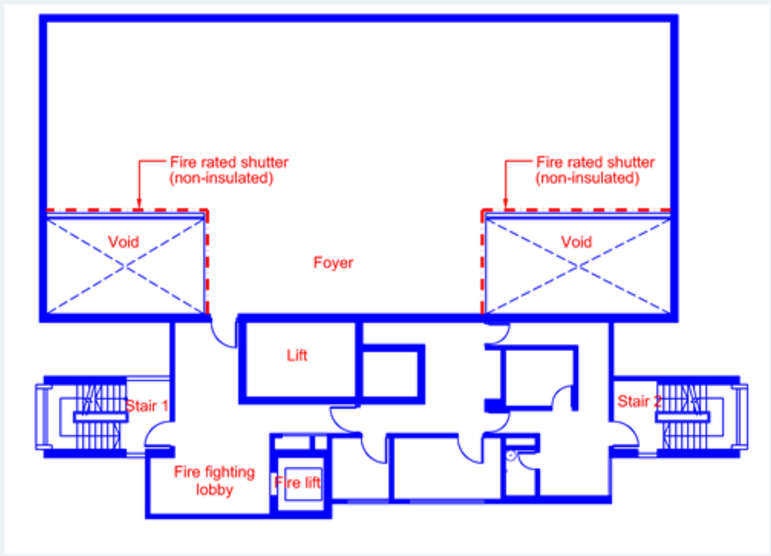


Figure 3.7.7a

The employment of fire shutter to substitute compartment wall is now permitted provided the fire shutter in-lieu of compartment wall meet stability, integrity and insulation provisions when tested to BS 476: Part 20-23. Do note that placement of combustible items around fire-rated shutter is not allowed.

b. Fire resistance

The fire shutters, which are used to protect openings in compartment wall/ floor, shall have the necessary fire resistance including thermal insulation, not less than that of the compartment wall/ floor. However, fire shutters, which are installed at the edge of atria, voids such as escalator void areas and between floors, and door way, need not have thermal insulation.

c. Operation

The commonly used shutters such as vertical, horizontal and lateral fire shutters shall comply with SS 489 and the following:

(1) Vertical fire shutter operated by gravity during a fire

Upon activation by a fire alarm system or fusible link, the operating mechanism of curtains/leaves of the vertical fire shutter shall be released. The curtain/ leaves shall descend under gravity at a controlled rate.

(2) Electrically-operated vertical, lateral and horizontal fire shutter (fusible link is not required)

Upon activation by fire alarm system, the electrical motor shall drive the curtains/ leaves to descend and shall be backed up by emergency power supply. The power and signal cables shall be fire-rated.

(3) Activation time and closing speed

(a) For vertical fire shutter with height not exceeding 6m, the maximum time for full closure of the fire shutter shall not exceed 30 secs from time of activation, with a descending speed not exceeding 0.2m/sec.

(b) For vertical fire shutter with height exceeding 6m and not more than 12m, the maximum time of full closure of the fire shutter shall not exceed 60 secs from time of activation, with a descending speed not exceeding 0.2m/sec.

d. Mode of activation

The mode of activation for fire shutters at different locations shall be as follows:

(1) Fire shutters as separating wall between two buildings (if allowed in accordance with Cl.3.6.2)

(a) Two buildings separated by a common fire shutter:

Both gravity-operated and electrically-operated fire shutters shall be linked to the fire alarm systems of both buildings and shall be activated by the fire alarm system of either building. Activation solely by fusible link is not permitted.

(b) Two buildings separated by two separate fire shutters:

Both gravity-operated and electrically-operated fire shutters shall be activated by the fire alarm system of its own building. Activation solely by fusible link is not permitted.

(2) Fire shutters as compartment wall/ floor for limiting compartment area and cubical extent

Fire shutters as compartment wall/ floor for limiting compartment areas and cubical extent, as compartment between different purpose groups, as compartment of special rooms such as kitchen, electrical room, store room, etc., and as compartment of basement passenger/ goods lift lobby:

(a) For gravity-operated vertical fire shutters, activation by fusible link is acceptable.

(b) For electrically-operated fire shutters, activation shall be by local smoke detectors.

(3) Fire shutters as compartmentation at atrium/ voids or between floors (being part of the engineered smoke control design)

Only electrically-operated fire shutters are permitted. The signal to operate the respective fire shutter shall be from a dedicated smoke detector installed at the respective smoke zone.

Explanation and Illustrations

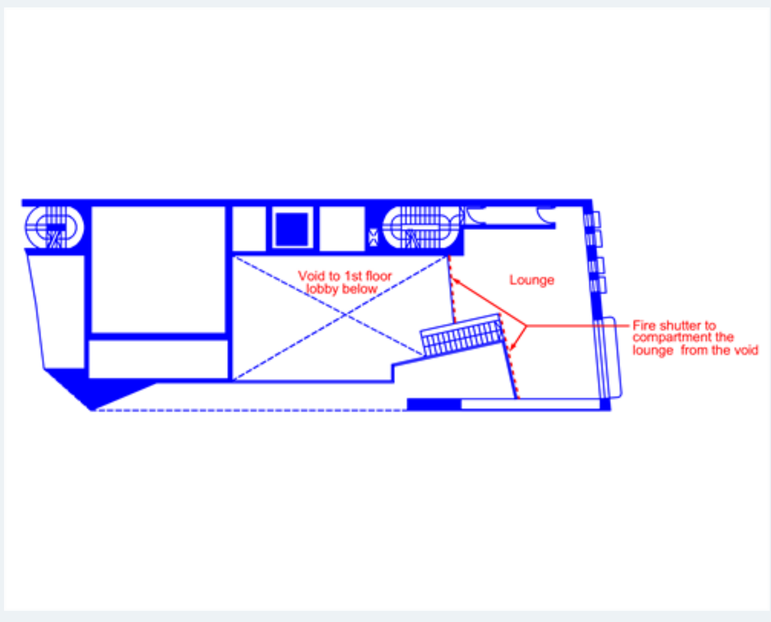


Figure 3.7.7b

The fire shutters, which are installed at the edge of atrium, void facing escalator and at door way are intended as relaxation. The reason for not requiring insulated fire shutter at door way is because the opening width is basically not overly big. The conventional fire door need not be tested to conform to insulation criterion. Hence, vertical fire shutter to substitute fire door will not be required to subject to insulation provision. All habitable spaces enclosed by the fire shutter are to be provided with exit for the occupants to escape either via a side door or a wicket door.

3.7.8 Fire safety signage for fire shutter and smoke curtain

Rationale

The additional exit directional signage on the fire shutters/smoke curtains is to guide occupants to the nearest exits as the lowered fire shutters/smoke curtains may block the building exit and/or directional signs during an fire emergency.

a. Exit directional signage marked with an arrow and the word "EXIT" shall be prominently painted/ pasted on fire shutters/ smoke curtains to redirect building occupants to the nearest exits if the activated shutters visually obscure the building exit and/ or directional signs. The sign shall be reflective and the letters at least 100mm in height.

b. Signage for alerting persons not to impede the operation of fire shutters/ smoke curtains shall be permanently displayed at prominent locations and suitable intervals close to the descending paths of the fire shutters/ smoke curtains. The lettering of the sign shall be at least 25mm high in a colour contrasting with the background and states the following where applicable:

(1) "FIRE SHUTTER – KEEP CLEAR"

(2) "SMOKE CURTAIN – KEEP CLEAR"

3.7.9 Emergency generator room

a. An emergency generator room shall be compartmented as stipulated under *Table 6.4A*.

b. An emergency generator can be located in an external space provided:

(1) the setback distance between the outdoor emergency generator from other surrounding hazards except water tank shall be at least 3m; and

(2) if there is more than one outdoor emergency generator, each outdoor emergency generator shall be separated from the other by a dividing wall of masonry construction for the full length and height of the adjacent outdoor emergency generator.

Rationale

The requirements is to ensure that emergency generators located outdoors are adequately protected from by any nearby fire which may affect their operation during an fire emergency.

CLAUSE 3.8 PROTECTED SHAFTS

3.8.1 Purpose of protected shaft

Explanation and Illustrations

The purposes of providing protected shaft are to delay or prevent the spread of fire between compartments through which staircases or other shafts pass directly and to enable people or things or air to pass between compartments. The purpose of each shaft are as follows:

a. The staircase shaft is a vertical shaft which enables the passage of movements of people.

b. The service shaft enables the passage of cable, building service ducts/pipes.

c. The lift shaft enables the movements of lift cars.

“Protected Shafts” include staircase, lift shafts, chutes, ducts or any other shaft enabling movement of people, goods, air, pipes, etc..

Protecting structures shall be treated as elements of structure for the purpose of determining the period of fire resistance rating.

Construction of compartment walls and floors shall be constructed entirely of non-combustible material. However, there were exceptions specially allowed for under the conservation programme. The exemption was an understanding between the SCDF and URA. As a general guide, QPs are required to seek prior consultation with the SCDF before making formal building plan submission.

Any structural members carrying compartment walls or floors must also comply with the requirement of non-combustibility. Apart from the contribution made by suspended ceilings under Cl.3.3.5, the fire resistance of the structural members must be attained without assistance from any combustible material (with the exception of buildings designated for conservation).

A protected shaft shall not be used for any purpose additional to those given as defined under Cl.1.4.85. All services such as, pipe/duct installation shall not be located inside a protected staircase,unless otherwise permitted in Cl.3.8.7. Likewise, no washroom is allowed to be located inside an exit staircase.

3.8.2 Requirements of protected shaft

Explanation and Illustrations

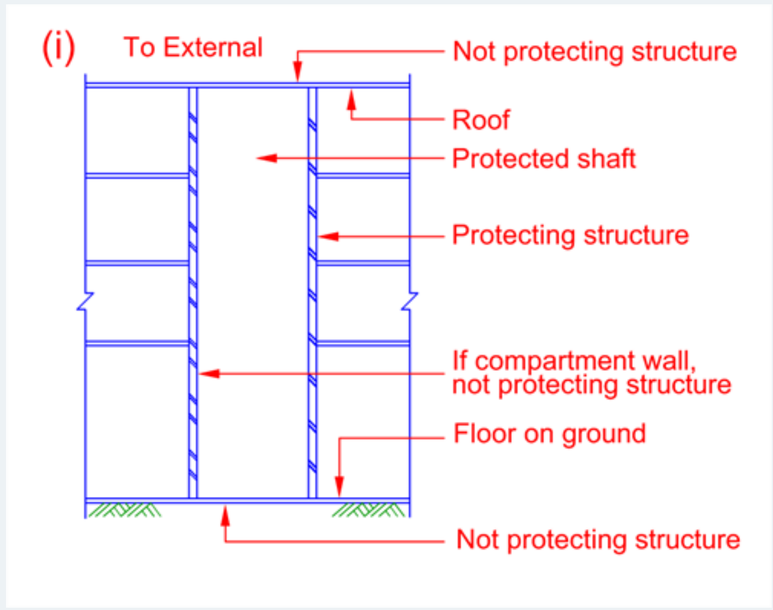


Figure 3.8.2 - 1

Protected shafts penetrate across compartments or floors in a building. They can be shafts carrying utilities (piping, electrical and telecommunication cables etc.) or service shafts carrying lifts and exit staircases. The enclosing walls and floors to the protected shaft shall be constructed of non-combustible materials, including any beam or column, which forms part of the enclosure.

In the above figure, a protected shaft is enclosed at the top by roof slab, the sides by fire-rated walls and the bottom by the ground floor slab. The protecting structures to the shaft would exclude the roof slab, which is exposed to the external, the ground floor slab, which is in contact with the ground and any compartment wall, which separates one compartment from another.

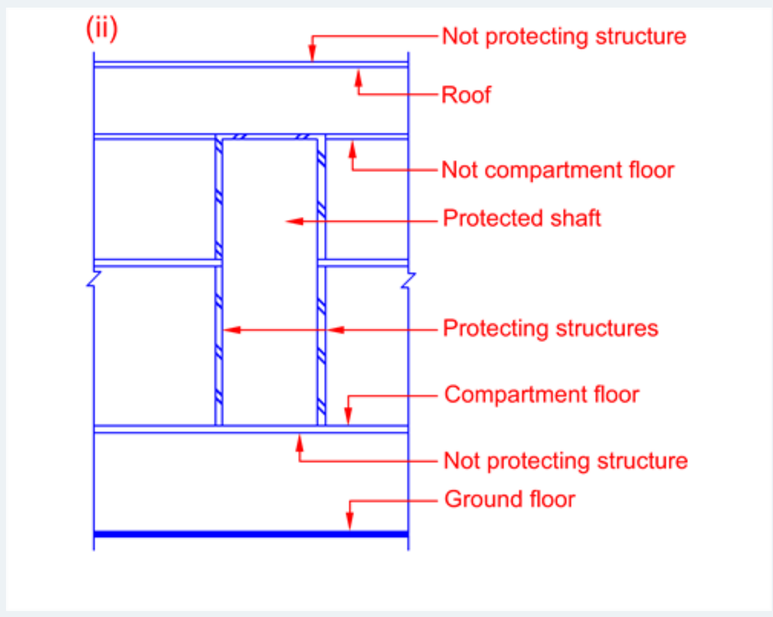


Figure 3.8.2 - 2

Protected shaft is enclosed by internal walls, ceiling and floor. Protecting structures will include the walls and slab above; and the floor at the base of shaft is excluded, because it is a compartment floor.

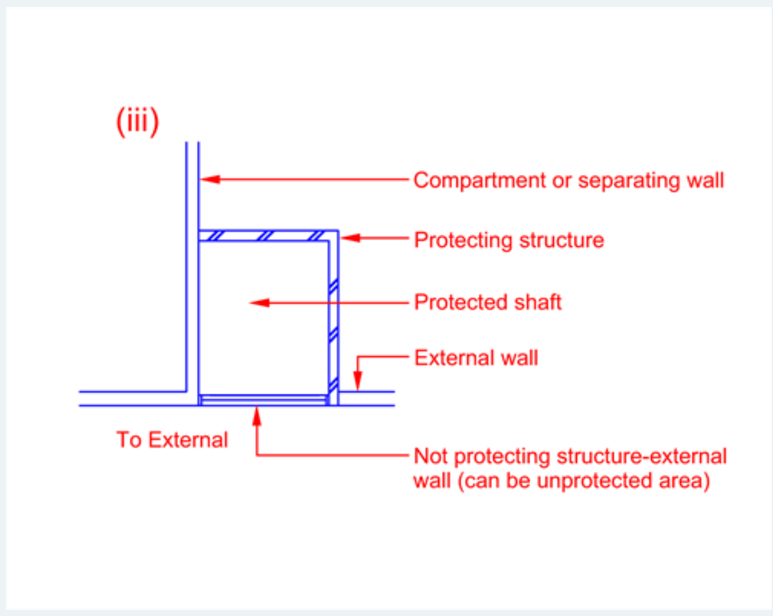


Figure 3.8.2 - 3

Protected shaft is located against an external wall. The protecting structures will include internal walls, which are not compartment or separating wall.

Where the protection afforded to a compartment is penetrated to allow the movement of people, goods or anything else between compartments by means of e.g. a staircase, lift or duct, the protection to the compartment must not be lowered or diminished. This is achieved by enclosing the means of transportation from one compartment to another in a protected shaft which is so constructed that any penetration of the enclosures to the shaft poses no direct or indirect threat to the compartments connected by the shaft. Hence, the term “protected shaft” and “protecting structure” for the structure enclosing such a shaft. The elements enclosing the shaft (unless formed by adjacent external walls) are compartment walls and floors.

The above figure illustrates a shaft, which is enclosed by compartment or separating wall, external wall and internal walls called protecting structure. The fire resistance of the compartment or separating wall should be based on the size of the floor area or cubical extent of the adjoining larger compartment and shall not be less than 1 hour.

The fire resistance of the external wall would be determined by the separation distance requirements under Cl.3.5. The external wall is not a protecting structure and could be fully unprotected areas having no fire resistance. The remaining 2 walls of the shaft are protecting structure which must be imperforate except for certain permitted openings, e.g. inspection doors which need to have fire resistance equivalent to half that of the protecting structure. All protecting structure shall be constructed of non-combustible material except for surface linings, which shall comply with Cl.3.13. The fire resistance of the protecting structures shall be that for the elements of structure of the building.

Protecting structures exclude external wall. External walls need not have fire resistance rating, subject to complying with Cl.3.5 to be unprotected areas.

Every protected shaft shall be required to:

a. form a complete barrier to fire between the different compartments which the shaft connects;

b. have the appropriate fire resistance to comply with the requirements of Cl.3.3; and

c. be constructed of non-combustible material (together with any beam or column which forms part of the enclosure and any structure which carries it).

3.8.3 Openings in protected shaft

a. A protected shaft shall have no openings in its enclosure, except in the case of any part of the enclosure:

(1) which is formed by a separating wall, any opening which complies with the requirements of Cl.3.6 for separating walls, or

(2) which is formed by a compartment wall or a compartment floor, any opening which complies with the requirements of Cl.3.7 for compartment wall or compartment floor, or

Explanation and Illustrations

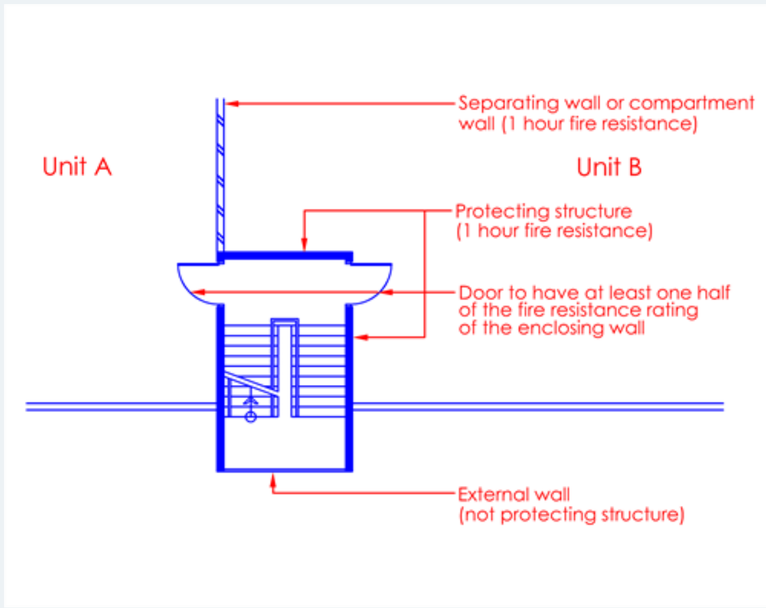


Figure 3.8.3a.(1)

Protected shaft bounded on three sides by protecting structure and fourth side by an external wall. Permitted opening to each unit shall be protected by a door of at least one half of the fire resistance rating of the enclosing wall, or half an hour, whichever is the greater. The aggregate fire resistance of the 2 doors shall not be less than the fire resistance of the protecting structure.

(3) which is formed by the protecting structure:

(a) a door which has the appropriate fire resistance to comply with the requirements of Cl.3.4 for test of fire resistance, or otherwise permitted by provision of Cl.3.8.6, or

(b) the passage of a pipe, excluding protecting structure to exit staircase and exit passageway, or

(c) inlets to and outlets from and opening for the duct, if the shaft contains or serves as a ventilation duct.

b. Such openings in the protected shaft shall be protected to comply with the relevant provisions of Cl.3.9 for protection of openings.

Explanation and Illustrations

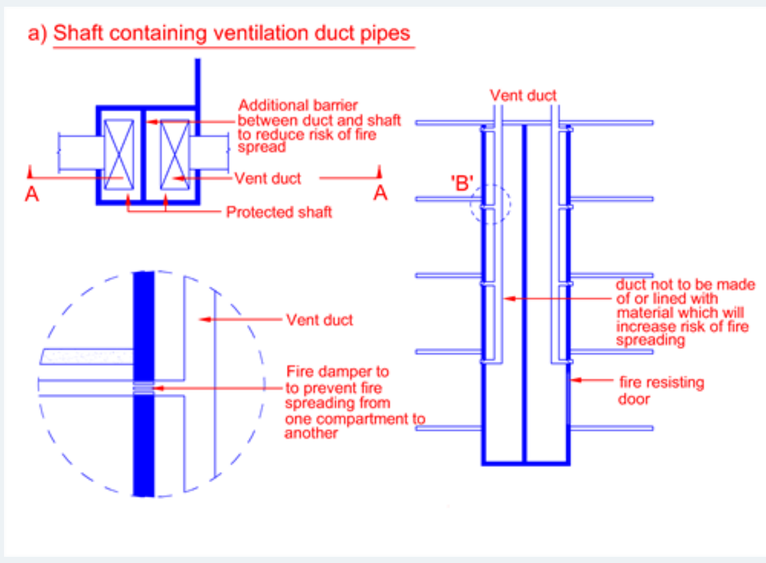


Figure 3.8.3a.(3) – 1

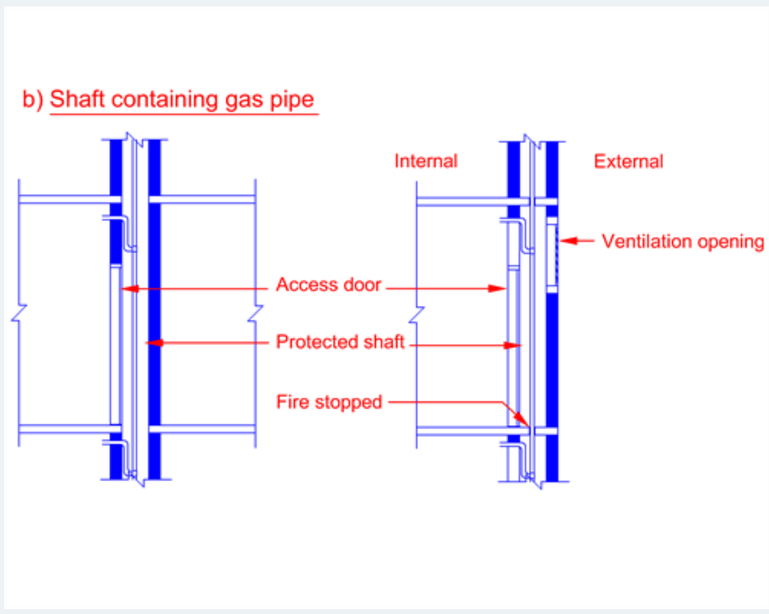


Figure 3.8.3a.(3) – 2

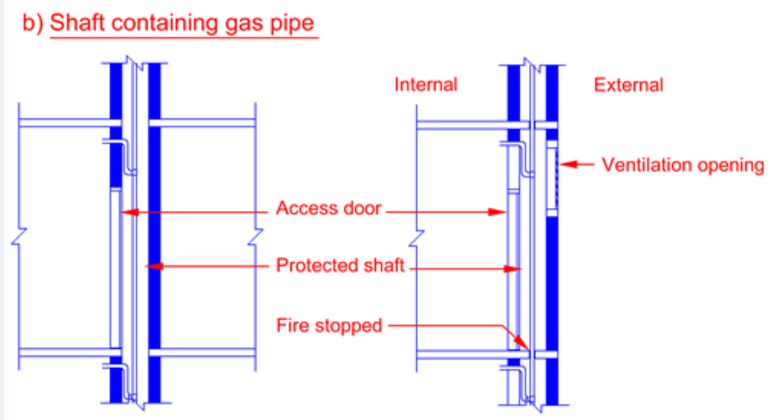


Figure 3.8.3a.(3) - 3

Fire resisting doors to comply with Cl.3.9.2 and shall have ½-hr fire resistance or half the resistance of the enclosing walls, whichever is the greater:

a. Any opening in compartment floor/wall would constitute a break in compartmentation. Therefore even small service pipes, strictly speaking must be enclosed in protected shaft.

b. However, Cl.3.9 allows pipe size not greater than those sizes provided in *Table 3.9A* to be unprotected, provided the pipes are to be spaced at min. 50mm apart or half the diameter of the larger pipe, whichever is larger. This is to avoid clustering of pipes which would weaken the compartment floor or wall

c. Openings in compartment floors to accommodate staircases, lifts and services form a vertical shaft which can become a ready means of passage of fire from one storey to another, accentuated by the flue effect created by a fire.

d. Hence, protected shafts are needed to maintain the overall fire integrity of the building. However, these shafts need to have door openings for movement of people, e.g. staircase, lifts and maintenance purposes in the case of shafts containing services. All the door openings to protected shaft are considered the sources of weakness in the integrity of the shafts and they must be protected.

e. Door openings

Doors in protected shaft must have at least ½-hr fire resistance rating or half the fire resistance of the protecting structure whichever is greater.

Such a relaxation from the full standard of fire integrity is reasonable as it is expected that combustible materials would not be placed next to the door and that a fire has to break into the shaft and break out again at the upper level. Also if the top of the shaft is adequately ventilated, the tendency for lateral spread is considerably reduced.

f. The primary purpose of protecting structure is to provide the compartmentation between floors. As such the structure shall have full fire resistance as the elements of structure. The relaxation on fire resistance accorded to fire doors shall not be extended to the protecting structure i.e. halve the fire resistance of the elements of structure. The main reason is that by halving the fire resistance of protecting structure, the threat of failure and collapse of the enclosing walls would be greater in times of fire emergency and should the walls collapse, large opening would be created in the shaft to permit the spread of fire and smoke, which is not acceptable. As to door openings in protected shaft, the eventual failure of the fire door is considered acceptable owing to the limited door opening size. See illustrations (c) and (d) [*Figure 3.8.3a.(3) - 3*].

g. Ventilation ducts

Ventilation ducts are usually constructed of sheet metal, which do not have fire resistance and therefore should a fire occur, they will quickly distort and collapse leaving a hole in any wall through which they pass. Conversely, a fire occurring in the duct could also cause collapse.

Therefore, where the duct penetrates the protected shaft, a fire damper should be fitted at the opening of the protecting structure. The fire damper shall be capable of sealing the opening in the protecting structure and be installed independently of the duct trunking. In this way, the fire damper would not be affected by collapse of duct work and be able to maintain the fire integrity of the shaft. See illustration (a) [Figure 3.8.3a.(3) - 1].

h. Pipes

Where pipes are contained within a protected shaft, the problem of maintaining the integrity of the fire compartment is made simple, irrespective whether the pipes are made of UPVC or combustible materials. However, for gas pipes or pipes containing combustible liquids, they shall be located in separate shafts.

i. The construction of gas pipes shaft is different from other shafts owing to the need to provide through or external ventilation. Gas pipe shaft shall comply fully with SS CP 51. See illustration (b) [*Figure 3.8.3a.(3) - 2*].

j. General

In order to maintain the level of integrity of protected shafts, openings in protected shafts shall be restricted to the following:

(1) Openings for pipe

(2) Door openings to lift shaft, staircase

(3) Openings for ventilation ducts

(4) Access openings for electrical cables shaft

(5) Openings for chutes, linen or refuse

3.8.4 Non-combustibility of protecting structures

Explanation and Illustrations

(No illustration)

The requirement that all protecting structure shall be constructed of non-combustible materials is also spelled out under Cl.3.8.2. As to the provision of combustible finishes to floor, wall and ceiling, it must be observed that such provision will not be permitted inside protected shafts that are used for the passage of people such as exit staircases and exit passageways under Cl.3.10.4 and Cl.3.13.6.

Every protecting structure shall be constructed wholly of non-combustible materials except that floor, wall and ceiling finishes which do not contribute to the fire resistance of such protecting structure are not be required to comply with the requirements for non-combustibility.

3.8.5 Ventilation of protected shaft

Explanation and Illustrations

(No illustration)

Protected shaft used for passage of people, such as exit staircases shall be provided with adequate natural ventilation by fixed openings in the external walls. Such openings shall have an area of not less than 10 percent of the floor area per floor of the staircase. Alternatively, the staircase can be mechanically ventilated under *Cl.2.3.3d.(7)*. However, for internal exit staircase serving more than 4 storeys, the supply air shall be mechanically conveyed via a vertical duct extending through the staircase height and discharging from outlets distributed at alternate floor. Where the internal exit staircase exceeds 24m in height without provision for natural ventilation, the staircase shall be pressurised in accordance with *Cl.2.3.3d.(8)*.

The mechanical ventilation system to internal staircase serving more than 4 storey and the pressurisation system to internal exit staircase exceeding 24m shall be connected to emergency power supply. In addition, a remote manual start-stop switch shall be make available to firefighters at the fire command centre, or at the fire indicating board where there is no FCC. The start-stop switch provides the firefighter a quick means to shut-off the fans should it be detected that smoke had been drawn into the staircase by the fresh air supply fan.

A protected shaft conveying piped flammable gas should be adequately ventilated directly to the outside air by ventilation openings at high and low level in the shaft or comply with the modes of ventilation allowed in SS 608. All gas pipe installations shall be vetted and approved by acceptable organisation (e.g. Powergas) before any works can be carried out on site.

Ventilation of protected shaft shall comply with the following:

a. A protected shaft used for the passage of people, such as exit staircases, shall be ventilated to comply with the relevant provisions of the Code.

b. A protected shaft containing a pipe conveying gas shall be adequately ventilated directly to the outside air or have other modes of ventilation allowed under *SS 608*.

3.8.6 Doors in protecting structures

Explanation and Illustrations

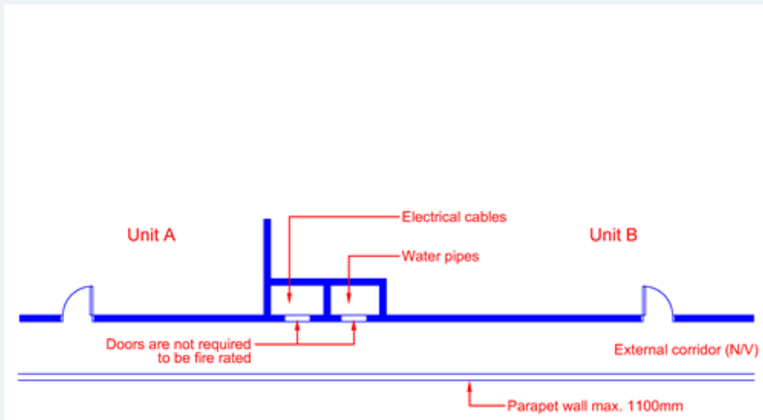


Figure 3.8.6 - 1

As the doors in the electrical and pipe shafts are opening into an external corridor which is naturally ventilated, there is no need to fire rate the doors.

Protected shaft A serves 2 compartments. Compartment A could be a common area e.g. lounge and compartment B in factory/warehouse unit.

Door A1 is opening in the direction of exit travel, whereas door A2 is the entrance door of the factory/warehouse unit, which swings inward. The number of exit door openings in a protected shaft containing an exit staircase shall not exceed two per floor. This is to prevent additional openings from weakening the integrity of the protecting structure.

The aggregate fire resistance of door A1 and A2 shall not be less than the compartment wall or the protecting structures to the shaft. This is to ensure that the fire resistance between compartment A and B is not reduced at the door openings.

Door A1 can be held in the open position provided it is fitted with electromagnetic or electromechanical device. See Cl.1.4.34.

All doors in shaft A & B shall have the fire resistance rating of half that of the enclosing protecting structures to the shafts, but shall never be less than half hour. See also Cl.3.8.3 for further explanation.

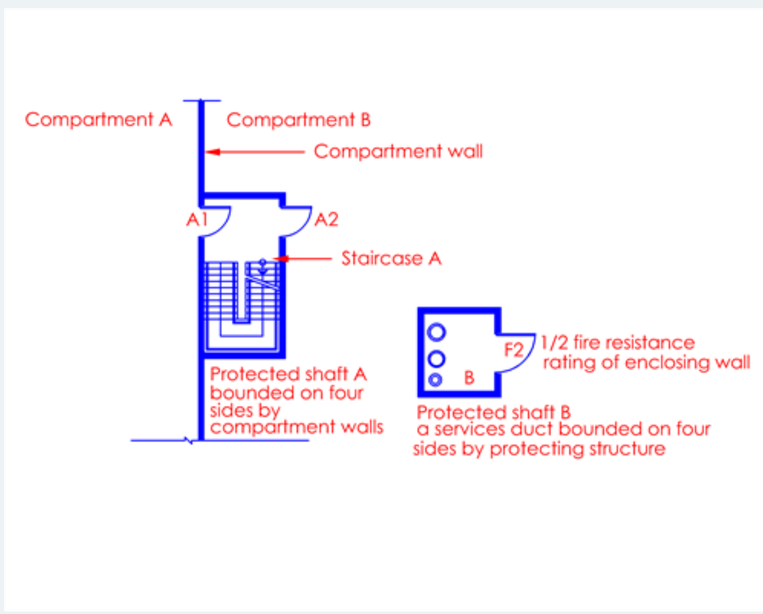


Figure 3.8.6 - 2

Protected shaft A serves 2 compartments. Compartment A could be a common area e.g. lounge and compartment B in an office unit.

All doors in shaft A & B shall have the fire resistance rating of half that of the enclosing protecting structures to the shafts, but shall never be less than half hour. See also Cl.3.8.3 for further explanation.

Door A1 is opening in the direction of exit travel, whereas door A2 is the entrance door of the health care occupancy unit, which swings inward. The number of exit door openings in a protected shaft containing an exit staircase shall not exceed two per floor. This is to prevent additional openings from weakening the integrity of the protecting structure.

The aggregate fire resistance of door A1 and A2 shall not be less than that of the compartment wall or the protecting structures to the shaft. This is to ensure that the fire resistance between compartment A and B is not reduced at the door openings.

Door A1 can be held in the open position provided it is fitted with electromagnetic or electromechanical device. See Cl.1.4.34.

a. Any door fitted to an opening in protecting structure shall have fire resistance for not less than half the period required by other provisions of the Code for the protecting structure surrounding the opening.

b. Exception

(1) Any door fitted to an opening in protecting structure of a shaft containing services, such as electrical cables, pipes (including gas pipe in separate shaft), ducts etc., is not required to have the fire resistance rating if the door is located along the wall facing the external corridor.

(2) Any metal door fitted to an opening in protecting structure of a rubbish/ bin chute is not required to have the fire resistance rating if:

(a) the thickness of the rubbish/ bin chute door is at least 1.5mm;

(b) the rubbish/ bin chute door is sealed with rubber gasket; and

(c) the rubbish/ bin chute door shall be self-closing type.

c. Any door fitted to an opening in protecting structure of a shaft containing services, such as electrical and telecommunication cables, pipes (including gas pipe in separate shaft), ducts etc., is not required to comply with the requirements in *Cl.2.3.9d.(2)* if it is fitted with a self-closing device. Rising mains and hose reel doors shall not be fitted with self-closing device and shall comply with the stipulated corridor width when the door is in its fully opened position. Areas within the swing paths of the rising mains and hose reel doors shall be clear of any obstruction/ storage at all times.

3.8.7 Protected shaft containing exit staircase

a. A protected shaft which contains an exit staircase shall not contain any services e.g. pipes, cables, ducts, etc., that are not solely serving the same exit staircase (even if the services are protected with fire-rated dry construction), except for:

(1) cut-off sprinkler and pipe for that staircase;

(2) UPVC or cast iron rain water downpipes serving the roof directly above the exit staircase, and not routed through anywhere outside the staircase;

(3) rising mains;

(4) metal water supply pipe and water tap not exceeding 50mm in nominal diameter; and

(5) access control systems (comprising facial recognition camera, manual override mechanism, CCTV, etc.) installed inside naturally ventilated exit staircase for the exit door to allow restricted access to the roof level shall comply with all of the following:

(a) Cables shall be housed in metal conduits.

(b) Electrical components installation in accordance with *SS 638*.

Explanation and Illustrations

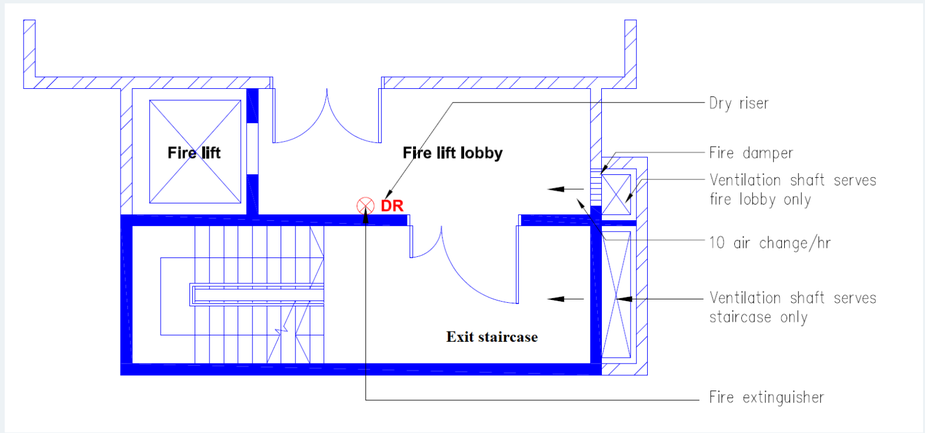


Figure 3.8.7a.

A fire lift and fire lift lobby in a building, which exceeds 24m in habitable height, have to be complemented by an exit staircase adjacent to them. Separate ventilation shafts are required to be provided for the staircase and fire lift lobby as depicted in *Cl.7.1.10.*

Exit staircases serving any building irrespective of the height, shall be devoid of combustible wall, floor and ceiling finishes. Building services which are not solely serving the exit staircase shall not be allowed to be routed through or inside the staircase. This is to prevent any possibilities of a fire occurring inside the staircase and the spread of fire into the staircase via the services such as electrical cables, ducts, combustible pipes, etc.. Cl.6.2.2 of the Fire Code allows vertical stack of rising main and landing valve to be located inside the staircase as a last resort where smoke-stop lobby and common area outside the staircase are not available. SS CP 10 allows sub-alarm panels to be located in the exit staircase provided there is no fire lift lobby or smoke-stop lobby in the building. The fire alarm cables shall be in metal conduit or trunking. This relaxation shall not apply to buildings which are more than 4 storeys in height where provision of smoke-stop lobby is a requirement.

The exit staircases are the means of escape in fire emergencies. All occupants must use the staircases to evacuate safely from any storey level to the final exits at ground level. The time taken to descend a staircase in a high-rise buildings could be more than an hour. With the staircase fully packed with evacuating occupants during an emergency, the staircase must be maintained safe from smoke, heat and fire throughout the fire resistance period of the enclosing protecting structures to the staircase. An exception is allowed under *Cl.3.8.9d.* for maximum 4 storey residential building.

b. The protecting structure shall be constructed of masonry, or drywall. If drywall construction is used, all of the following conditions shall be complied with:

(1) the drywall shall be non-combustible;

(2) the drywall shall have fire resistance rating for not less than the relevant period specified in *Table 3.3A* having regard to the purpose group of the building of which it forms a part and the dimension specified in that table;

(3) the drywall shall, in terms of impact & deflection performance, meet the partition grade specified under BS 9999 (Test for partitions) in accordance with *BS 5234-2*;

(4) the drywall shall meet the criteria, in terms of water absorption and bending strength performance, when subject to the test of *BS EN 520* or *ISO 1896*; and

(5) the building shall have at least two independent exit staircase shafts (scissors exit staircases are considered single shaft).

Explanation and Illustrations

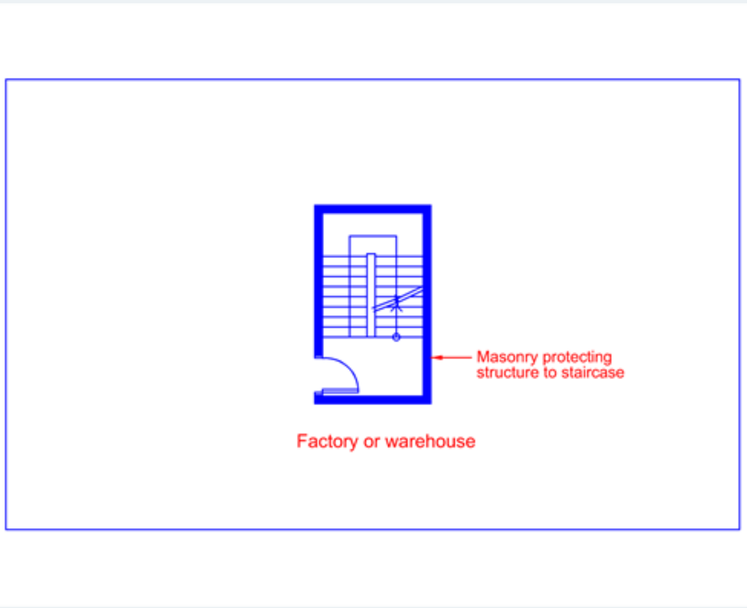


Figure 3.8.7b. - 1

Building designed with single exit staircase shall have the protecting structure constructed of masonry, which is more solid and stable than fire-rated dry walls. The main concern is that if the protecting structure, which is constructed of dry wall is damaged, smoke and heat would get into the staircase to affect the evacuees making their way down. Single exit staircase shall have its protected structure constructed of masonry.

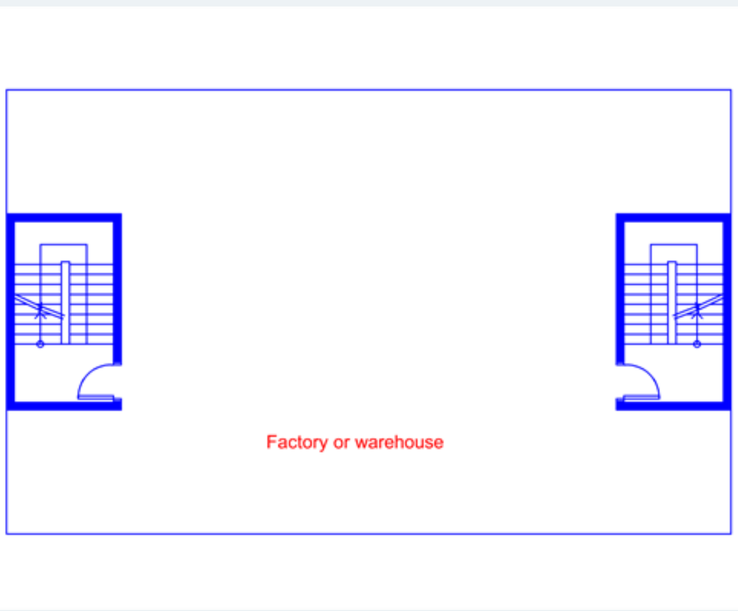


Figure 3.8.7b. - 2

Where two independent staircases are provided, the protecting structure to each of the staircase can be constructed of drywall.

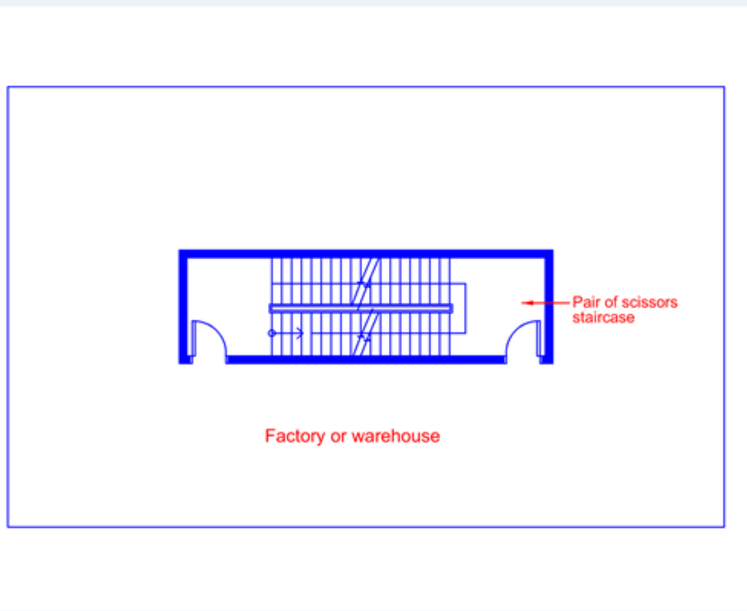


Figure 3.8.7b. - 3

Where a building is designed with a pair of scissors staircases to meet the provision of exit requirements, the scissors staircases shall be considered as within a common shaft if drywall is used for the construction of the protecting structure. The main reason is that if one of the shaft is damaged, the other shaft is likely to be affected, thereby causing smoke to get into both staircases. This would render the pair of scissors staircases inaccessible. In addition, the drywall enclosures are prone to other damages, thus affecting the effectiveness and integrity of the protected shafts. However, for the purpose of exit computation, the pair of scissors staircases shall literally be taken as 2 staircases though it could only qualify as a single shaft.

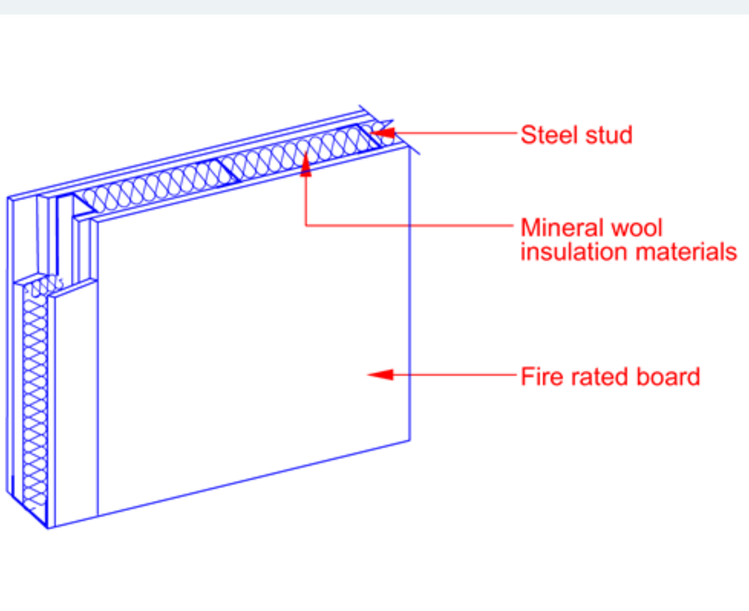


Figure 3.8.7b. - 4 : Drywall construction

Non-combustible steel studs, insulation materials and fire-rated boards shall be used for the construction of drywall.

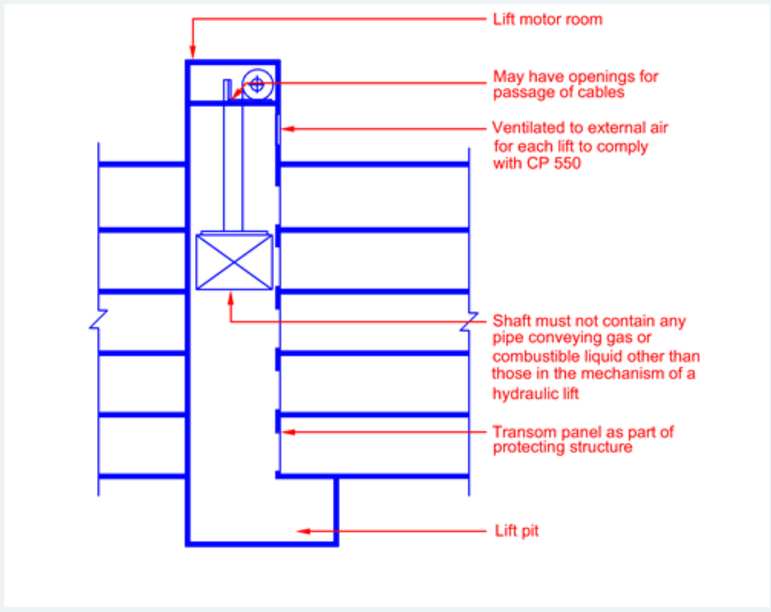
3.8.8 Lift shaft

A protected shaft which contains a lift shall comply with the following:

a. It shall not contain any pipe conveying gas or combustible liquid, other than those in the mechanism of a hydraulic lift.

b. The protecting structure shall be constructed of masonry, or drywall. If drywall construction is used, the conditions stipulated under *Cl.3.8.7b.(1)* to *(5)* shall be complied with. The drywall shall also meet the criteria of cyclic loading and dynamic test as specified under Cl.3.3 of the National Construction Code of Australia *C 1.8*.

Explanation and Illustrations

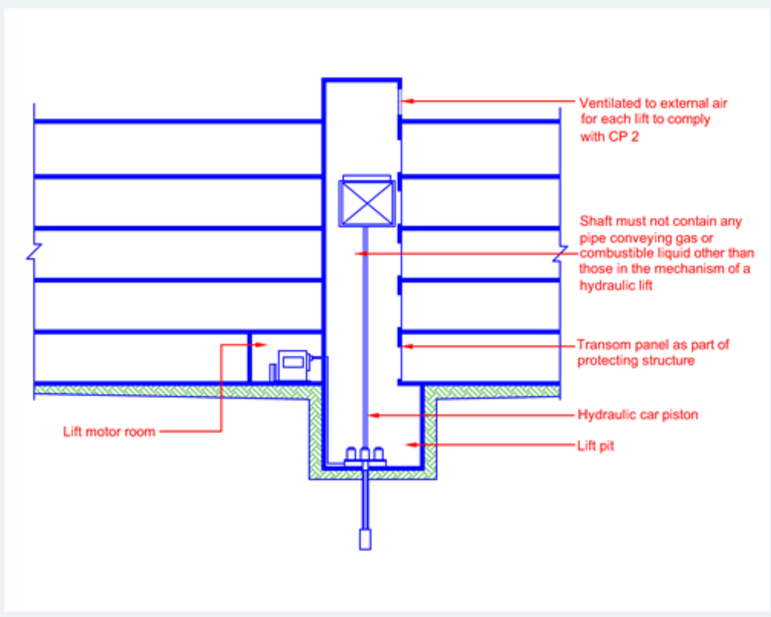


Section

Figure 3.8.8a. - 1 : Protected shaft for electrical lift

Lift shaft which is not located at the edge of atrium floors or at the external wall outside the building shall be constructed of masonry.

Cl.3.8.8a. specifically permits combustible liquid in the mechanism of hydraulic lift. The liquid is concealed in vessels and forms part of the mechanical system to permit the homing of the lift during an emergency. The liquid has a high flash point of over 400°C.



Section

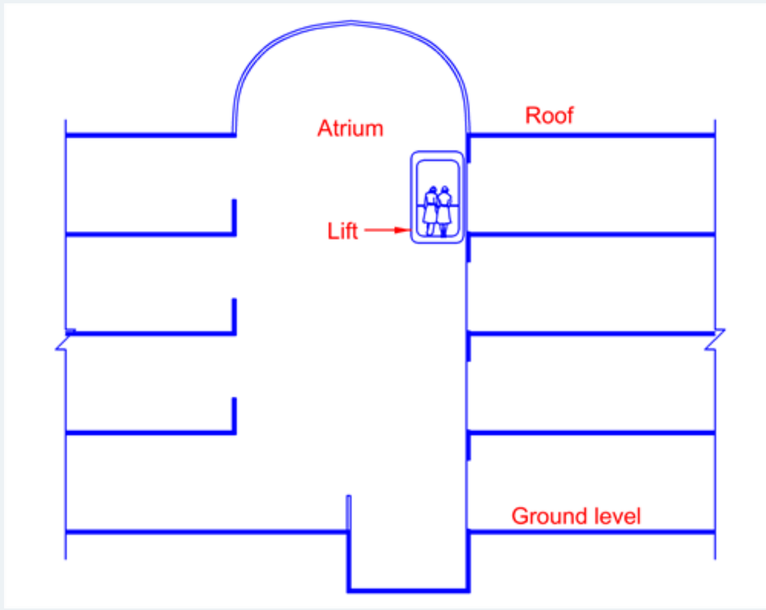
Figure 3.8.8a. - 2 : Protected shaft for hydraulic lift

Lift shaft, which is not located at the edge of atrium floors or at the external wall outside the building, shall be constructed of masonry.

Cl.3.8.8a. specifically permits combustible liquid in the mechanism of hydraulic lift. The liquid is concealed in vessels and forms part of the mechanical system to permit the homing of the lift during an emergency. The liquid has a high flash point of over 400°C.

c. Where a lift is either located at the edge of atrium floors or at the external wall and outside the building, the lift shall be considered as not enclosed within a protected shaft.

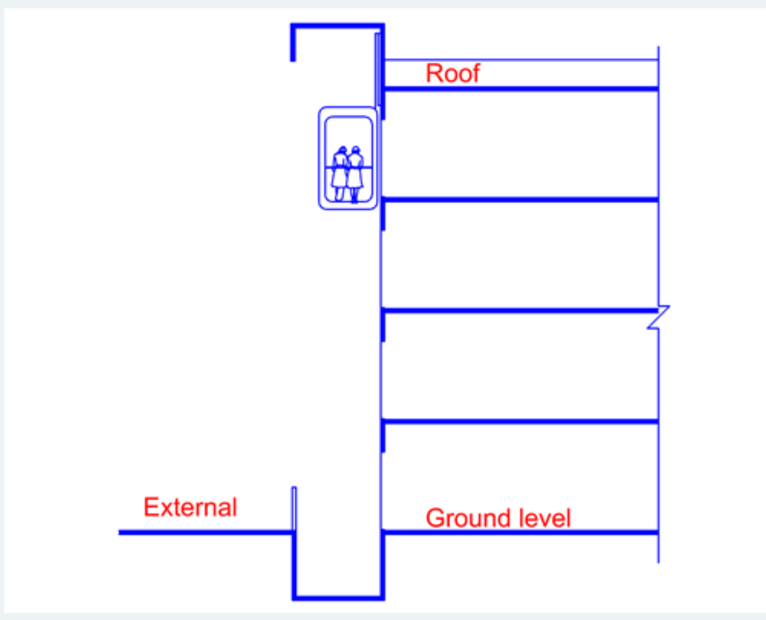
Explanation and Illustrations



Section

Figure 3.8.8c. - 1

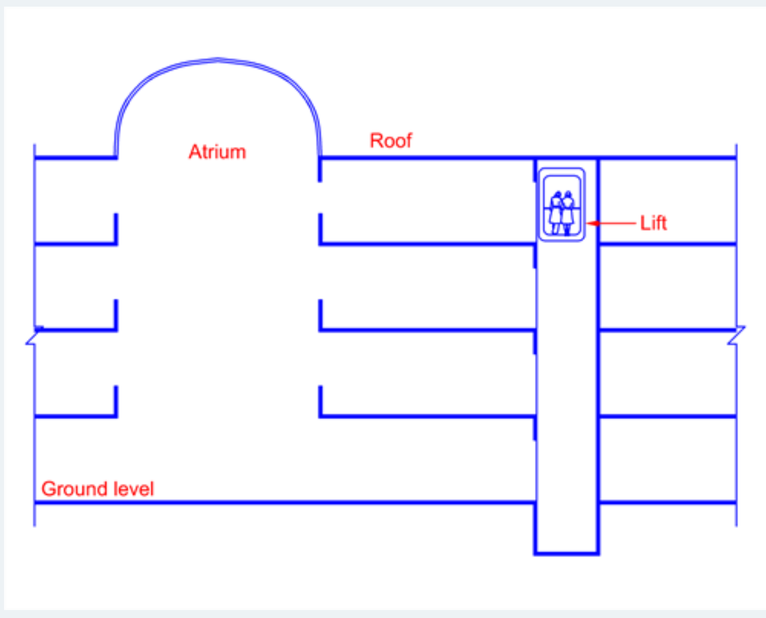
In the above figure the lift is unenclosed and being located within the atrium void. There is no penetration of any compartment floor and smoke migration caused by the 'piston-effect' of lift movement is no longer a concern. Smoke from a fire in any occupancy floor will flow from the ceiling layer into the atrium void where it will tend to rise upwards due to its natural buoyancy. A smoke control system would eventually extract the smoke out of the building.



Section

Figure 3.8.8c. - 2

The lift is sited outside the external wall of the building. There is no concern of smoke and heat being transferred from floor to floor. Hence it is not required to be enclosed in a protected shaft. This type of lift is commonly known as 'bubble lift' or 'sky lift'.



Section

Figure 3.8.8c. - 3

The above figure shows that the lift is located away from the atrium void. As the lift punctures through the compartment floors, it must be enclosed in a protected shaft to prevent the spread of smoke and heat from floor to floor.

d. The protected shaft shall be vented in accordance with *SS 550*. The vents shall be so arranged as to induce exhaust ventilation of the shaft. Where vents cannot be provided because of the location of the lift shaft, a ventilation duct protected by drywall complying with *Cl.3.8.7b.* serving as ventilation of the shaft may be provided instead. If the duct is not fire-rated, fire dampers shall be provided to the duct at the wall of the lift shaft, provided such relaxation shall not apply to shafts containing a fire lift.

e. Openings for the passage of lift cables into the lift motor room located above or at the bottom of the shaft shall be as small as practicable.

Explanation and Illustrations

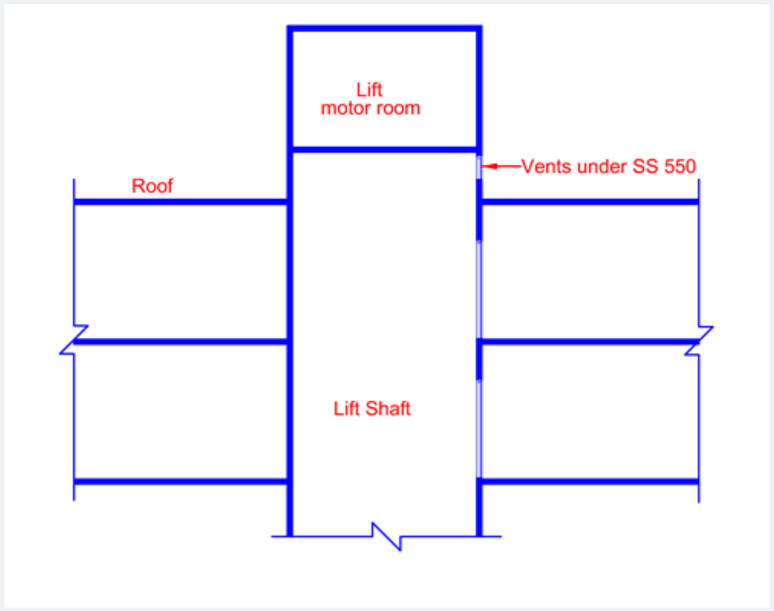


Figure 3.8.8d. – 1

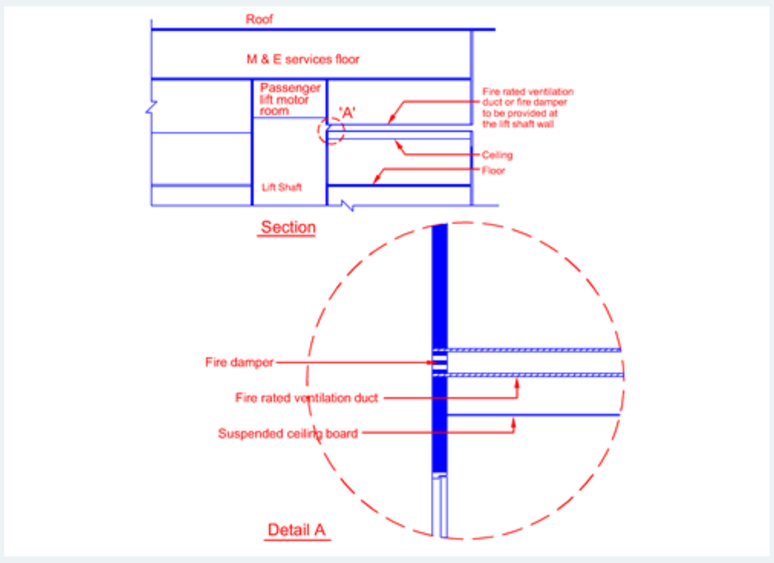


Figure 3.8.8d. – 2

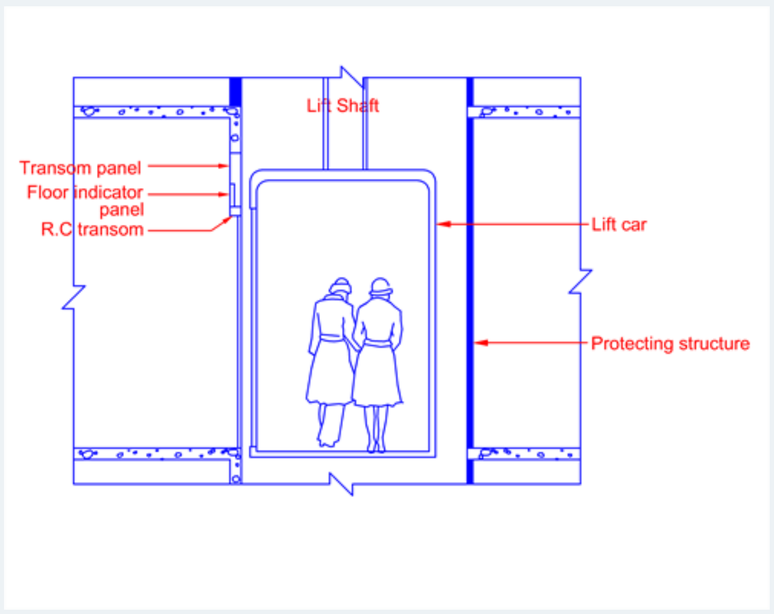
All lift shafts shall be vented at the top in accordance with SS 550. In situations, where the lift shafts could not be brought above the roof as shown in Figure 3.8.8d. – 2, horizontal fire rated duct could be used to provide air relief to the lift shaft. If the duct is not fire rated, appropriate fire damper could be provided in the wall of the protected lift shaft as shown 'A' in the above diagram. The above relaxation shall not be applicable to fire lift.

f. Fire resistance

(1) A transom panel above the lift entrance shall be considered as part of the protecting structure and shall therefore conform to the fire resistance requirements of the protecting structure.

(2) In the case of motor-room-less lifts, the lift control panel enclosure located at the lift lobby shall not affect the fire resistance requirements of the protecting structure.

Explanation and Illustrations



Section

Figure 3.8.8f.

Floor indicator panel should be surface mounted. If it is built into the transom panel, care should be taken to ensure that the fire resistance of the panel is not lowered. It is a common mistake to puncture the transom panel to receive the floor indicator panel without giving consideration to the fire integrity of the panel. Such practice contravenes the above requirement, as Cl.3.8.2 requires that the protecting structure, including the transom panel, forms a complete barrier and should have the appropriate fire resistance rating.

g. If it serves any basement storey, it shall be enclosed by a protected lobby with walls having 1-hr fire resistance rating and fire door of ½-hr fire resistance rating. If the protected lobby also acts as a smoke-free lobby required under Cl.2.2.13, it shall be mechanically ventilated in accordance with Cl.7.1.10.

Exception:

(1) Where the lift landing area is adjoining an air well or external space of minimum clear area 10m² and minimum width of 3m, the distance between the nearest edge of lift door opening to the air well shall not exceed 3m.

(2) Where the basement storey forms part of a building under PG I or a single household cluster housing compartment within a PG II development and has a basement area not exceeding 100m².

Explanation and Illustrations

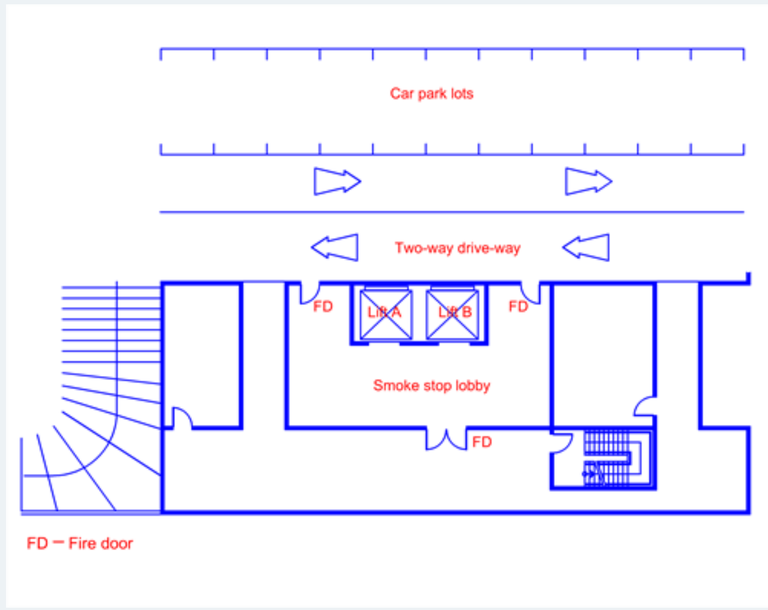


Figure 3.8.8g. - 1

Lift opening into basement and not adjoining a void that opens to the sky or any external spaces, shall be provided within a smoke-stop lobby having 1-hr fire-rated enclosures and ½-hr fire door.

The smoke-stop lobby acts as a buffer zone to prevent smoke from being drawn into the lift shaft through the 'piston-effect' of the movement of the lift.

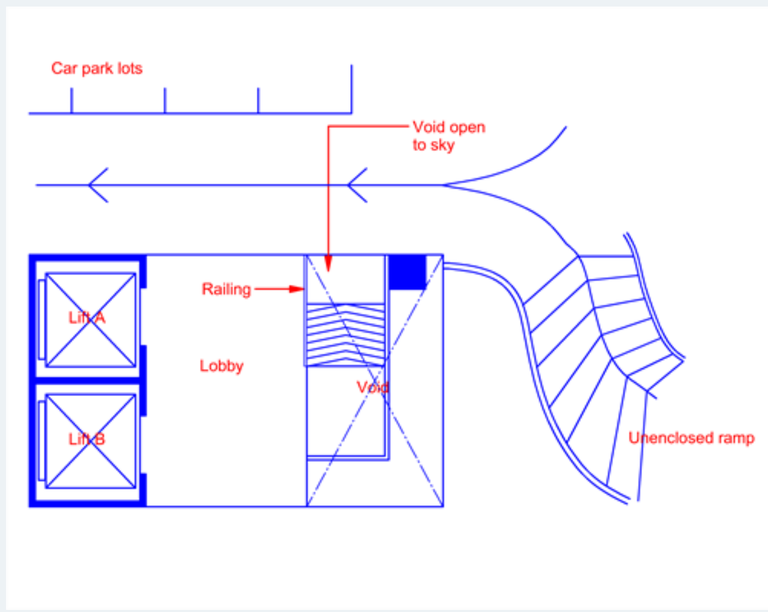


Figure 3.8.8g. - 2 : Basement floor plan

Lift opening into basement storey and adjoining a void opening to the sky or any external spaces does not require a smoke-stop lobby. Smoke occurring in the vicinity of the lift would be drawn into the void and vented upward into the open space. This provision would help to reduce the chance of smoke being sucked into the lift shaft.

h. Private lift

A private lift that is provided for the exclusive use of occupants in residential buildings under PG II shall comply with all of the following requirements:

(1) A smoke detector shall be provided at the lift landing area. The activation of any of the smoke detectors at the lift landing area shall cause the lift to home to the designated floor.

(2) Emergency power supply from a standby generating plant shall be provided to home the lift to the designated floor when there is a power failure in the building.

Explanation and Illustrations

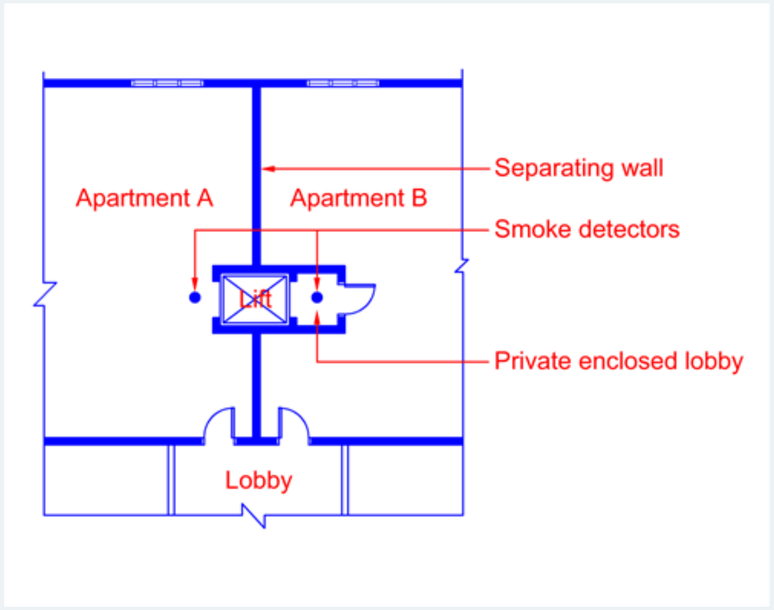


Figure 3.8.8h. – 1 : Private lift

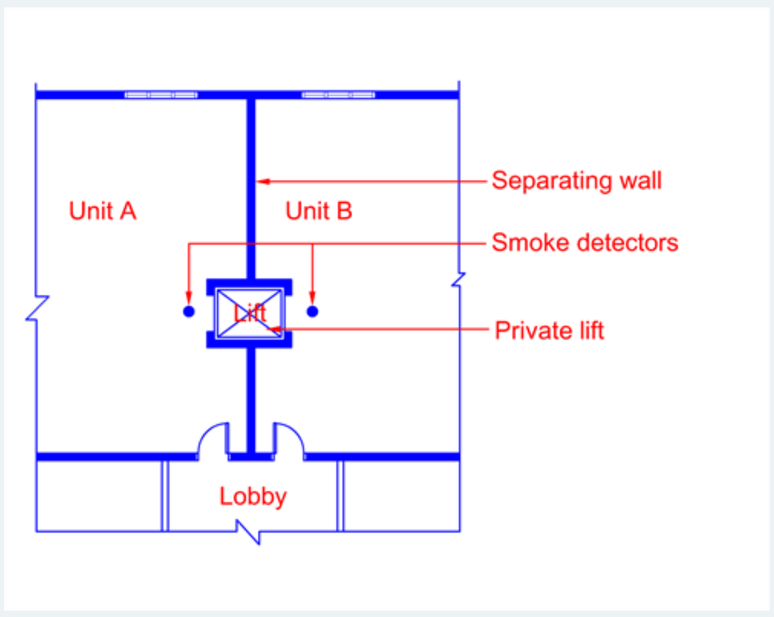


Figure 3.8.8h. - 2

(3) An alternate designated floor (e.g., any other floor with common lobby) shall be identified. The lift shall be brought to the alternate designated floor in the event that there is a fire at the 1st storey designated floor. For buildings without an alternate designated floor, the lift shall return to the last called floor in the event that the designated floor is on fire.

(4) The lift shall not serve as a fire lift.

(5) Private lifts shall comply with *SS 550*.

Rationale

This requirement is to ensure that a private lift will not home to the designated floor if it is on fire. For residential buildings having private lifts and are unable to provide an alternate designated floor, the lift control has to be programmed to bring the passengers to a safe floor, normally the last called floor, for egress if the fire is on the designated floor.

3.8.9 Protected shaft containing other services installations

A protected shaft used for the enclosure of services shall comply with the following:

a. The protecting structure for a protected shaft, containing mechanical ventilation ducts serving areas specified in *Cl.5.2.1g.(1)* and *Cl.5.2.1h.* or kitchen exhaust ducts, which pass through floor slabs, shall be of masonry construction. Such a shaft shall be completely compartmented from the rest of the shaft space containing other ducts or any other services installations. A protected shaft containing ducts serving other areas which pass through floor slabs can be constructed of drywall. If the protected shaft is of drywall construction, the conditions stipulated in *Cl.3.8.7b.* shall be complied with.

Explanation and Illustrations

The protecting structure for protected shaft containing kitchen exhaust duct and mechanical ventilation ducts which pass through one or more floors and serving areas such as:

a. Exit staircases and exit passageways

b. Smoke-stop and fire lift lobby

c. Areas of refuge within the same building

d. Emergency generator

e. Engine driven fire pump

shall be constructed in masonry. Each shaft shall be separately compartmented from one another. Protected shaft containing ducts serving other areas not mentioned above and which pass through two or more floors can be constructed of fire-rated materials, instead of masonry.

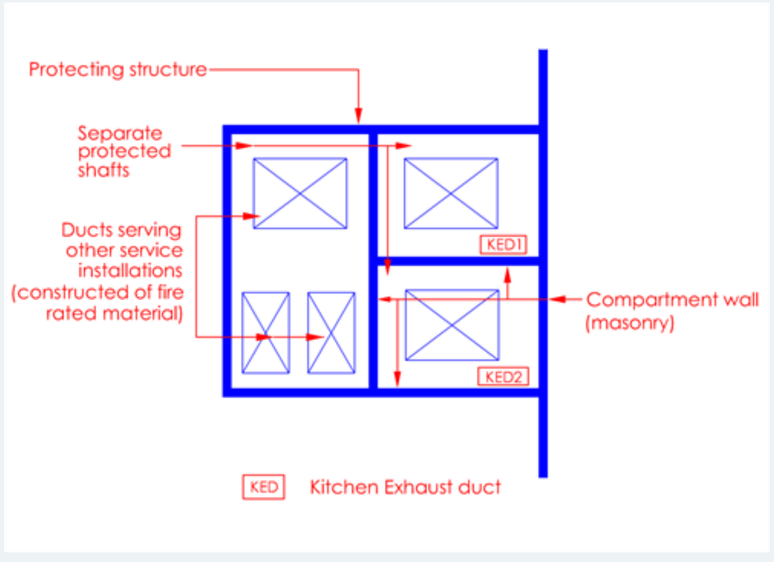
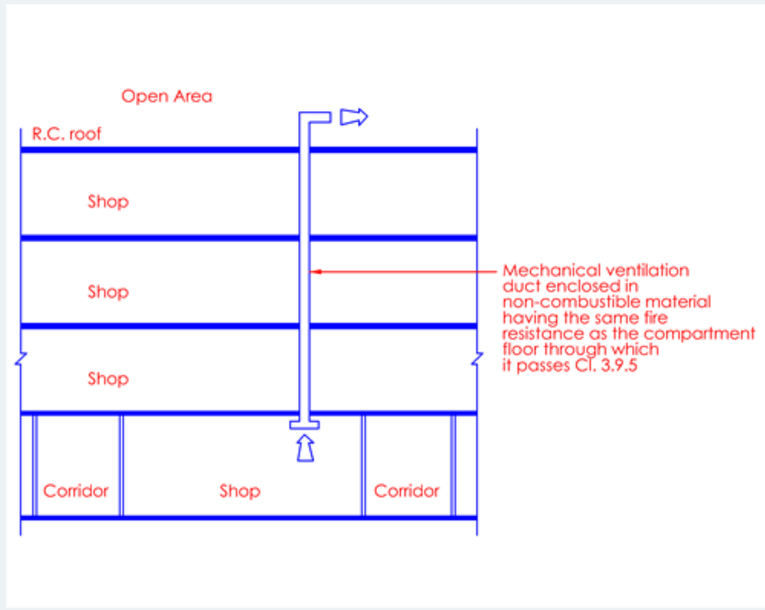


Figure 3.8.9a. - 1



Section

Figure 3.8.9a. - 2

Kitchen exhaust duct shall be in a separate compartment from that for a mechanical ventilation duct. Kitchen exhaust ducts serving different kitchens shall be in separate shafts. Mechanical ventilation duct serving the area of refuge shall be in different shaft from that serving the pump room. The main reason for separate shafts is to prevent smoke and fire spread from shaft to shaft.

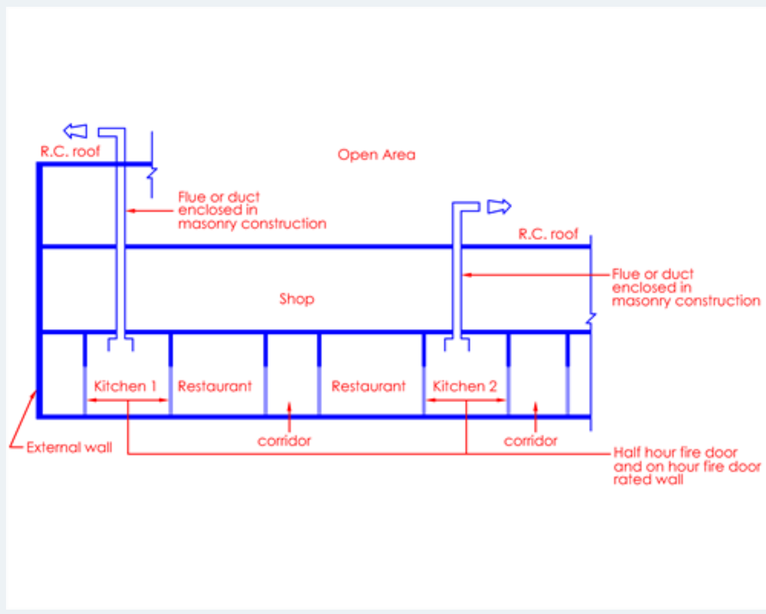


Figure 3.8.9a. - 3

a. In the above figure, the roof is not considered a floor slab, as it is exposed to the external air. Hence, the flue or duct does not pass through the floor. (See Kitchen 2)

b. When the flue or duct passes through one or more floors (any floor), it shall be encased in masonry material to ensure stability and prevent mechanical damage. (See Kitchen 1)

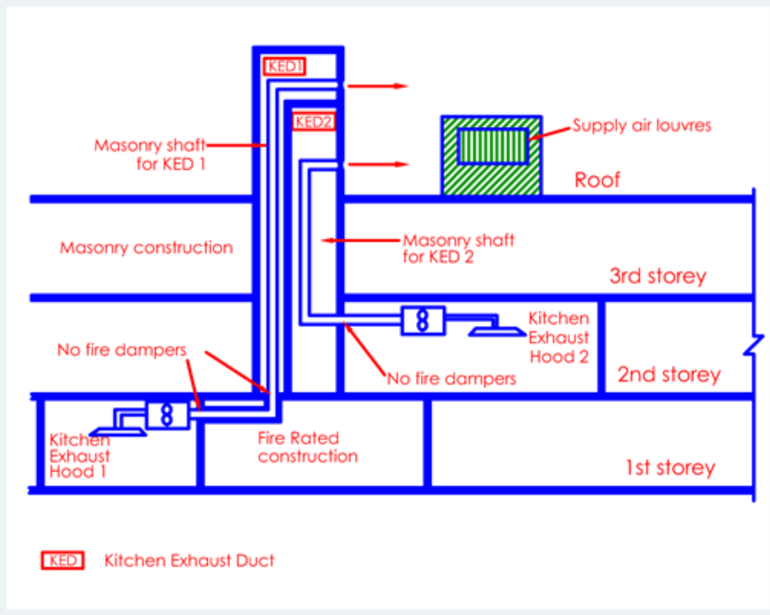


Figure 3.8.9a. - 4

Kitchen exhaust shaft for each kitchen is completely separated. The horizontal run of the exhaust from kitchen 1 is protected with fire-rated material.

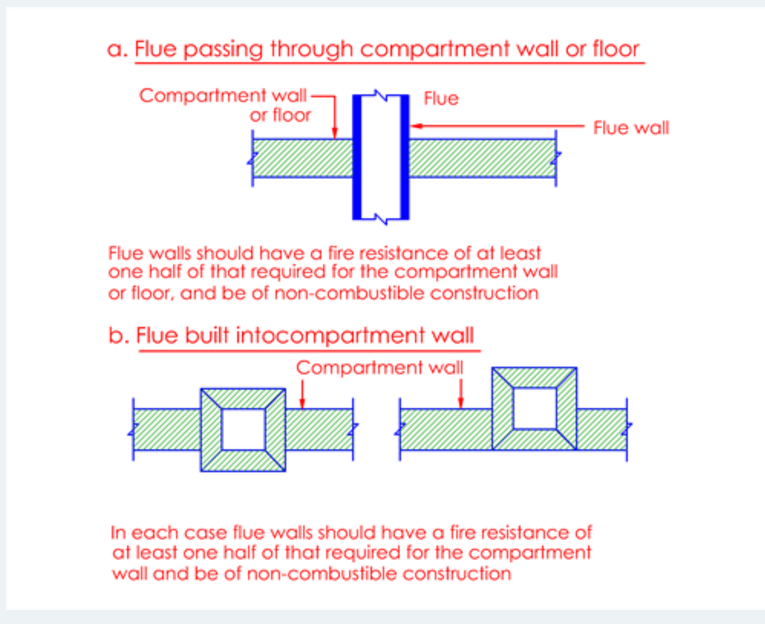


Figure 3.8.9a. - 5

If a flue, or duct containing flues or appliance ventilation duct(s), passes through a compartment wall or compartment floor, or is built into a compartment wall, each wall of the flue or duct should have a fire resistance of at least half that of the wall or floor in order to prevent the by-passing of the compartmentation.

b. Cavity barriers

A protected shaft used for the enclosure of electrical power services shall be interrupted at every floor level with at least ½-hr fire resistance cavity barriers. Protected shaft used for the enclosure of telecommunications services shall be interrupted by at least ½-hr fire resistance cavity barriers at vertical intervals not exceeding 15m. The cavity barriers within trunking enclosing electrical and telecommunication cables can be exempted if the following conditions are met:

(1) the cables shall be flame retardant type complying with *IEC 60332*;

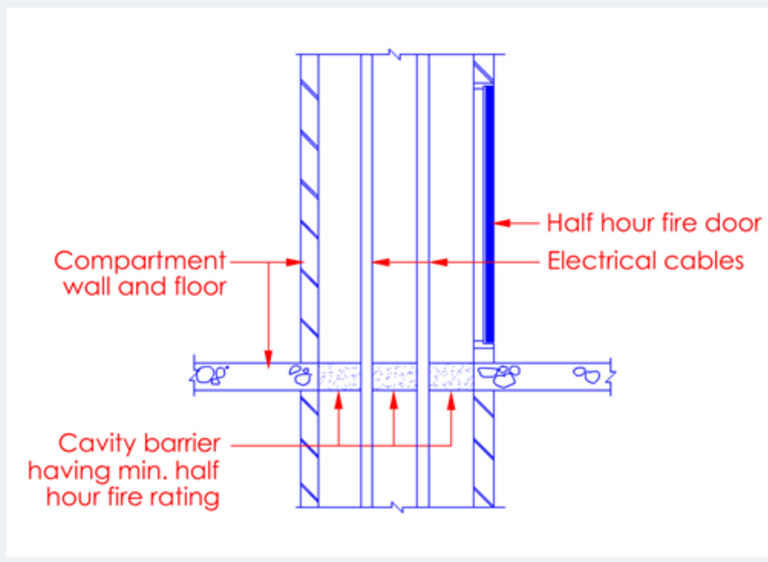
(2) the floor within the shaft shall be sloped upward with an angle of at least 45° to the floor level; and

(3) the fire doors to the protected shaft are installed with self-closing devices.

Rationale

Owing to the difficulty in fire-stopping the gaps within the trunking running through multiple floor levels within a protected shaft, this requirement was exempted provided additional fire safety requirements are complied with. These requirements include the use of flame retardant cables to reduce the possibility of fire from occurring/spreading, sloping of the floor within the shaft upwards at an angle of at least 45° to prevent illegal storage of any combustible materials, and the provision of self-closing devices to the fire resisting doors to ensure that the doors are closed at all times to prevent fire from spreading.

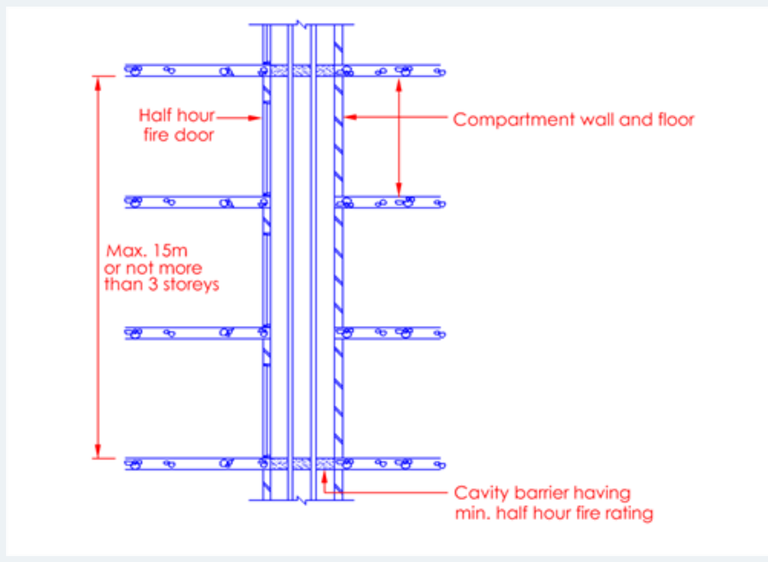
Explanation and Illustrations



Section

Figure 3.8.9b. - 1

Protected shaft containing electrical cables shall be interrupted at every floor with cavity barrier having min. ½-hr fire rating to prevent vertical spread of fire and smoke. The main concern is that cables are a source of fuel and ignition. The presence of fire stopping at every floor would help to confine fire to a single storey or segment of the shaft.



Section

Figure 3.8.9b. - 2

Protected shaft containing telecommunications cables including cable TV lines is provided with cavity barrier at vertical intervals not exceeding 15m or 3 storeys whichever is the shorter. The cables are mainly of low voltage and hence of a lower risk when compared to electrical cables.

c. Self-closing devices

Automatic self-closing devices are not required to be installed on fire resisting doors opening into protected shafts which are interrupted by at least ½-hr fire resistance cavity barriers at every floor level, or protected shafts containing sanitary pipes or water pipes, provided that the fire resisting doors are kept closed and locked at all times.

Explanation and Illustrations

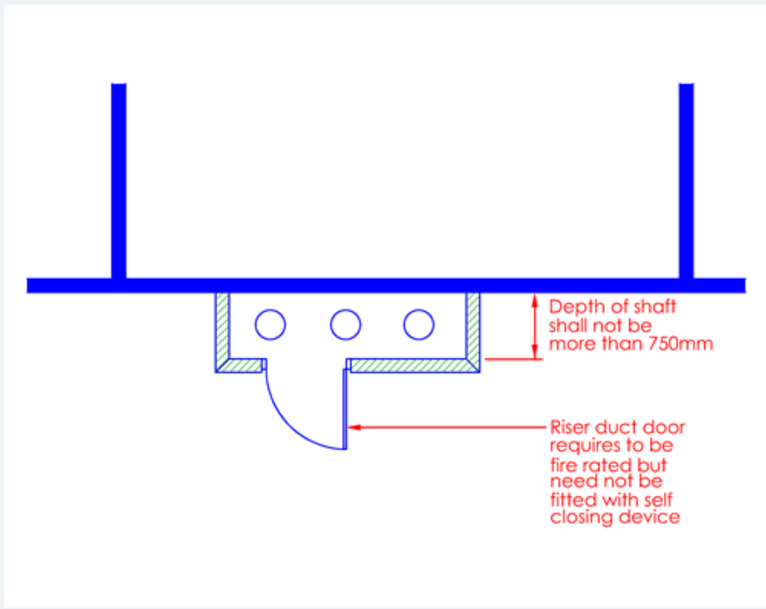


Figure 3.8.9c.

Provision of self-closing device for the inspection door of a protected shaft, which is interrupted by barriers having ½-hr fire resistance at every floor, is not required. The above relaxation is also applicable to telecommunication cable shafts, provided they are interrupted by barriers with fire resistance of at least ½ hour at every floor level.

An important point to note is the depth of the shaft which shall not exceed 750mm. If it exceeds 750mm, the shaft would be considered as a room and provision of self-closing device for the fire door becomes a necessity. The above relaxation is based on the understanding that it is unlikely that a shaft would be converted to a store if its depth is less than 750mm and that the door would normally be kept in the locked position when workmen are not carrying out servicing work. Also, maintaining the door in locked position is the responsibility of the management corporation of the estate.

d. Siting of protected shafts

All protected shafts containing services shall not be located within an exit staircase except for the case of residential apartment/ maisonette development under PG II not exceeding 4-storey where smoke-free lobby is not required

Explanation and Illustrations

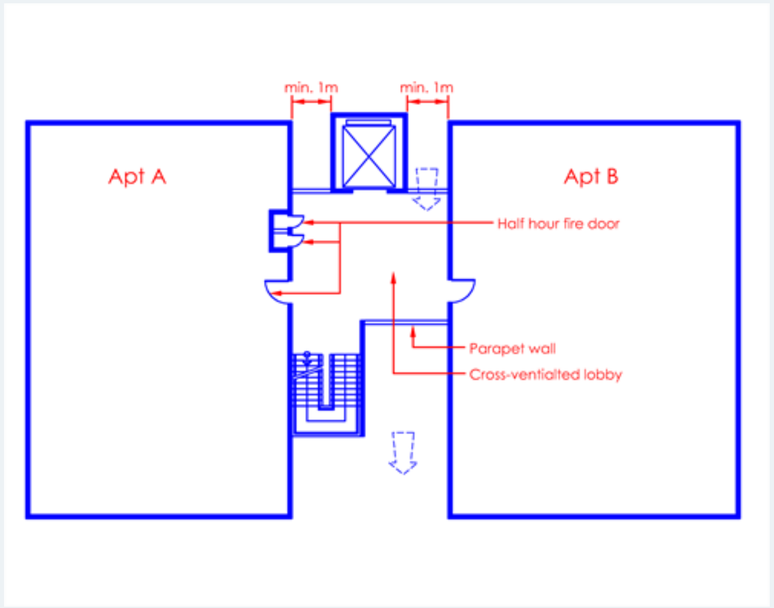


Figure 3.8.9d. – 1

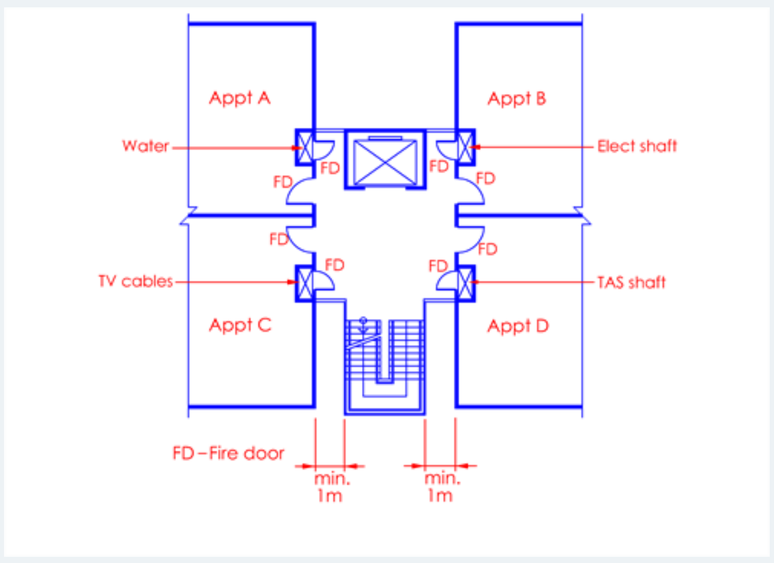


Figure 3.8.9d. – 2

Protected shafts such as for lift, TAS/Elect/Water/Cables are permitted to be located within a protected shaft containing an exit staircase for buildings under PG II, provided:

a. that building does not exceed 4 storeys where provision of smoke-stop lobby is not a requirement; and

b. that no shaft shall contain pipes carrying gas or combustible liquids. The above exception is only applicable to low-rise buildings where provision of smoke-stop lobby is not a requirement and that the staircase would be naturally ventilated. However, where there is availability of common area, such services shall be located outside the staircase shaft, see *Figure 3.8.9d. – 2*.

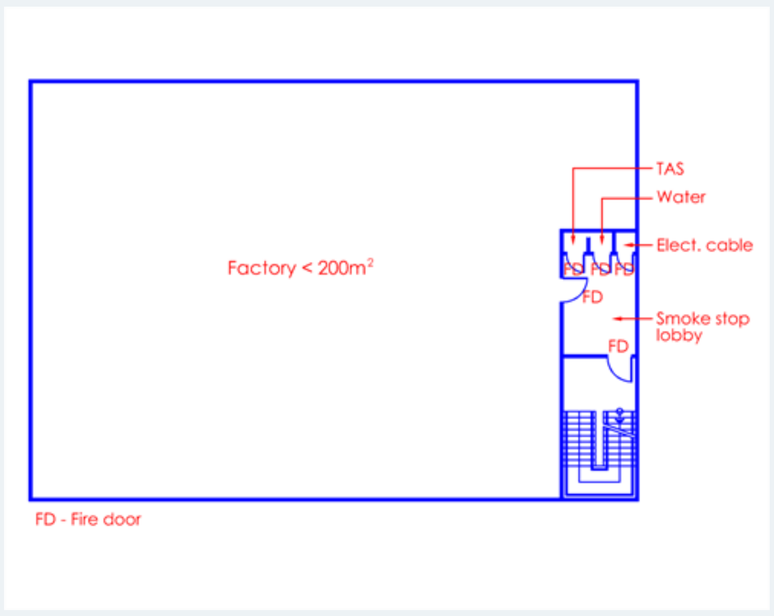


Figure 3.8.9d. – 3

A factory or warehouse building which does not require the provision of smoke-stop lobby to exit staircase by virtue of its height shall be required to comply fully with the above requirement. All protected shafts containing services are located in a common lobby adjoining the exit staircase.

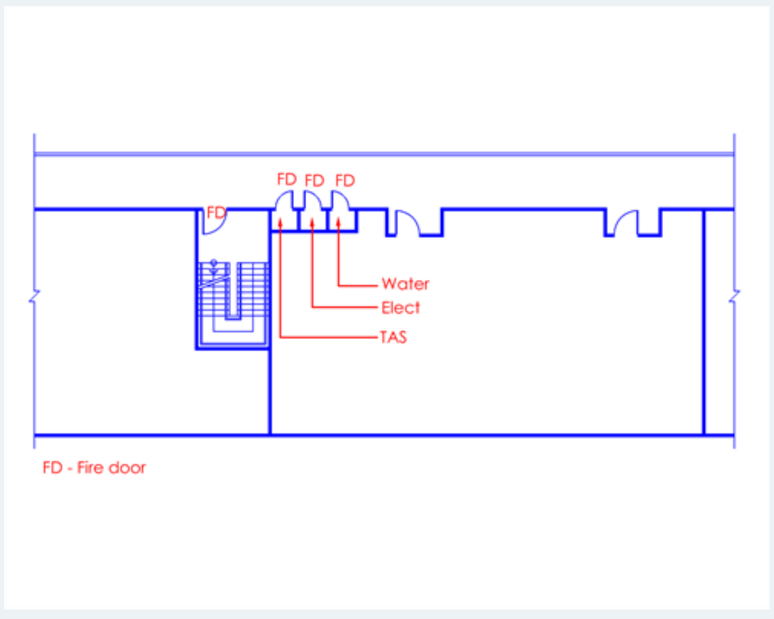


Figure 3.8.9d. – 4

Although the services are enclosed in protected shafts, they are not permitted to be located in exit staircase. The main reasons are:

a. Within the protected shaft, the combustible materials e.g. Cables PVC pipes are source of fire risk. A fire could originate from these combustible materials and spread into the exit staircase enclosure.

b. Exit staircase is a dedicated route for escape of occupants, services which are not serving the staircase shall not be located inside the enclosure.

CLAUSE 3.9 PROTECTION OF OPENINGS

3.9.1 Application

Explanation and Illustrations

(No illustration)

For functional purposes, openings in compartment walls, floor etc. are required in buildings to allow movement of people and the installation of services such as pipes, ventilation ducts etc.. To prevent the spread of fire and smoke, such openings shall be appropriately protected.

The provisions of this Clause concern the protection of openings permitted in elements of structure or other forms of fire resisting construction, which are required to act as a barrier to fire and smoke.

3.9.2 Fire doors

Fire doors for protection of openings shall comply with all of the following:

a. Fire doors shall have the appropriate fire resistance as required by relevant parts of the Code.

Explanation and Illustrations

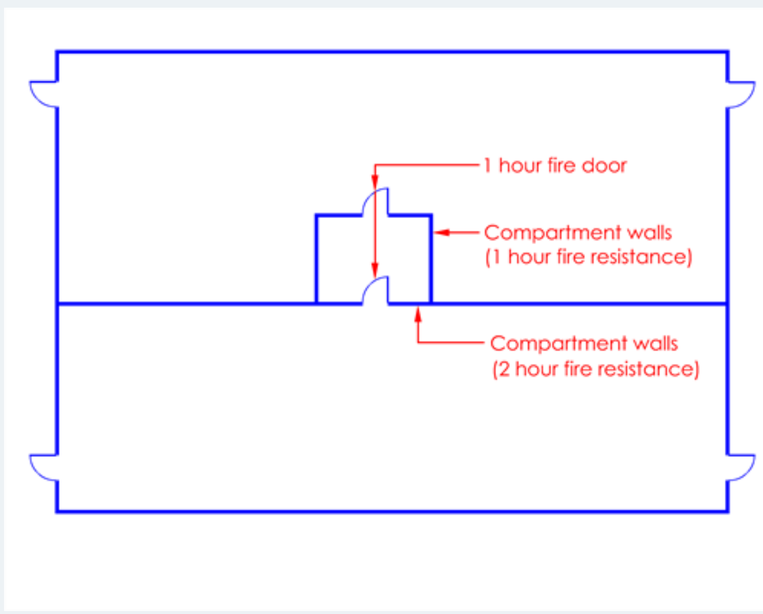


Figure 3.9.2a. - 1

The two 1-hr fire door arrangement is deemed to satisfy compartmention and be equivalent to the fire resistance rating of the compartment wall (2 hours).

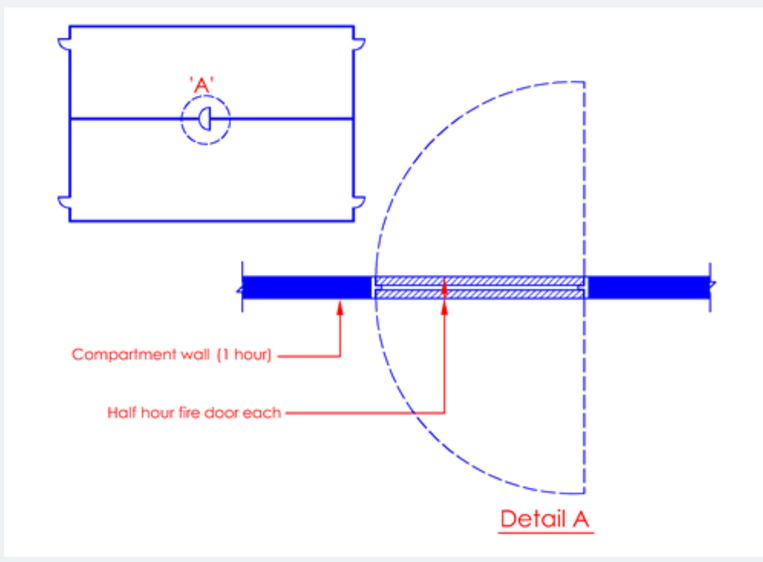


Figure 3.9.2a. - 2

The provision of fire doors shown in the above figure usually occur in separating walls, compartments e.g. hotel guestrooms or protecting structures / dormitories, hostel bedrooms or protecting structures. The 2 doors shall be independent of each other and having its own door frame. However, the 2 doors may share the same door frame only if that set of door is tested to achieve the required rating. This arrangement shall not form part of the escape exit route.

b. All fire doors shall be fitted with an automatic self-closing device which is capable of closing the door from any angle and against any latch fitted to the door. The omission of a self-closing device to the bolted door leaf of a two-leaf door is acceptable if the door is the entrance door to a residential unit under PG II.

Explanation and Illustrations

(No illustration)

All fire doors are required to be fitted with an automatic self-closing device which shall not include rising butt. Self-closing device is not required to be fitted to doors of protected shafts having a depth of not more than 750mm under *Cl.3.8.9c.*.

Fire resisting door to exit openings of apartment/maisonette units, protected staircases, protected lobbies, exit passageway, compartment walls etc. shall have minimum half hour fire resistance. Doors to exit facilities shall not be fitted with any locking device. However, doors to exit openings of apartment/maisonette units would be fitted with locking devices for security reasons. As fire door is to protect the openings in exit facilities, it should always remain in the closed position to prevent the spread of smoke and heat. The main function of the self-closing device is to return the door to its closed position after being opened for movement of occupants, goods etc.. The passage latch fitted to the door is to hold the fire door in closed position to counteract the pressure differential between the door in a fire situation.

Many private residential apartment/maisonette buildings have card key access or automatic locking devices fitted to doors of exit staircases to prevent unauthorised access by outsiders.

To gain entry into the staircase or to exit from it into any floor, the occupants need to key in a code number or use a card key access to unlock or release the locking device to the door. In times of power failure or activation of fire alarm system, if available, the locking device would be unlocked by itself and all the exit doors could be opened manually. Prior approval should be obtained from the SCDF before any door to exit facility is fitted with any form of locking device.

When the door to the exit facilities consists of double leaves or multiple leaves, all the leaves shall be fitted with self-closing device and sequential closer.

Where the entrance door of the apartment or maisonette unit consists of large and small leaves, self-closing device shall be required to be provided to the large leaf, provided the clear width of the opening of the large leaf when open at an angle of 90° is not less than 850mm. The smaller leaf is not to be taken into consideration as it would usually be bolted-shut, unless there is a need to open it for movement of large furniture, etc.. If the door opening has 2 leaves of equal width for use as exit to meet the minimum clear width of opening under *Cl.2.2.9b.*, both leaves shall be fitted with self-closing device and sequential door closer.

Self-closing device to fire door shall be properly maintained regularly. Faulty device shall be repaired immediately to prevent fire door being left in the open position.

c. Where a self-closing device would be considered a hindrance to the normal use of the building, fire doors can be held open as follows:

(1) by a fusible link, or

(2) by electromagnetic or electromechanical devices which can be activated via smoke detector and/or the building alarm system.

d. Any hinge on which a fire door is hung shall be of the approved type, complying with SS 332.

e. Any fire door fitted in an opening which is provided as a means of escape:

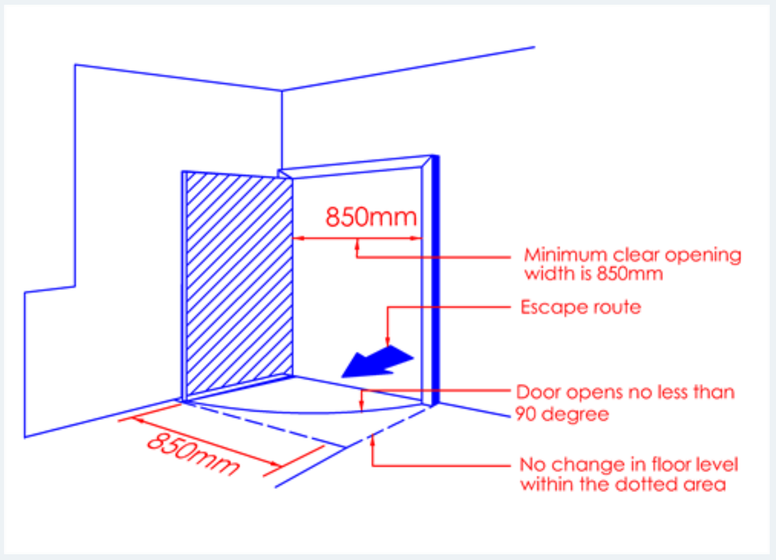
(1) shall be capable of being opened manually, without the use of key, tool, special knowledge or effort for operation from the inside of the building;

(2) shall not be held open by any means other than by an electromagnetic or electromechanical device which can be activated via smoke detector and/ or the building alarm system, except in the case of fire doors opening into pressurised exit staircases; and

(3) shall open in the direction of exit travel in accordance with *Cl.2.3.9.*

f. Fire doors, where required, shall be constructed and installed to comply with specifications stipulated under SS 332.

Explanation and Illustrations



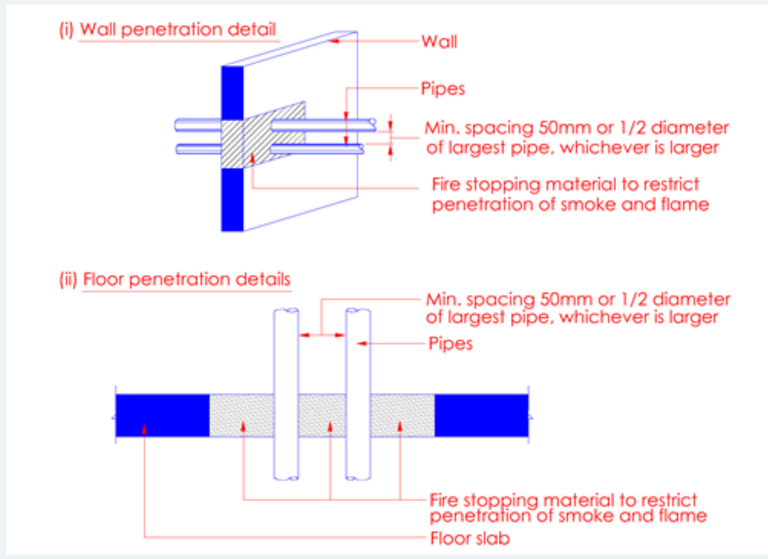
Axonometric view

Figure 3.9.2f.

All fire doors are required to be listed under a recognised certification body. It is important to note that fire door opening into pressurised exit staircases shall not be fitted with electromagnetic or electromechanical device. This is to ensure that the integrity of the pressurised exit staircase is maintained at all times.

3.9.3 Pipes

Explanation and Illustrations

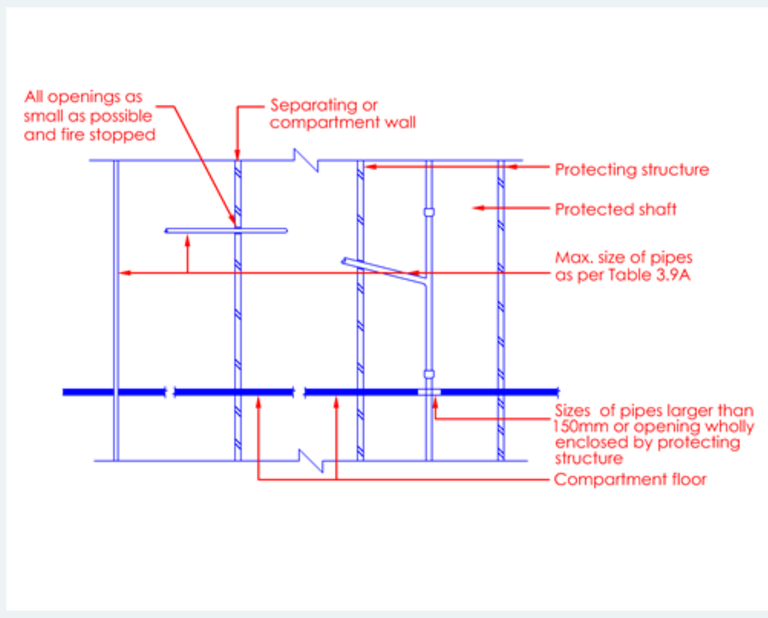


Top figure : Axonometric view

Bottom figure : Section

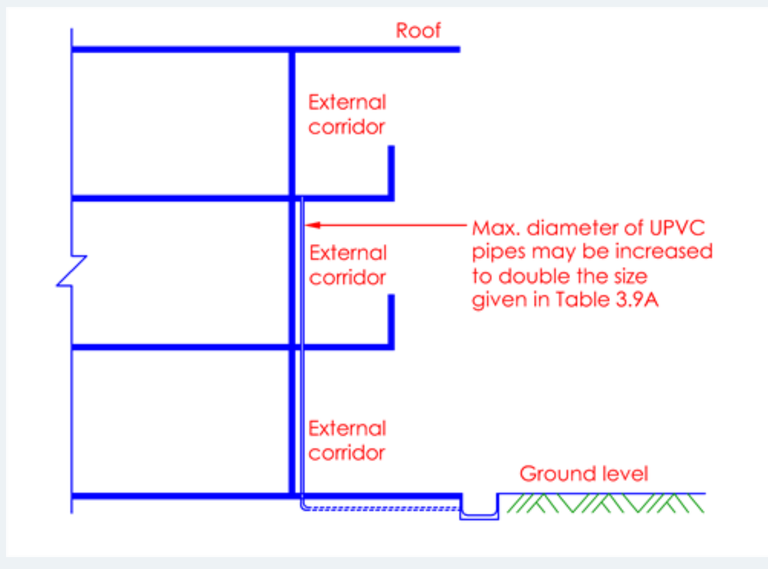
Figure 3.9.3 – 1

The clustering of pipes without proper spacing would further weaken the integrity of the fire resisting walls in times of fire emergency.



Section

Figure 3.9.3 – 2 : Penetration of elements of structure by pipes



Section

Figure 3.9.3 – 3

External corridor would be well ventilated. Hence fire risk is lower and the threat of spread of fire and smoke from floor to floor is very much reduced.

a. Pipes passing through a separating wall, compartment wall or compartment floor shall be kept as small as possible and be fire-stopped around the pipe. The nominal diameter of the pipe shall not be more than the respective dimension given in *Table 3.9A*. These pipe penetrations are permitted only for conveying non-hazardous & non-combustible substances such as air, water, etc., and approved fire-stopping material shall be applied around the pipe penetration. The clear spacing between pipes shall be at minimum 50mm or half the diameter of the largest pipe, whichever is larger.

b. The following pipes of nominal diameter larger than 150mm, subject to the conditions listed under *Cl.3.9.3c.* below, are permitted to penetrate through a separating wall, compartment wall or compartment floor:

(1) emergency standby diesel generator steel exhaust pipes connected directly to the external space;

(2) pipes of non-combustible material (such as cast iron or steel) with pipe wall thickness of at least 5mm, and melting point of at least 1200°C; and

(3) thermal insulated pipes with pipe wall thickness of at least 5mm and combustible insulation in compliance with *Cl.7.1.2c.(1)*. The metal sheath for insulation material shall be at least 0.6mm thick galvanised steel with the melting point, including pipe support, of at least 1200°C.

Rationale

Other than the maximum sizes allowed under Table 3.9A, larger pipes such as chilled water pipes can also be permitted to penetrate through a separating wall, compartment wall or compartment floor. This is because the conditions stipulated in Cl.3.9.3c. will help to minimise the risk of fire spreading across different compartments.

c. The following conditions shall be complied with for penetration of pipes stipulated under *Cl.3.9.3b.*:

(1) For non-sprinkler-protected area, pipe supports within 3m from the pipe penetration shall be strengthened such that the tensile stress generated on the supports shall not exceed 10N/mm^2 and will not be softened or fracture when exposed to temperature of 750°C. For sprinkler-protected area, the pipe supports and pipe penetrations shall be protected by the sprinkler system;

(2) Combustible materials or services (e.g., pipe or ductwork) are not permitted to be placed within 1m before and after the penetration [except for those thermal insulated pipes constructed under *Cl.3.9.3b.(3)* For the purpose of this sub-clause, fire-rated materials are deemed as non-combustible; and

(3) The penetration shall not pass through fire-rated wall/ floor of exit staircase, fire lift lobby, smoke-free lobby, electrical switch room, transformer room, generator room, battery room and fan room serving fire protection system, fire pump room, FCC, fuel tank room, and areas handling hazardous materials. Except for exit staircase, the penetration of pipes through the abovementioned rooms/ spaces is permitted if the pipes are fully enclosed by fire-rated enclosure with the same fire-rating as the fire-rated walls/ floors it passes through

d. In addition to *Cl.3.9.3a.*, fuel and vent pipes for emergency standby diesel generators and fuel tanks located outside the room they served shall be enclosed in construction having at least 2-hr fire resistance rating. They shall not be located in intakes/ fresh air vent shafts.

e. Routing of gas pipes in basements

(1) All gas pipes that are routed in basement shall be API pipes with welded joints. These joints shall be 100% radiography checked in accordance with SS 608. The gas pipes are not required to be fire-rated if they are running outside essential areas such as an exit staircases, smoke-free or fire lift lobby, fire pump room, generator room, FCC, etc.. If gas pipes run pass through an essential area, they are required to be encased in masonry.

(2) For mechanically ventilated basement, the gas pipes shall be provided with pipe sleeves to vent the gas pipes. One end of the sleeve shall be exposed to the external space in accordance with SS 608.

(3) For naturally ventilated basement that complies with *Cl.6.4.1d.(2)(b)(ii)*, the provision of pipe sleeve is not required.

3.9.4 Ventilation ducts

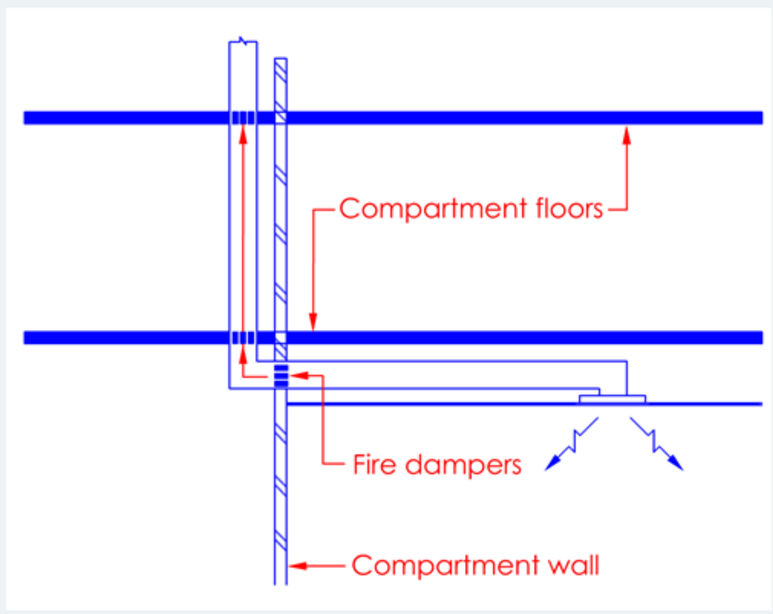
A ventilation duct which passes directly through a compartment wall or compartment floor shall comply with the following:

a. Where the ventilation duct does not form a protected shaft or is not contained within a protecting structure,

(1) the duct shall be fitted with a fire damper where it passes through the compartment wall or compartment floor; and

(2) the opening for the duct shall be kept as small as practicable and any gap around the fire damper shall be fire-stopped.

Explanation and Illustrations



Section

Figure 3.9.4a.

Proper fire stopping around the duct where it penetrates the compartment floor/wall and provision of fire damper at the compartment wall/floor would help to prevent fire and smoke spread from compartment to compartment.

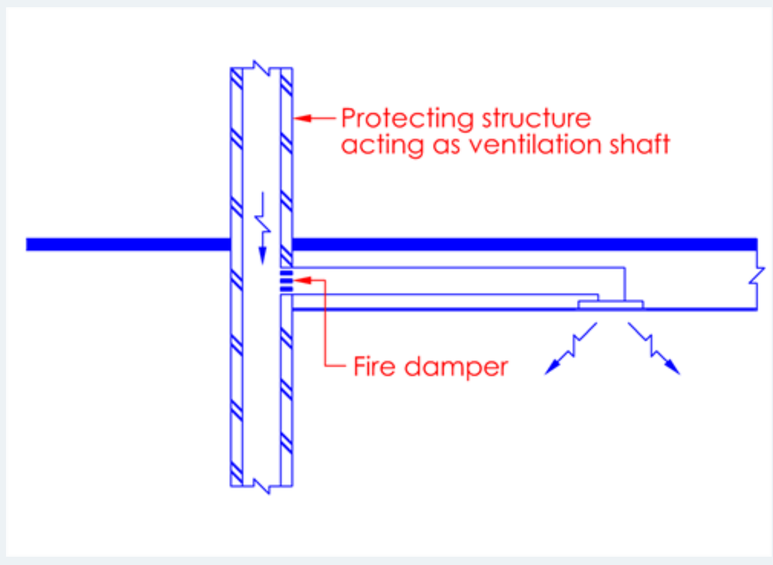
b. Where the ventilation duct forms a protected shaft or is contained within a protecting structure, the duct shall be:

(1) fitted with fire dampers at the inlets to the shaft and outlets from it; and

(2) constructed and lined with materials in accordance with the requirements in Chapter 7.

c. The installation of ventilation ducts and fire dampers shall comply with the requirements in Chapter 7.

Explanation and Illustrations



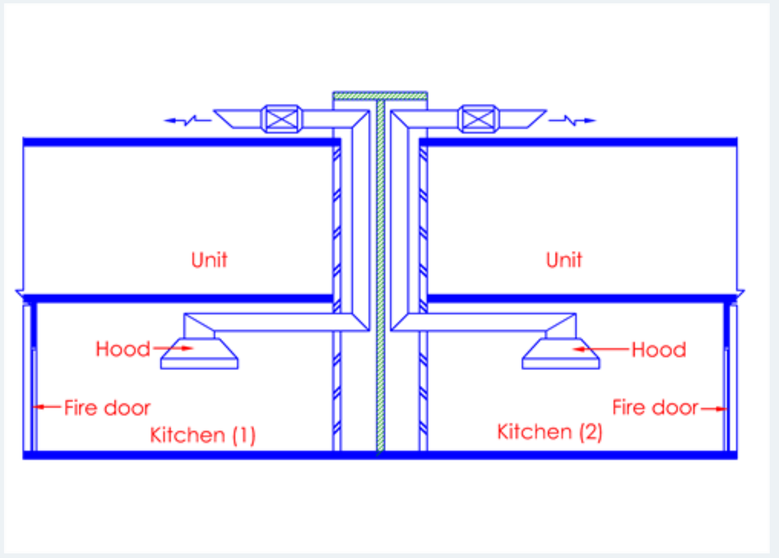
Section

Figure 3.9.4b.

The provision of fire damper at the entry to the protected shaft would help to complete the compartmentation to prevent fire or smoke from being drawn into the protected shaft via ventilation duct.

3.9.5 Flues

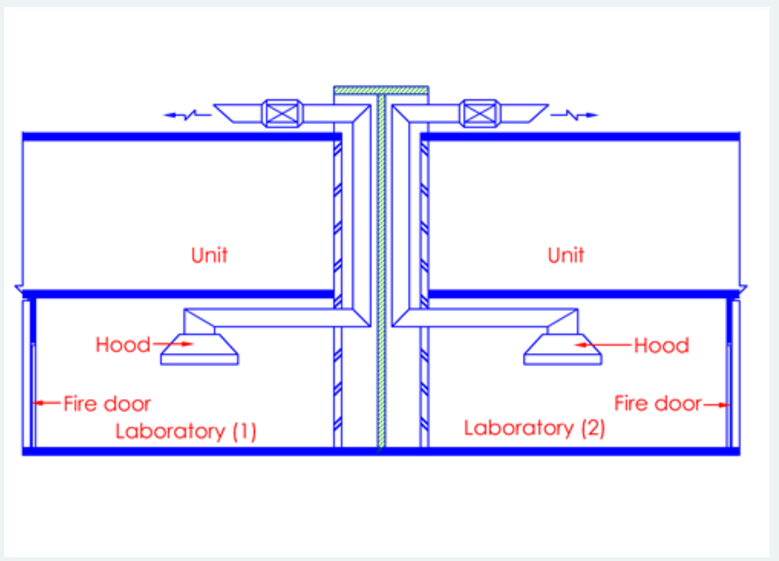
Explanation and Illustrations



Section

Figure 3.9.5 - 1

Separate kitchen exhaust shaft enclosed in masonry or drywall construction shall be provided for Kitchen (1) and (2). This is to prevent fire and smoke from spreading from one compartment to another. The wall enclosing the shaft shall have the same fire resistance as the compartment wall or floor.



Section

Figure 3.9.5 - 2

The enclosing walls to the duct serving the laboratory are required to be constructed of non-combustible materials, instead of masonry, and need to have not less than ½ the minimum period of fire resistance rating of the compartment walls or floor through which the duct passes.

Ducts encasing one or more flue pipes which pass through a compartment wall or compartment floor shall be of non-combustible construction, having fire resistance of not less than half the minimum period of fire resistance required for the compartment wall or compartment floor through which it passes, except for kitchen flue pipes when the fire resistance shall be as required for the compartment wall or compartment floor.

3.9.6 Services passing through FCC, fire pump room, emergency generator room and smoke control fans room

Explanation and Illustrations

(No illustration)

Services not forming part of the FCC, Fire Pump Room, Emergency Generator Room and Smoke Control Fans Rooms but routed inside the mentioned spaces are disallowed. In the case of site constraint, the services not required for the operation of the mentioned system shall be separated and encased with masonry construction.

Air ducts, sanitary pipes, gas pipes, electrical conduits/ cable tray and other services that are likely to permit the passage of flame or smoke in the event of a fire shall not be permitted to pass through any of the following spaces:

a. FCCs

b. Fire pump rooms

c. Emergency generator rooms

d. Smoke control fans rooms

except where such services are required for the operation of the equipment in these areas.

3.9.7 Services running inside and/or passing through fire lift lobby and smoke-free lobby

Explanation and Illustrations

(No illustration)

Where the services need to be routed inside fire lift lobby and smoke-stop lobby, adequate protection must strictly be adhered to. The unprotected services are required to be protected with 1-hr fire resistance enclosure, or separated with 1-hr fire resistance ceiling from the protected lobby space.

a. Air ducts, sanitary pipes, gas pipes, electrical conduits/ cable trays, and other services, e.g., fan coil units, ventilation fans (essential or non-essential) are permitted to locate, run inside and/ or pass through a fire lift or smoke-free lobby provided all these services are protected with a 1-hr fire resistance rating enclosure, or separated with a 1-hr fire resistance ceiling from the said lobby.

b. For cablings/ pipings of firefighting or fire protection systems serving or running through the above lobbies, and for other services that are required for operation of the above lobbies during fire emergency, e.g., lighting, mechanical ventilation systems, these need not be separately protected.

c. Exception

(1) Services running inside and/ or passing through an external corridor.

(2) Metal water supply pipe and water tap not exceeding 50mm in nominal diameter.

(3) CCTV systems provided it complies with *Cl.3.8.7a.(5)*.

3.9.8 Gas pipes running inside an internal corridor/lobby

Gas pipes running inside an internal corridor/lobby without fire resistance enclosure shall be encased with a pipe duct/sleeve vented to an external space.

CLAUSE 3.10 EXIT STAIRCASES

3.10.1 Non-combustibility of structure

Every exit staircase, including the treads/ risers and landing, shall be constructed of non-combustible materials. The exception is for buildings under PG I, where only the stringer or structures supporting the treads/ risers and landing shall be constructed of non-combustible materials.

3.10.2 Compartmentation

Explanation and Illustrations

(No illustration)

The exit staircase shall be separated away from all unprotected spaces and openings. For more details of separation distance for unprotected openings, refer to Cl.2.3.3.

The exit staircase shall be separated from other parts of the building by a masonry structure or drywall complying with *Cl.3.8.7b*. which shall have fire resistance for not less than the period required by Cl.3.3 for elements of structure. The flight, landing and supporting structures of the exit staircase shall comply with Cl.3.10.1 and fire resistance rating is not required.

3.10.3 Exit doors

Doors opening into the exit staircase shall have at least ½-hr fire resistance rating and fitted with an automatic self-closing device.

3.10.4 Finishes

Explanation and Illustrations

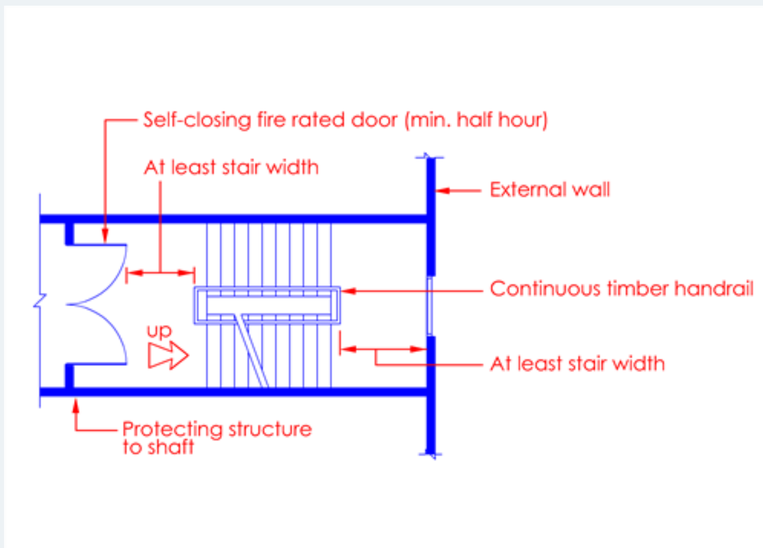


Figure 3.10.4

The protecting structure, excluding the external wall, to the staircase shall be constructed of non-combustible materials. Ceiling/wall and floor finishes shall be of non-combustible materials to ensure that the level of safety in the staircase is maintained at all times. The only exception allowed is the handrail material.

Finishes to the ceilings/ walls and floors of exit staircase shall be of non-combustible materials.

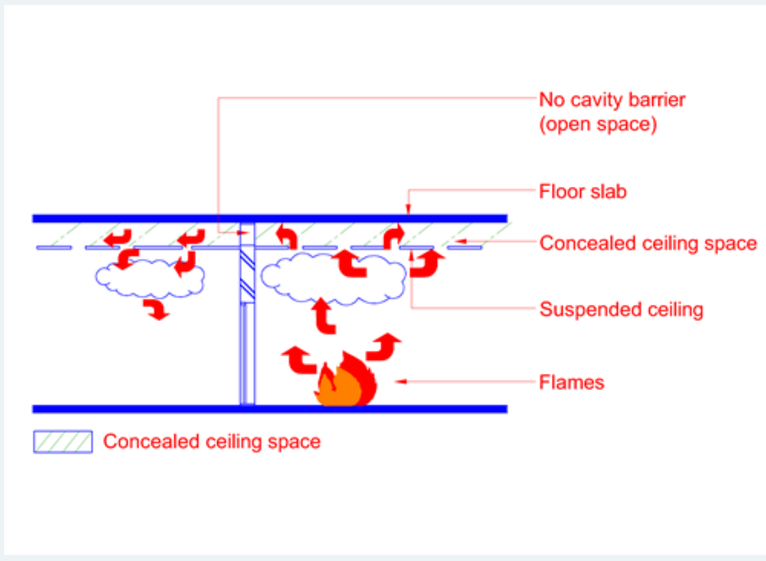
CLAUSE 3.11 CONCEALED SPACES

3.11.1 General provision

Rationale

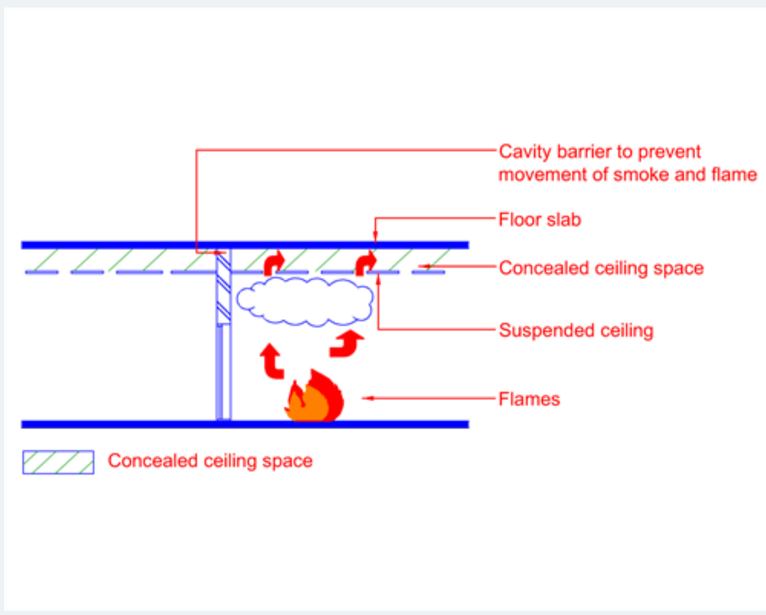
Concealed spaces or cavities in a building provide a ready route or flue for smoke and flame to spread undetected, thus increasing the risk to life safety of occupants in the building. This is particularly so in the case of void spaces above a suspended ceiling, in a roof space or in a raised floor system. Therefore, cavity barriers constructed of fire-rated materials shall be provided to prevent the spread of smoke and fire in the concealed spaces.

Explanation and Illustrations



Section

Figure 3.11.1 – 1



Section

Figure 3.11.1 – 2

Concealed spaces or cavities in building provide a ready route or flue for smoke and flame to spread undetected for quite some time, thus increasing the risk to life safety of occupants in the building. This is particularly so in the case of void spaces above a suspended ceiling or in a roof space or in a raised floor system. Provisions are available in the Fire Code to reduce the risk of concealed smoke and flame spread by the introduction of cavity barrier when the area or linear dimensions of cavities exceed the limits as per *Table 3.11A*. Cavity barriers shall be constructed of non-combustible materials and shall have at least ½-hr fire resistance.

Concealed spaces in a building, such as those within suspended ceilings or raised floors, shall be sub-divided by construction of cavity barriers to restrict the spread of smoke and flames.

3.11.2 Closing the edges of cavities

Explanation and Illustrations

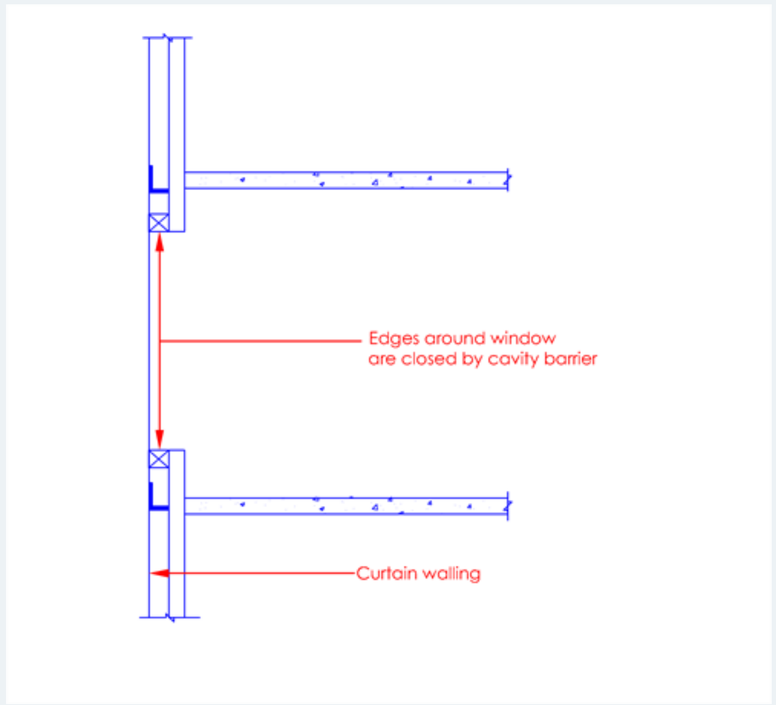
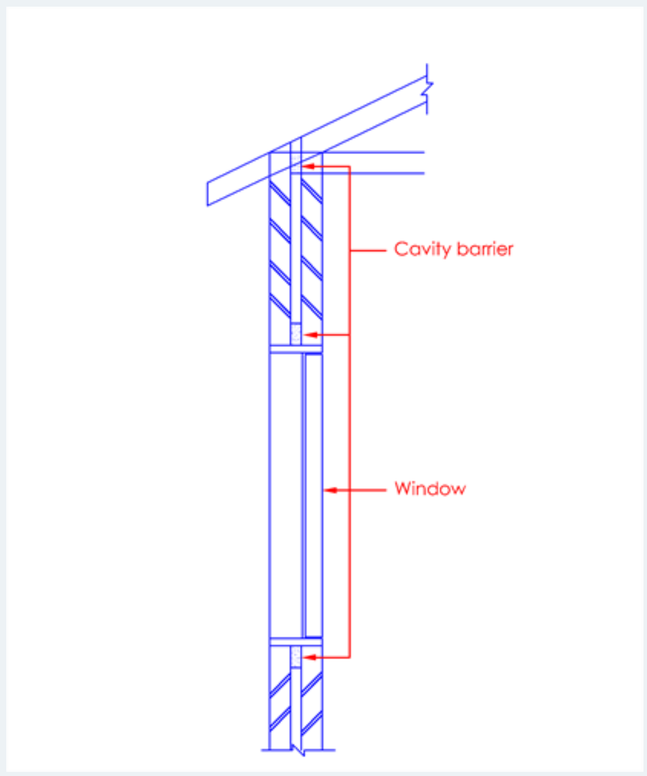


Figure 3.11.2 – 1



Section

Figure 3.11.2 – 2

"Cavity barrier" means any construction provided to close a cavity against, or restrict the spread of smoke and flame within it.

In Figure 3.11.2 - 1 above, cavity barriers are used to close the edges around the window opening. Similar application is provided to window in external cavity wall in Figure 3.11.2 - 2.

Cavity barriers shall be used to close the edges of cavities, edges around openings through a wall, floor and any other part of the construction which contains a cavity and to separate any cavity in a wall, floor or any other part of the construction from any other such cavity.

3.11.3 Interrupting cavities

Explanation and Illustrations

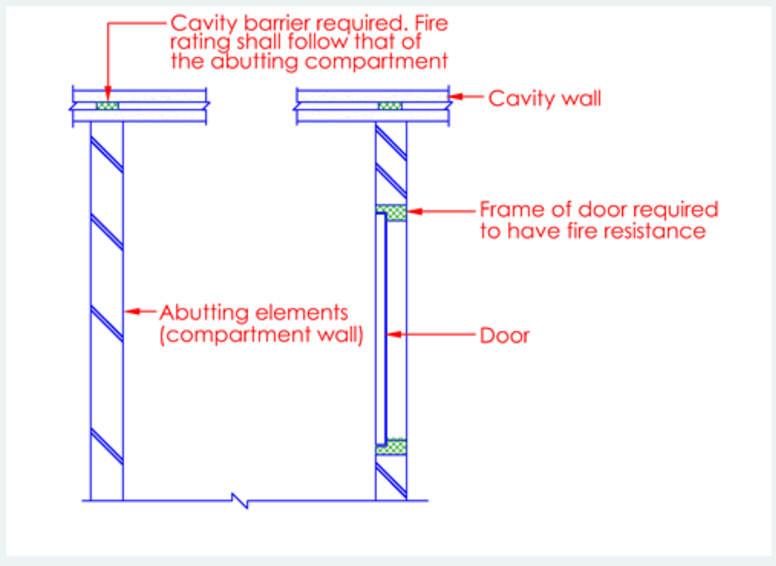
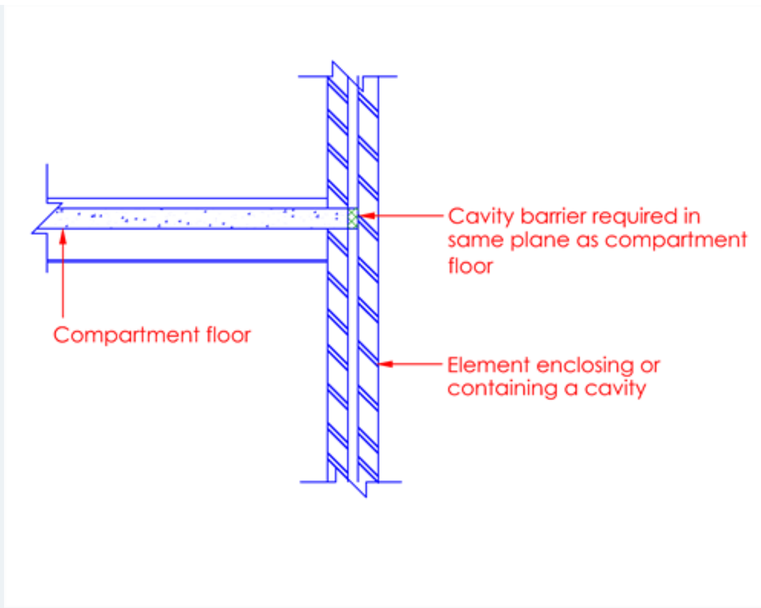


Figure 3.11.3 – 1

Cavities must be closed where the fire barrier elements (compartment walls) abut the cavity (including the frame of a door).



Section

Figure 3.11.3 – 2

Cavity in the walls shall be closed where the compartment floor abuts it.

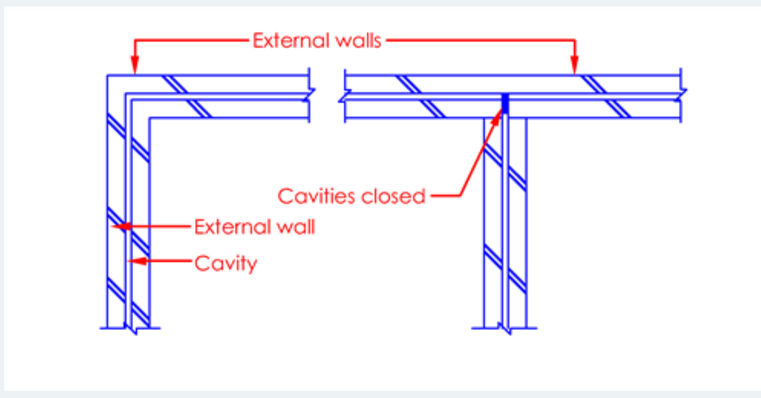
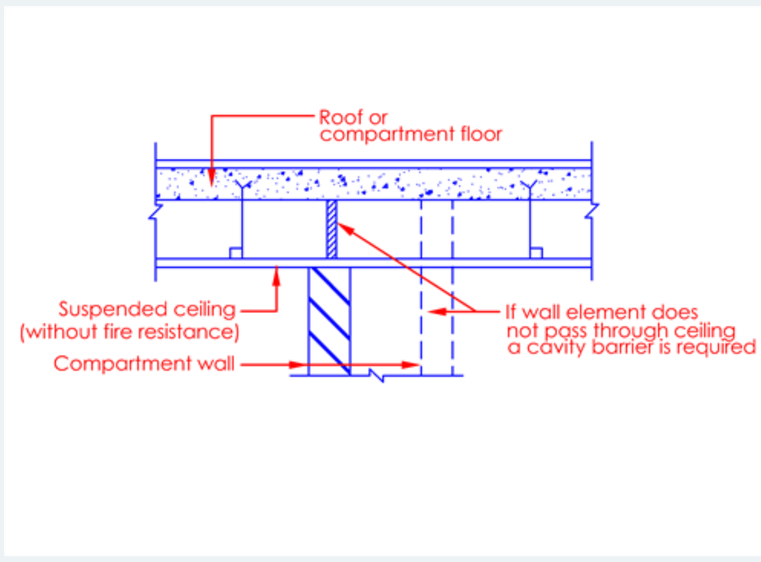


Figure 3.11.3 – 3

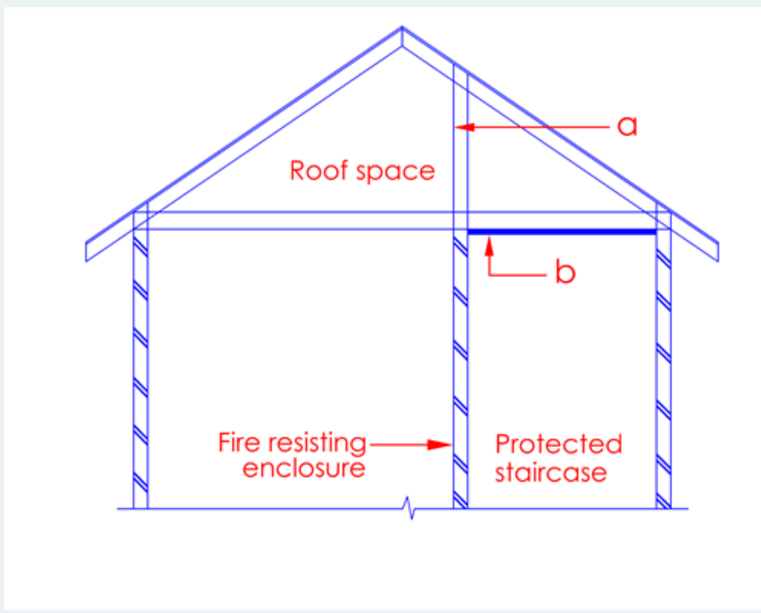
Any cavity within an element, or at the junction of two elements, must be closed by a cavity barrier.



Section

Figure 3.11.3 – 4

It is a common practice to bring the compartment wall right-up to the underside of the structural slab above. The cavity barrier above the compartment wall shall be treated as an extension of the compartment wall below.



Section

Figure 3.11.3 – 5

The roof space over a protected staircase must be separated by either a cavity barrier at (a) having the same fire rating as the wall of the staircase below, or a fire-rated ceiling at (b). See Cl.1.4.18 for further illustration. Extending the masonry wall right up to the underside of the roof coverings at (a) would meet the requirement under Cl.3.10 of having masonry enclosure to exit staircase.

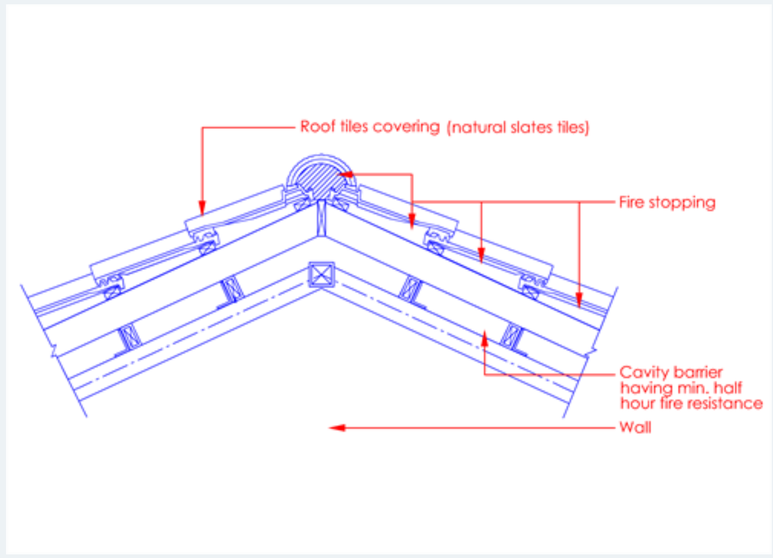
If a fire-resistant barrier (such as a compartment wall, floor, ceiling or roof) abuts a cavity (including a roof space), such a barrier shall be extended to sub-divide the cavity to form a complete fire resistant barrier. Such cavity barriers shall be of fire resisting construction at least equal to the provision for that required of the fire resisting barrier.

3.11.4 Sub-division of extensive cavities

Cavities, including roof spaces, unless otherwise permitted, shall be sub-divided so that the maximum distance between cavity barriers shall not exceed the relevant dimensions given under *Table 3.11A*.

3.11.5 Fire resistance and fixing of cavity barriers

Explanation and Illustrations



Section

Figure 3.11.5 - 1

Cavity barriers must be tightly fitted to rigid construction and mechanically fixed in position wherever possible. Where this is not possible (for example, in the case of a junction with slates tiles, corrugated sheeting or similar materials) the junction should be fire-stopped to prevent the spread of fire and smoke in the concealed space.

Cavity barriers must also be fixed so that performance will not be made ineffective by:

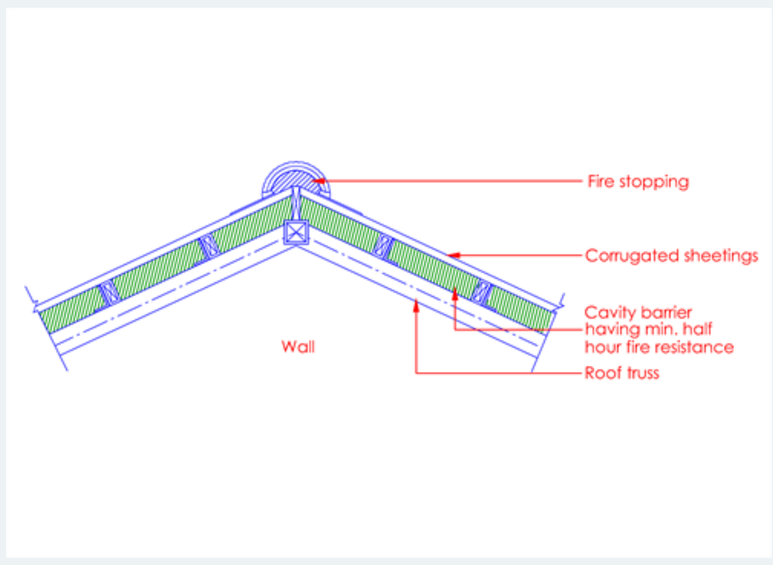
a. movement of the building due to subsidence, shrinkage or temperature change;

b. collapse in fire of any services penetrating them;

c. failure in fire of fixings; and

d. failure in fire of any material or construction which they may abut. For example, if a suspended ceiling is continued over the top of a fire-resisting wall or partition, and direct connection is made between the ceiling and the cavity barrier above the line of the wall or partition, premature failure of the cavity barrier can occur when the ceiling collapses. However, this does not arise if the ceiling is designed to provide fire protection of 30 minutes or more.

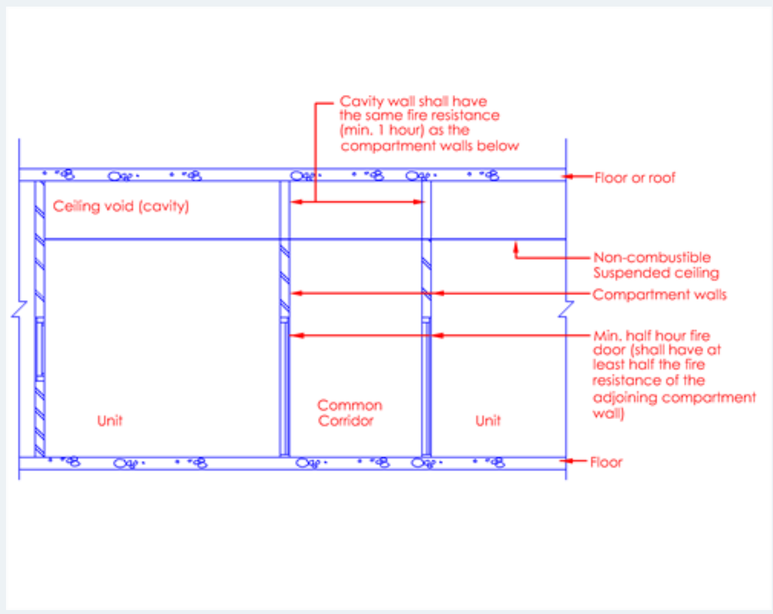
failure in fire of any material or construction which they may abut. For example, if a suspended ceiling is continued over the top of a fire-resisting wall or partition, and direct connection is made between the ceiling and the cavity barrier above the line of the wall or partition, premature failure of the cavity barrier can occur when the ceiling collapses. However, this does not arise if the ceiling is designed to provide fire protection of 30 minutes or more.



Section

Figure 3.11.5 - 2

The main purposes of extending the compcompartment walls into the ceiling space are to complete the compartmentation to each apartment unit and to prevent smoke and fire spread via the concealed ceiling space.



Section

Figure 3.11.5 - 3

Compartment walls should be carried right up to the full storey height, to a compartment floor above or to the roof coverings, as appropriate. The walls in the ceiling above the common corridor shall not be treated as cavity barriers. They shall be treated as extension of the compartment walls below.

The main purposes of extending the compartment walls into the ceiling space are to complete the compartmentation to each apartment unit and to prevent smoke and fire spread via the concealed ceiling space.

Cavity barriers shall be:

a. constructed to provide at least ½-hr fire resistance rating; and

b. tightly fitted to rigid construction or the junctions shall be fire-stopped to comply with the requirements of Cl.3.12.

3.11.6 Openings in cavity barriers

Explanation and Illustrations

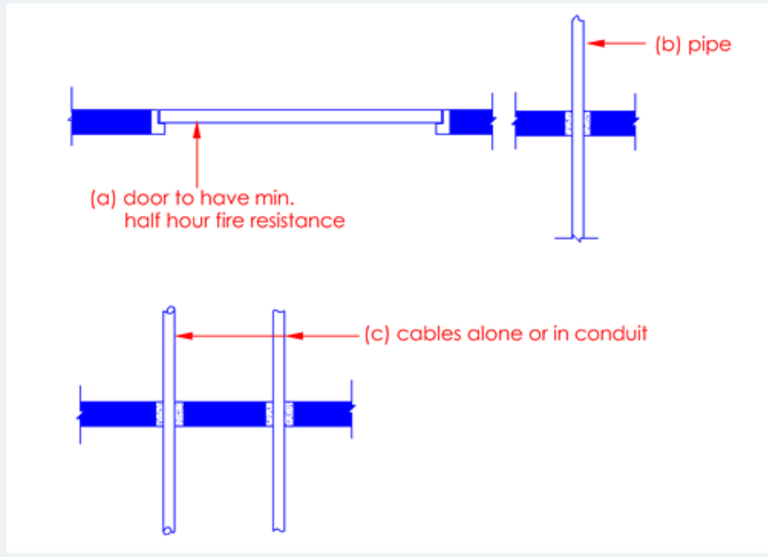


Figure 3.11.6 – 1

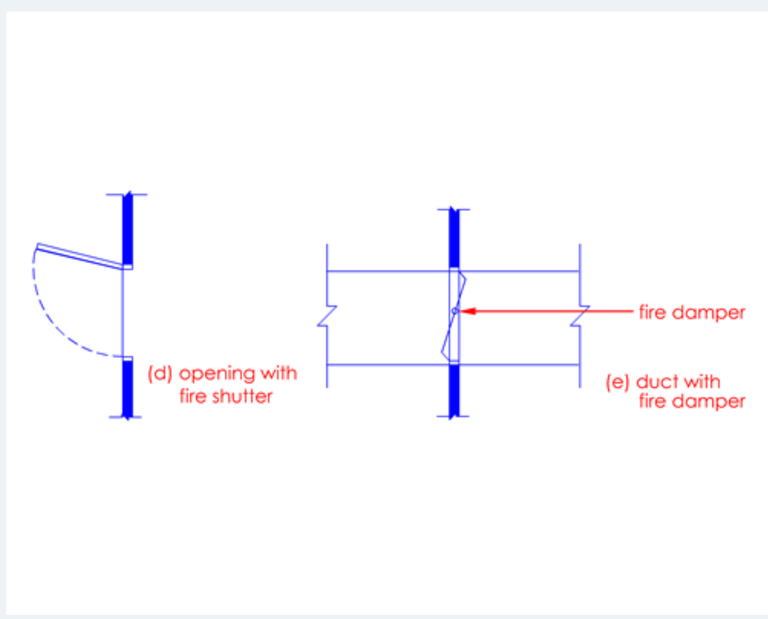


Figure 3.11.6 – 2

Penetrations of cavity barriers shall be restricted to those illustrated above. All openings through cavity barriers must be no larger than necessary and be fire stopped. The fire stopping shall not restrict thermal movement.

A cavity barrier shall have no opening except for:

a. a door which has the same fire resistance rating as the cavity barrier, and are kept closed all the times;

b. a pipe which complies with the provision under Cl.3.9.3;

c. a cable or conduit containing one or more cables;

d. a duct which is fitted with suitably mounted automatic fire damper where it passes through the cavity barrier; and

e. other openings fitted with a suitably mounted fire damper.

3.11.7 Raised floors for fixed stages and display platforms

Explanation and Illustrations

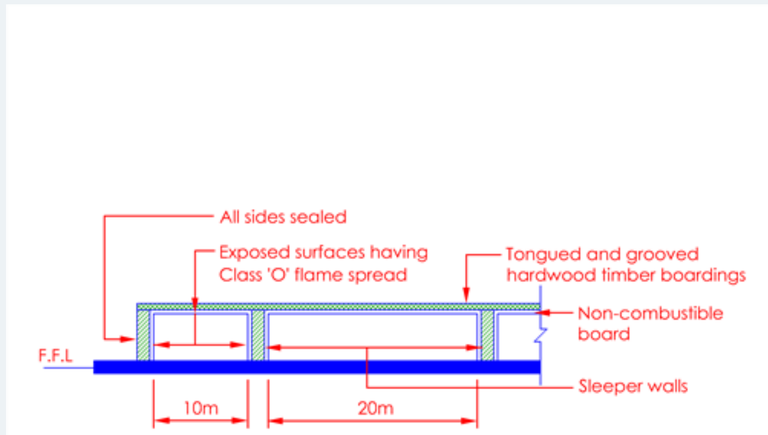


Figure 3.11.7 – 1 : Raised floor with exposed surfaces in cavity having Class '0' flame spread

The space between the floor and the raised floor or platform shall not be used for storage purpose. Electrical wiring in the space shall be in conduit in accordance with SS CP 5. Under *Table 3.11A*, cavity barrier is to be provided at 20m dimension in any direction. Sleeper walls, which are provided for support to the floor or platform, act as a cavity barrier in the concealed space.

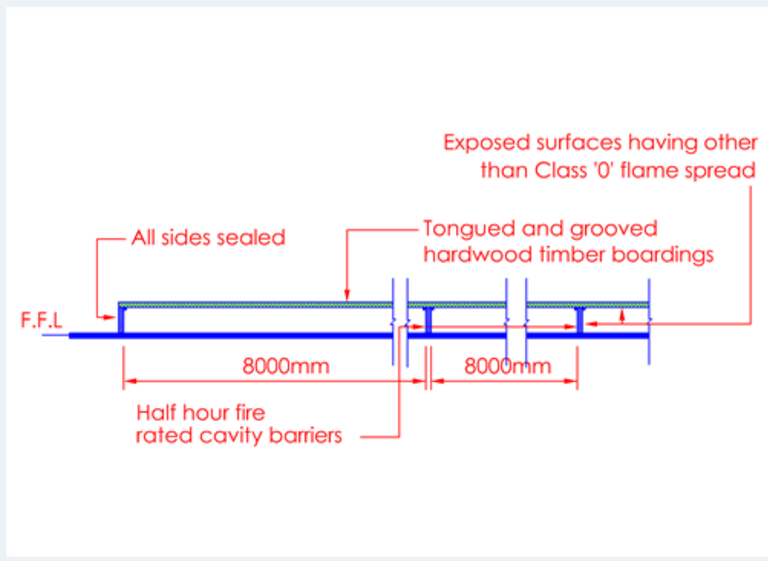


Figure 3.11.7 – 2 : Raised floor with exposed surfaces in cavity having other than Class '0' flame spread

The space between the floor and the raised floor or platform shall not be used for storage purpose. Electrical wiring in the concealed space shall be in conduit in accordance with SS CP 5. Under *Table 3.11A*, cavity barrier is to be provided at 8m dimension in any direction. As such, ½-hr fire-rated cavity barriers are provided to sectionalise the concealed space.

The construction of raised floors for fixed stages and display platforms shall comply with the following requirements:

a. the concealed space between the structural floor and raised floor shall not be used for storage;

b. no services or installation shall be permitted within the concealed space other than electrical wiring in conduit in compliance with the requirements of *SS 638*;

c. all sides of the raised floor shall be properly sealed; and

d. the concealed space shall be subdivided by cavity barriers in compliance with the requirements of Cl.3.11.4 and *Table 3.11A*.

3.11.8 Raised floors with or without accessible panels

The construction of raised floors with or without accessible panels shall comply with all of the following requirements:

a. The supporting structure shall be constructed of non-combustible materials having a melting point of at least 750°C.

b. The concealed space between the structural floor and raised floor shall not be used for storage.

c. No services or installations shall be permitted within the concealed space other than:

(1) electrical wiring in metal conduit and metal trunking in compliance with the requirements of *SS 638*;

(2) communication cables for computer equipment; and

(3) fire protection installations serving the area.

d. Where the raised floor is used as a plenum, requirements in Cl.7.1.4 shall be satisfied.

e. Decking of the raised floor shall be constructed of non-combustible material. Where combustible material is used as core material, if allowed in the case of sprinkler-protected buildings, the top, bottom, all sides and cut edges shall be covered with material with surface property complying with Class 0 (excluding materials for floor finishes).

f. In the case of raised floors with accessible panels, access sections or panels shall be provided such that all concealed spaces between the structural floor and raised floor are easily accessible.

Explanation and Illustrations

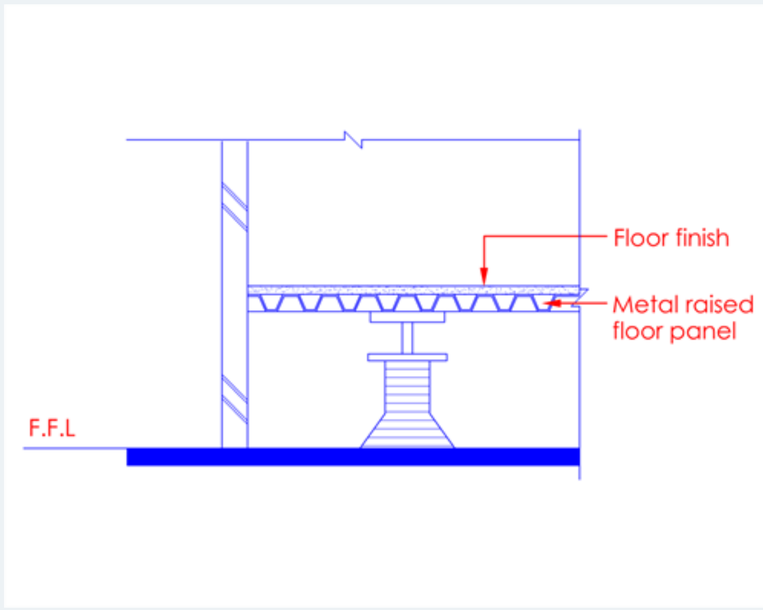


Figure 3.11.8e. - 1

Non-combustible raised floor panels and supports are allowed to be used in non-sprinkler or sprinkler-protected buildings.

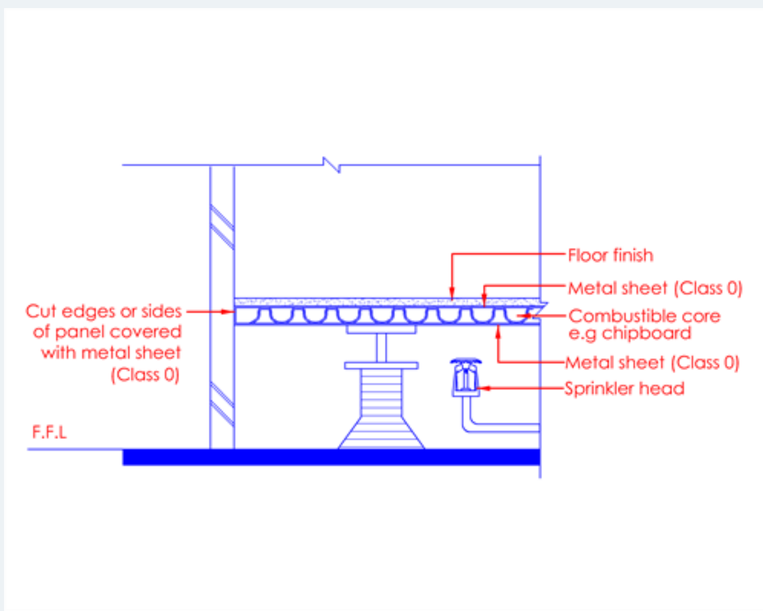


Figure 3.11.8e. - 2

Raised floor panel constructed of combustible core, e.g. chipboard, shall only be allowed to be used in buildings protected by sprinkler system and that the underside of the raised floor is adequately covered by the sprinkler system.

g. Openings in the raised floor for entry of electrical cables shall be effectively closed to prevent entry of debris or other combustible material into the concealed spaces.

h. All sides of the raised floor shall be properly sealed.

i. the concealed space shall be subdivided by cavity barriers such that the maximum unobstructed area within the concealed space does not exceed 930m^2.

j. Where the concealed space is fitted with an automatic sprinkler system which complies with the requirements in Chapter 6, cavity barriers are not required.

k. For a non-sprinkler-protected building, if the height of the concealed space measured between the top of the structural floor and underside of the raised floor decking exceeds 150mm, it shall be fitted with an automatic smoke detection system complying with requirements of *SS 645*. For a sprinkler-protected building, the concealed space shall be fitted with an automatic smoke detection system as above if its height is between 150mm to 400mm, and automatic sprinkler system if it exceeds 400mm; and

l. Where the height of concealed space measured between the top of the structural floor and the underside of the raised floor decking is less than 50mm, the requirements on provision of cavity barriers shall not be applicable.

Explanation and Illustrations

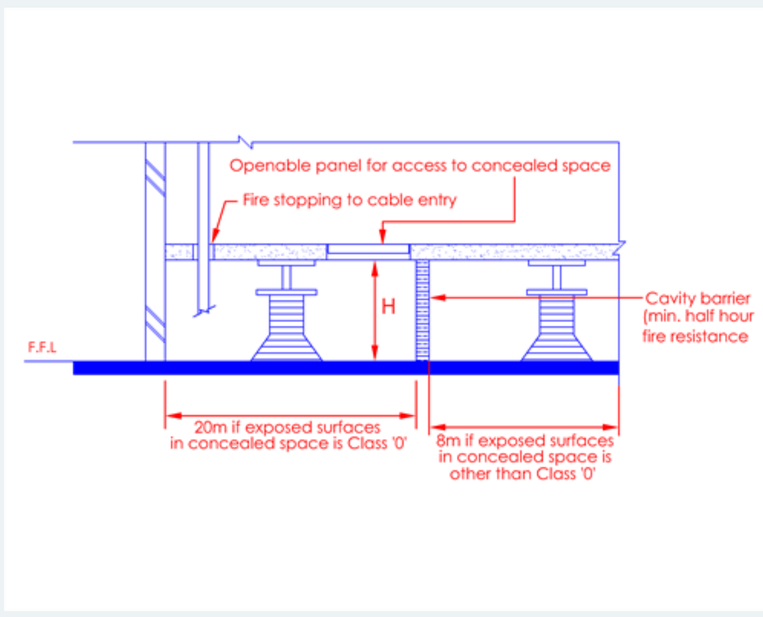


Figure 3.11.8g. to j.

The provision of cavity barriers shall comply with *Table 3.11A* of the Fire Code.

Non-sprinkler protected building

Cavity barriers shall be provided in accordance with *Table 3.11A*. The height of concealed space (H), measured between the finished floor level and the underside of the raised floor decking shall not exceed 400mm. The concealed space shall be fitted with smoke detection system in accordance with SS CP 10 Code of Practice for the Installation and Servicing of Electrical fire Alarm Systems. SS CP 10 also allows that smoke detector system is not required to be provided in concealed space which does not exceed 150mm in height. Automatic smoke detection system is applicable if the height of concealed space exceeds 400mm.

Sprinkler protected building

Cavity barriers shall be provided in accordance with *Table 3.11A*. Where the height of the concealed space does not exceed 400mm, smoke detection system complying with SS CP 10 shall be provided. The height of concealed space may exceed 400mm if the space is fitted throughout with sprinkler system. Where sprinkler system is provided inside the concealed space, cavity barriers are not required to be provided – *Cl.3.11.8j.*.

3.11.9 Provision for concealed spaces between floor or roof and suspended ceilings

Provision of cavity barriers within the concealed spaces of suspended ceiling can be exempted provided all of the following requirements are complied with:

a. The concealed space shall not be used for storage.

b. The supporting elements shall be constructed of non-combustible material.

c. The exposed surfaces within the concealed space is of Class 0 flame spread (excluding surfaces of any pipe, cable, conduit or insulation of any pipe).

d. In the case of a detector protected building:

(1) if the concealed space does not exceed 800mm in depth, or

(2) if the concealed space is fitted with detectors which comply with the requirements of Chapter 6.

e. In the case of a sprinkler-protected building:

Explanation and Illustrations

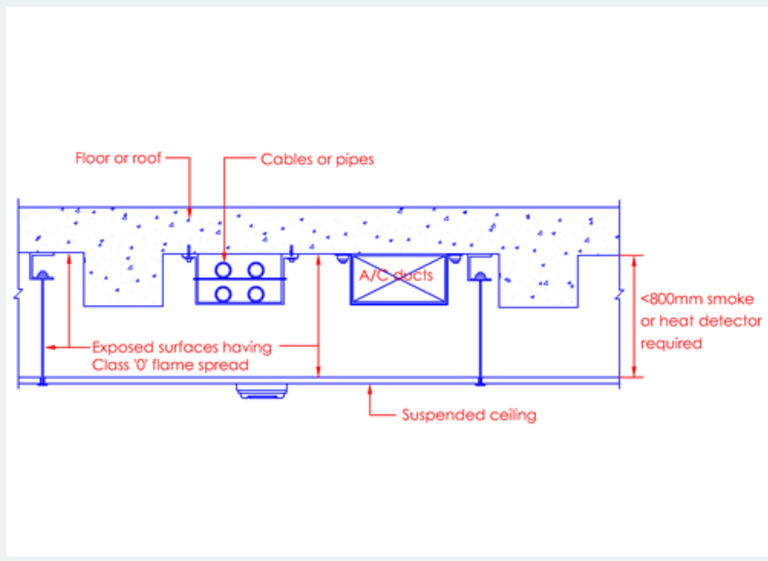


Figure 3.11.9d. : Detector protected building (non-sprinkler protected)

Provision of cavity barriers in concealed ceiling space may not required if the following requirements are complied with:

a. the space is not used for storage purpose;

b. the supporting elements eg. ceiling hangers or supports are constructed of non-combustible material;

c. the exposed surfaces within the concealed space is of Class 0 flame spread (excluding surfaces of any pipe, cable, conduit or insulation of any pipe or duct); and

d. concealed space does not exceed 800mm in depth; if exceeds 800mm, it shall be fitted with smoke or heat detectors.

(1) if the concealed space does not exceed 400mm in depth, or

Explanation and Illustrations

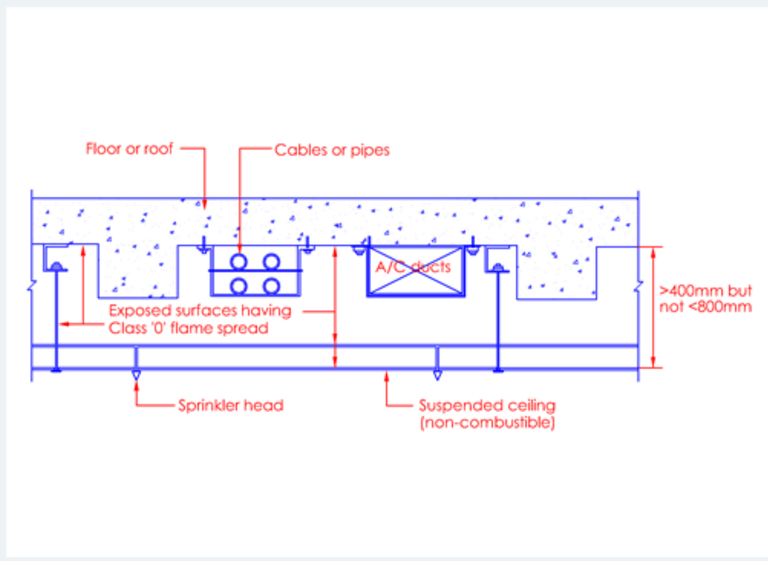


Figure 3.11.9e.(1). : Sprinkler-protected building - Depth of ceiling space does not exceed 400mm

Provision of cavity barriers in the concealed ceiling space may not required if the following are complied with:

a. the space is not used for storage purpose;

b. the supporting elements eg. ceiling hangers or supports are constructed of non-combustible material;

c. the exposed surfaces within the concealed space is of Class 0 flame spread (excluding surfaces of any pipe, cable, conduit or insulation of any pipe or duct); and

d. concealed space does not exceed 400mm in depth.

(2) if the concealed space exceeds 400mm and does not exceed 800mm in depth and no combustible material is used within the concealed space, or

Explanation and Illustrations

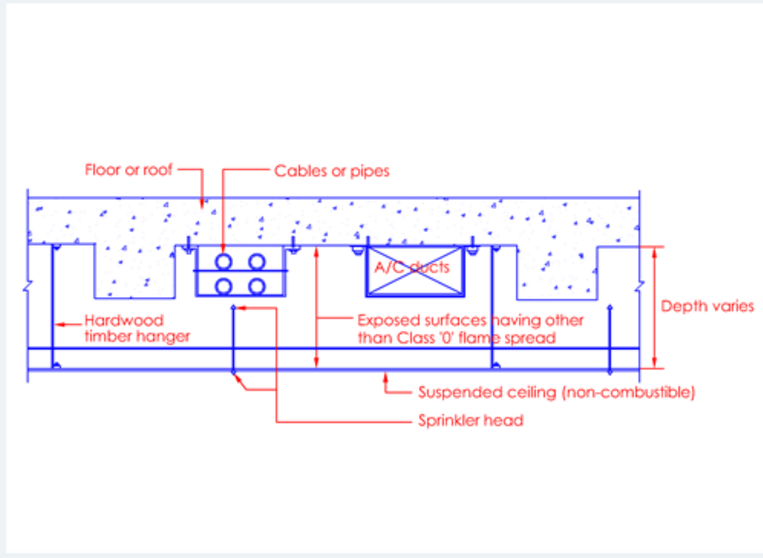


Figure 3.11.9e.(2) : Sprinkler-protected building - Depth of ceiling space exceeds 400mm but not exceeding 800mm

Provision of cavity barriers in the concealed ceiling space may not required if the following are complied with:

a. the space is not used for storage purpose;

b. the supporting elements e.g. ceiling hangers or supports are constructed of non-combustible material;

c. the exposed surfaces within the concealed space is of Class 0 flame spread (excluding surfaces of any pipe, cable, conduit or insulation of any pipe or duct); and

d. no combustible material is used within the concealed space. However, where the combustible content is small in quantity, the SCDF may, at its discretion grants exemption, provided the space is protected by sprinklers installed on the extended basis under SS CP 52 (whole coverage to be extended to the ceiling).

(3) if the concealed space is fitted with an automatic sprinkler system which complies with the requirements of Chapter 6.

Explanation and Illustrations

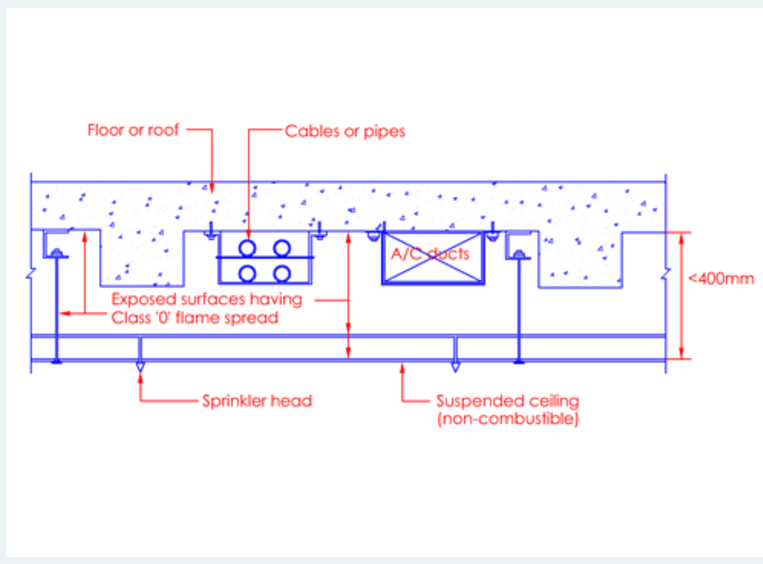


Figure 3.11.9e.(3) : Concealed space is sprinkler-protected in accordance with Chapter 6

Provision of cavity barriers in the concealed ceiling is not required. See also Cl.3.11.10 for further relaxation.

f. In the case of other buildings, the concealed space shall not exceed 800mm in depth.

Explanation and Illustrations

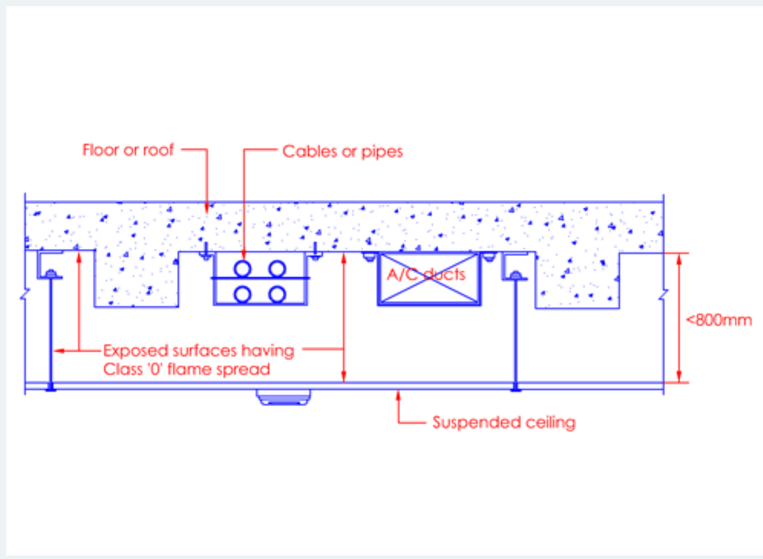


Figure 3.11.9f. : Other building which neither requires detector nor sprinkler system

Provision of cavity barriers in the concealed ceiling space may not required if the following are complied with:

a. the space is not used for storage purpose;

b. the supporting elements e.g. ceiling hangers or supports are constructed of non-combustible material;

c. the exposed surfaces within the concealed space is of Class 0 flame spread (excluding surfaces of any pipe, cable, conduit or insulation of any pipe or duct); and

d. concealed space does not exceed 800mm in depth; if exceeds 800mm, it shall be fitted with smoke or heat detectors.

3.11.10 Exemption of cavity barriers in ceiling space

Explanation and Illustrations

(No illustration)

1. Where the concealed ceiling space is protected by automatic sprinkler system, the above clause allows the following:

    a. Provision of cavity barrier is exempted;

    b. Combustible materials such as hardwood timber hangers for ceiling; and

    c. Exposed surfaces within the ceiling space may be of any class other than Class 0 flame spread ie. timber members.

2. The above relaxation shall not apply if the above ceiling construction is situated over an exit passageway or other designated means of escape facilities.

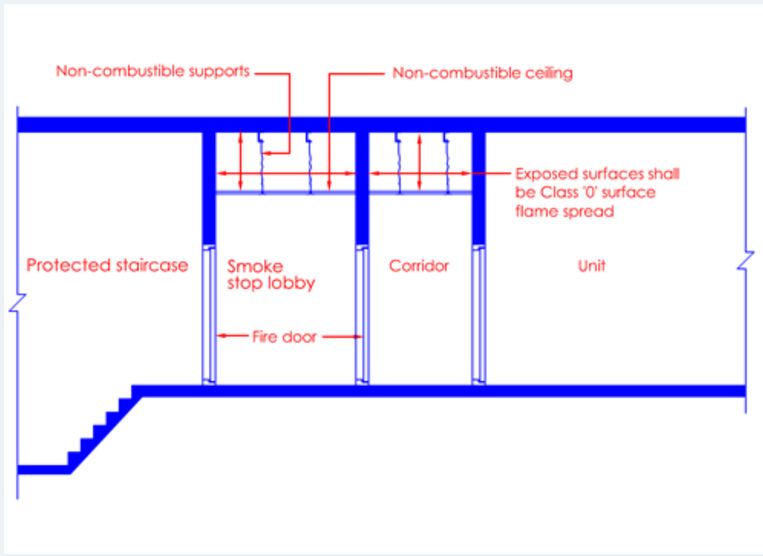
Where the concealed space of suspended ceiling is fitted with an automatic sprinkler system which complies with the requirements in Chapter 6,

a. the concealed space can be exempted from provision of cavity barriers; and

b. combustible materials can be used for the supporting elements and exposed surfaces of materials within the concealed space, provided the ceiling is not situated over an exit passageway, smoke-free lobby or other designated means of escape facilities.

3.11.11 Suspended ceiling over protected areas

Explanation and Illustrations



Section

Figure 3.11.11

The main concern is that spaces meant for safe escape of occupants shall be kept free of combustible materials. Common corridors are treated as escape routes. The exposed surfaces within ceiling space shall have a flame spread rating of Class '0'.

The concealed spaces of a suspended ceiling over an exit passageway, smoke-stop lobby, exit staircase or other designated means of escape facilities shall comply with the following:

a. the ceiling supporting elements and the ceiling shall be constructed of non-combustible materials.

b. the exposed surfaces within the concealed space shall be of Class 0 surface flame spread; and

c. where sprinkler system is installed within the concealed spaces at smoke-free lobby/ fire lift lobby, the ceiling supporting elements and its exposed surface may have a surface spread of flame not lower than Class 2.

3.11.12 Exemption

Buildings under PG I are not required to comply with the requirements on the provision of cavity barriers in concealed spaces. Residential units in buildings under PG II need not comply with requirements on the provision of cavity barriers in concealed floor and ceiling spaces.

CLAUSE 3.12 FIRE STOPPING

3.12.1 General provision

Explanation and Illustrations

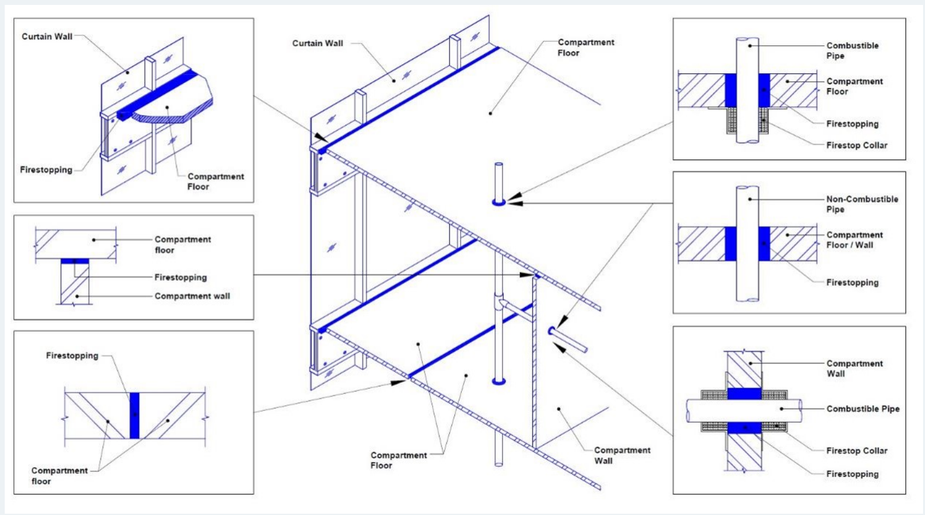


Figure 3.12.1: Fire stopping to a pipe in a compartment wall

Fire stopping is concerned with ensuring that the fire-resisting capability of a component, i.e. separating wall, compartment wall/floor, cavity barrier is not diminished or impaired when penetrated by services for example, a pipe, ducts, etc..

Therefore, whenever gaps are created by the penetration of such pipes, ducts in the fire-rated wall/floor, they must be kept as few as possible. The spacing and internal diameter of pipes passing through any elements of structure or cavity barrier shall comply with Cl.3.9.3 and *Table 3.9A*.

Openings for pipes, ducts, conduits or cables which pass through any part of a compartment (except for a part which does not serve as a fire resisting barrier) or cavity barrier, shall be:

a. kept as few in number as possible;

b. kept as small as practicable; and

c. all gaps shall be filled with fire-stopping materials.

Rationale

Fire-stopping materials will ensure the integrity of the fire compartment is maintained when penetrated by utility lines or pipes.

3.12.2 Fire-stopping

Materials for fire stopping shall have the necessary fire resistance when tested to *BS 476: Part 20* or other acceptable standards.

3.12.3 Materials for fire-stopping

Explanation and Illustrations

(No illustration)

To prevent displacement, materials used for fire stopping should be reinforced with (or supported by) materials of limited combustibility in the following circumstances:

a. in all cases where the unsupported span is greater than 100mm, and

b. in any other cases where non-rigid materials are used (unless they have been shown to be satisfactory by test)

Preference should be given to proprietary fire stopping and sealing system.

When cement mortar or gypsum board plaster or cement or gypsum based vermiculite/perlite mixes is used as fire stopping material, care should be exercised to ensure that workmen properly fill up the entire gaps with the appropriate fire stopping material instead of carrying cosmetic application by just filling up the gaps superficially.

Suitable fire-stopping materials include:

a. Fire-stopping and sealing systems (including those designed for service penetrations) which have been shown by test to maintain the fire resistance of the wall or other element.

b. Other fire-stopping materials include:

(1) cement mortar;

(2) gypsum-based plaster;

(3) cement or gypsum-based vermiculite/ perlite mixes;

(4) glass fibre, crushed rock, blast furnace slag or ceramic based products (with or without resin binders); and

(5) intumescent mastics.

The method of fire-stopping and choice of materials shall be appropriate to the situation and its application.

CLAUSE 3.13 CLASSIFICATION OF SPREAD OF FLAME

3.13.1 Requirements for Class 0

Explanation and Illustrations

(No illustration)

BS 476: Part 6 refers to a standard fire test for propagation of products.

Under this test, there is a means of comparing the contribution of combustible building materials to the growth of a fire by providing a measure of the rate of heat evolution of the samples, exposed in a small combustion chamber.

The performance of each sample is expressed as a numerical index from 0 to 100 or more. Low values of the indexes indicate a low rate of heat release. Three to five specimens are tested.

Index of performance I = i1 + i2 + i3 where sub-index i1 is derived from the first three minutes of test, i2 from the following seven minutes, and i3 from the final ten minutes. A high index i1 indicates an initial rapid ignition and heat release.

Any reference to a surface being Class 0 shall be construed as a requirement that:

a. the material of which the wall or ceiling is constructed shall be non-combustible throughout, or

b. the surface material (or, if it is bonded throughout to a substrate, the surface material in conjunction with the substrate) shall have a surface of Class 1 when tested to *BS 476 Part 7* and if tested in accordance with *BS 476: Part 6* shall have an index of performance (I) not exceeding 12 and a sub-index (i_1) not exceeding 6.

3.13.2 Class other than Class 0

Explanation and Illustrations

(No illustration)

BS 476: Part 7 refers to a standard fire test for the classification of the surface spread of flame of products. This test is able to determine the tendency of surfaces of flat material to support the spread of flame across their surfaces and specifies a method of classification appropriate to wall and ceiling linings. Class 0 represents the best performance, followed in descending order by Class 1, Class 2, Class 3 and Class 4. This clause is rephrased for clarity.

Any reference to a surface being of a class other than Class 0, shall be construed as a requirement that the material which the wall or ceiling is constructed shall comply with the relevant test criteria relating to surface spread of flame, which is specified in relation to that class in *BS 476: Part 7*.

3.13.3 Order of classification

Explanation and Illustrations

(No illustration)

The reason for having Class 0 is that Class 1 covered too wide a range of performance for use in critical areas. Where a higher degree of protection is required, for example in exit staircases, exit passageways (which constitute the escape route), Class 0 is specified.

Class 0 shall be regarded as the highest class (based on *BS 476 Part 6 & 7*), followed in descending order by Class 1, Class 2, Class 3 and Class 4 (based on *BS 476 Part 7*), as set hereunder:

a. Class 0 - Surface of no flame spread. Such surfaces shall conform to the requirements of Cl.3.13.1.

b. Class 1 - Surface of very low flame spread. This refers to surfaces on which during the first 1½ mins of test, the spread of flame does not exceed 165mm and the final spread of flame does not exceed 165mm under the relevant test conditions.

c. Class 2 - Surface of low flame spread. This refers to surfaces on which during the first 1½ mins of test, the spread of flame does not exceed 215mm and the final spread of flame does not exceed 455mm under the relevant test conditions.

d. Class 3 - Surface of medium flame spread. This refers to surfaces on which during the first 1½ mins of test, the spread of flame does not exceed 265mm and the final spread of flame does not exceed 710mm under the relevant test conditions.

e. Class 4 - Surface of rapid flame spread. This refers to surfaces on which the spread of flame exceeded the limit of Class 3.

3.13.4 Class of flame spread to be not lower than specified

Explanation and Illustrations

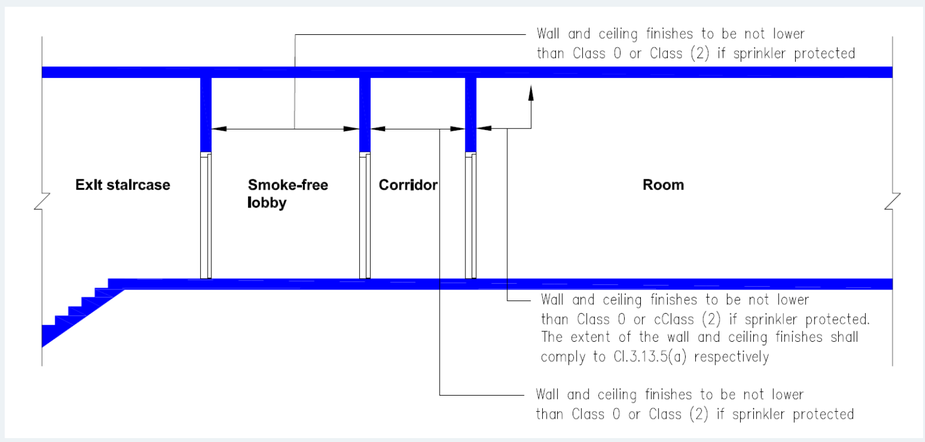


Figure 3.13.4

Wall, ceiling and floor finishes to exit staircase (including exit passageway) shall be of non-combustible materials or Class 0 (sprinkler-protected). For rooms, the extent of wall and ceiling finishes shall comply to *Cl.3.13.5a.* and *b.* respectively.

Where a building is protected by automatic sprinkler system, the surfaces of the walls and ceilings of the circulation space (corridor) and institutional occupancy area can be downgraded by 2 classes subject to Class 3 being the lowest.

The surface of a wall or ceiling in a room/space shall be of a class not lower than specified as relevant in the *Table 3.13A*, provided that

a. Where an automatic sprinkler system is fitted throughout in the building in compliance with the requirements in Chapter 6, there is no control on the surface of flame rating in rooms/spaces, except for the following occupancies/usage:

(1) healthcare facilities, including hospital, and nursing homes for handicapped, disabled, aged or persons with mental and/or mobility impairments;

(2) detention facilities; and

(3) exit staircases, exit passageways and smoke-free/fire lift lobbies.

b. Where a building is not protected by an automatic sprinkler system, surfaces of the walls and ceilings can be of a surface class not lower than Class 3 to the extent permitted by *Cl.3.13.5a.* and *Cl.3.13.5b.* respectively.

c. If timber is used as the surface material for the walls along the side gangways of an auditorium which is not sprinkler-protected, the requirements of this regulation pertaining to the requisite class of flame spread can be relaxed only in respect of those parts of such wall surfaces provided the aggregate area of such parts does not exceed 50% of the whole surface area

of the side walls of the auditorium.

Explanation and Illustrations

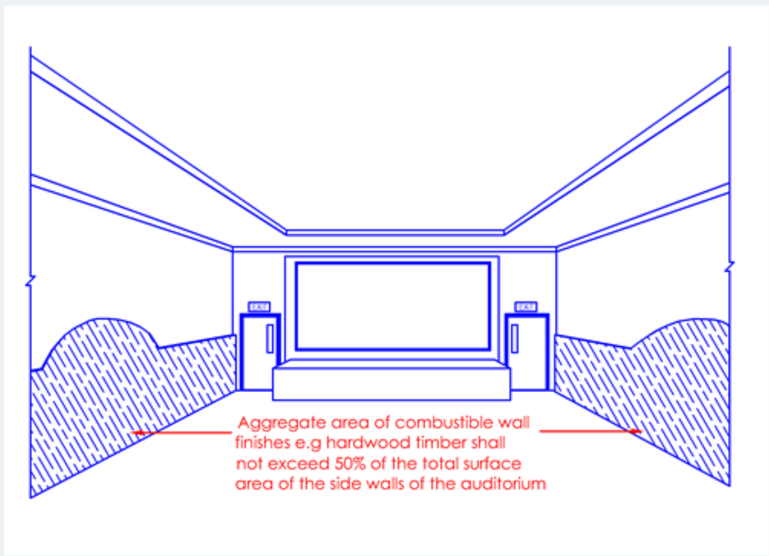


Figure 3.13.4c.

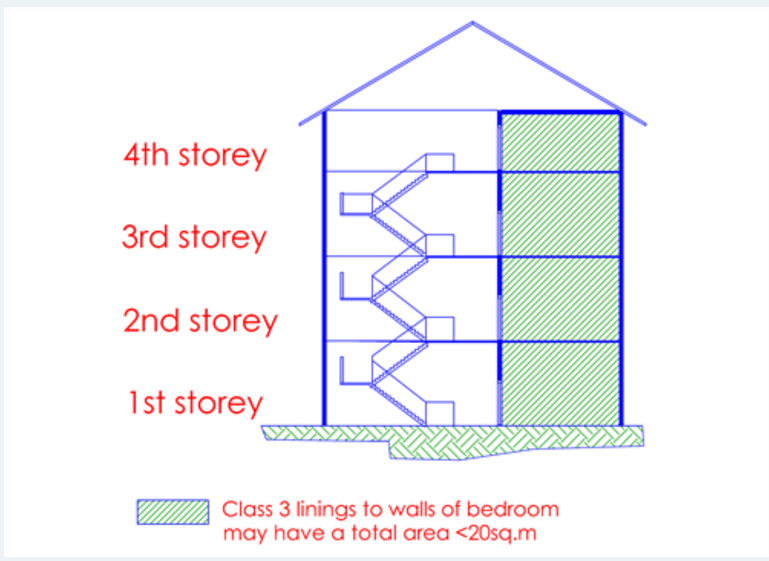
In the design of the auditorium, there is a need to meet the acoustic requirements. Timber was then considered as a preferred material for use. The above clause provides the relaxation for the use of timber as wall linings, provided the aggregate area of the timber linings does not exceed 50% of the whole surface area of the side walls of the auditorium. The other reason for the above relaxation is that each auditorium is required to be constructed as a fire compartment

3.13.5 Where class of flame spread can be of any class not lower than Class 3

a. Any part of the surface of a wall in a room or compartment can be of any class not lower than Class 3 if the area of that part (or if there are two or more such parts, the total area of those parts) does not exceed the following

(1) in the case of a building or compartment of PG III, 20m^2, or

Explanation and Illustrations



Section

Figure 3.13.5a.(1)

The linings to internal surfaces of a wall in a room or compartment are permitted to have any Class as permitted under *Table 3.13A*.

(2) in any other case, 60m^2.

b. Any part of the surface of a ceiling can be of any class not lower than Class 3 if that part of the surface is the face of a layer of material the other face of which is exposed to the external air (skylight included) and complies with any one of the following:

Explanation and Illustrations

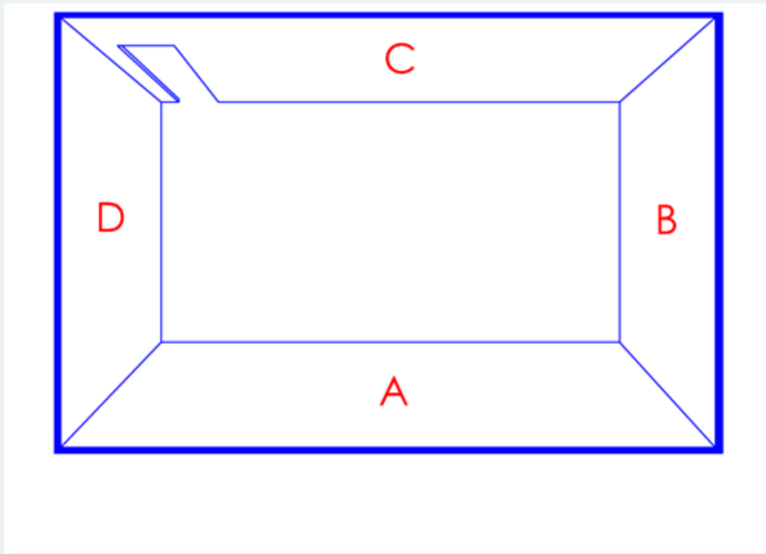


Figure 3.13.5a.(2) – 1

Computation of 60m² will be based on total surface areas of walls in a room having not lower than Class 3. In the above diagram, the total surface area of the 4 walls, if finished with Class 3 materials shall not exceed 60m².

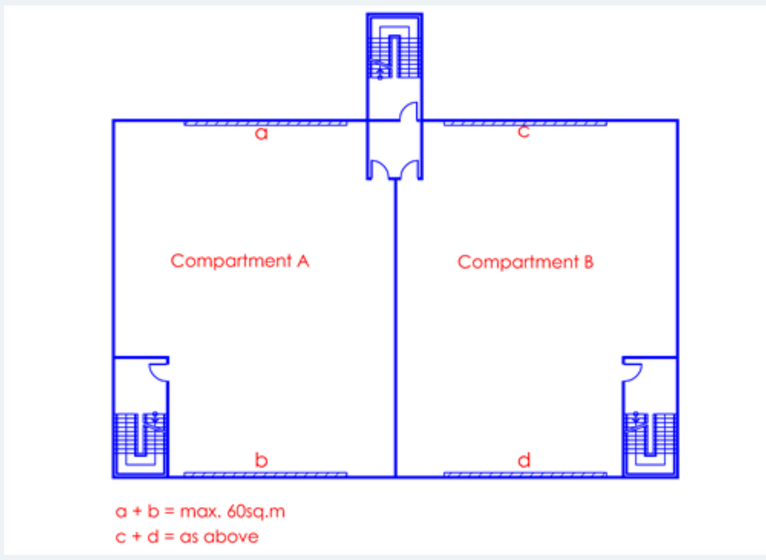


Figure 3.13.5a.(2) – 2

In the above diagram there are two compartments. Each compartment can have a total of 60m² of combustible wall finishes of not lower than Class 3. Subsequently, if the compartment wall is removed, there is a need to review the provision of wall finishes, subject to the total wall finishes to the whole floor shall not exceed 60m². Area of wall finishes in excess of 60m² is required to be removed.

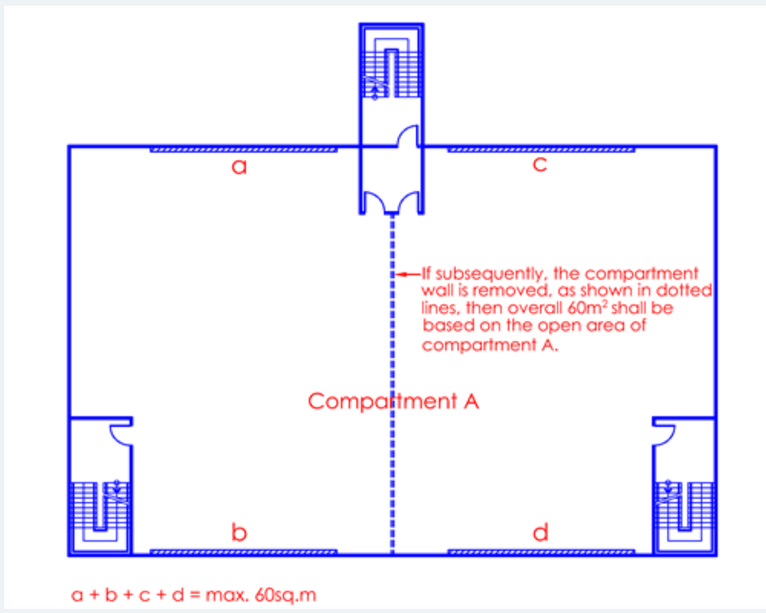


Figure 3.13.5a.(2) – 3

In the above diagram, if subsequently the compartment wall as shown in dotted lines is removed, the overall 60m² shall be based on total floor area of compartment A.

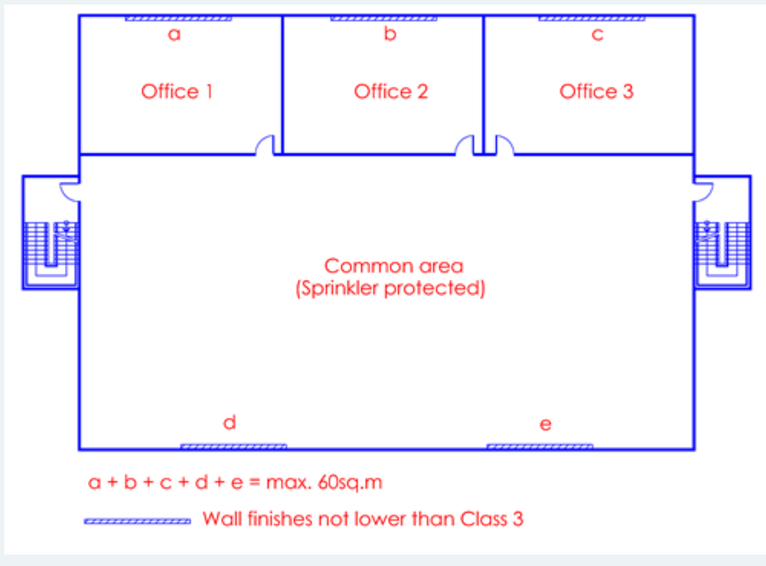


Figure 3.13.5a.(2) – 4

In situation where multiple floors are interconnected to form one compartment by atrium design, waiver application is required to vary the max. 60sq.m

For Class 3 wall finishes, the total area of 60sq.m excludes :

a. door frames and unglazed parts of doors;

b. window frames and frames in which glazing is fitted;

c. architraves cover moulds, picture rails, skirtings and similar narrow members; and

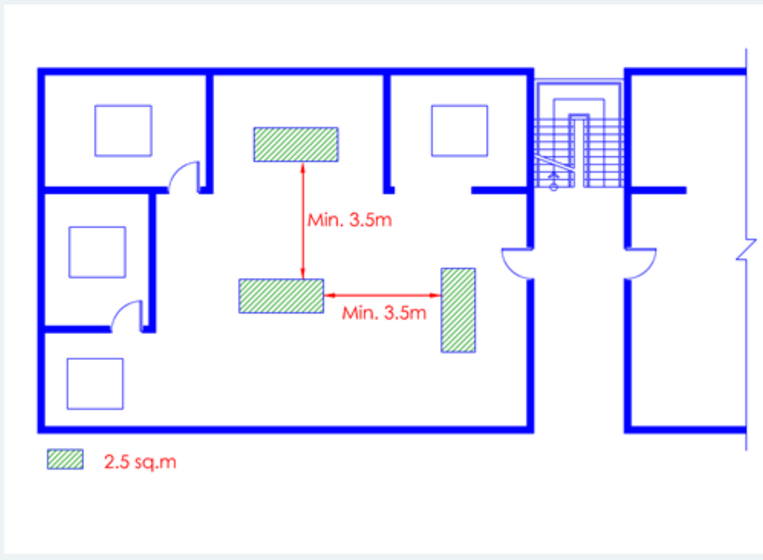
d. fitted furniture.

(1) The ceiling is that of a room in a building or compartment of PG III, IV, V or VII, or is that of a circulation space excluding a smoke-free lobby, exit staircase or exit passageway in a building or compartment of any purpose group, and

(a) the area of that part does not exceed 2.5m²; and

(b) the distance between that part and any other such part is not less than 3.5m.

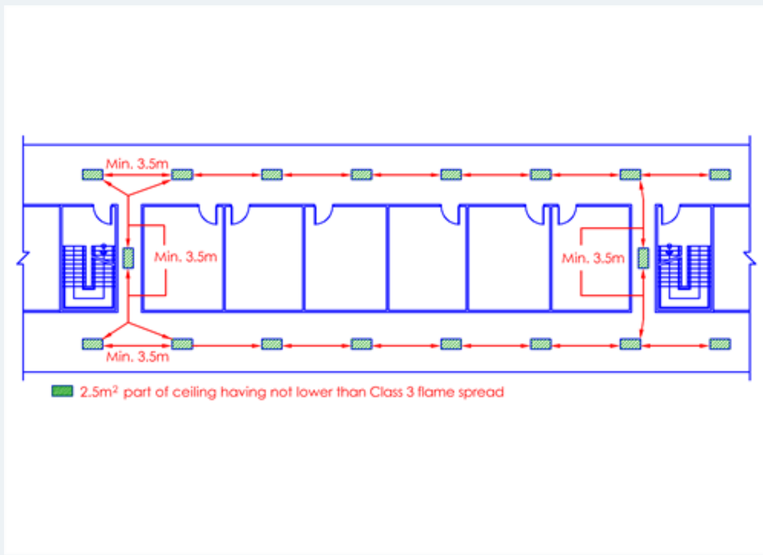
Explanation and Illustrations



Reflected ceiling plan

Figure 3.13.5b.(1) - 1

Ceilings of living room, dining room, kitchen and bedrooms are permitted to have combustible finishes of class not lower than Class 3. The control is based on the size and spacing of the ceiling material.



Reflected ceiling plan

Figure 3.13.5b.(1) - 2

The above clause is intended for lighting diffuser Any part of a ceiling to circulation space e.g. corridor can have not lower than Class 3 flame spread, provided each part shall not exceed 2.5m² and is separated from other such part by minimum 3.5m.

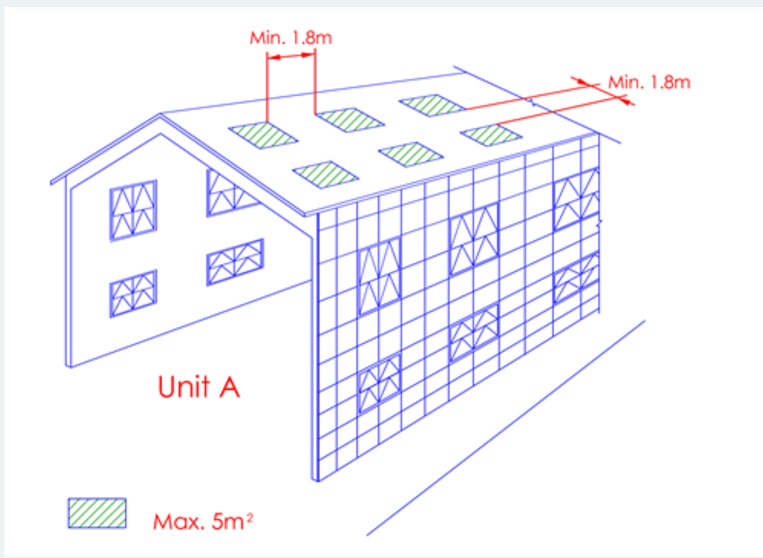
(2) The ceiling is that of a room in a building or compartment of PG VI or VIII, and

(a) the area of that part does not exceed 5m²;

(b) the distance between that part and any other such part is not less than 1.8m; and

(c) that part and all other such parts are evenly distributed over the whole area of the ceiling and together have an area which does not exceed 20% of the floor area of the room.

Explanation and Illustrations



Axonometric view

Figure 3.13.5b.(2)

1. Factories and warehouses are usually provided with translucent roof sheets or sky light for natural lighting.

2. Any part of ceiling which is combustible shall have an area not exceeding 5m² and a class not lower than Class 3 flame spread. It shall be separated from any such part by at least 1.8m.

3. The aggregate area of such part of ceiling shall not exceed 20% of the floor area.

(3) The ceiling is that of a balcony, verandah, open car porch, covered way or loading bay which (regardless of its floor area) has at least one of its longer sides wholly and permanently open.

Explanation and Illustrations

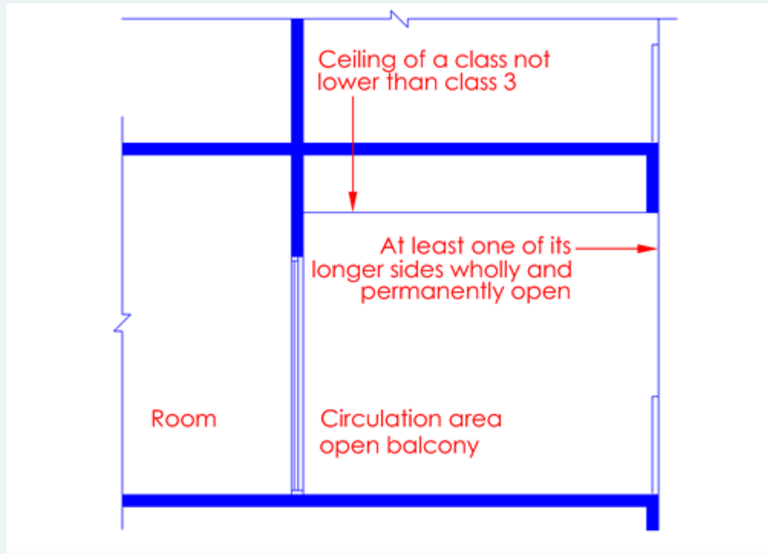


Figure 3.13.5b.(3) – 1

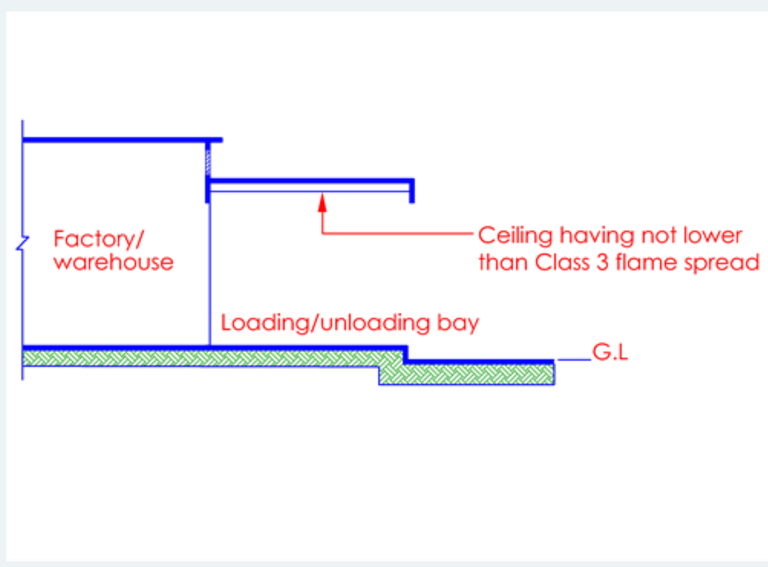


Figure 3.13.5b.(3) – 2

Unenclosed loading/unloading platform

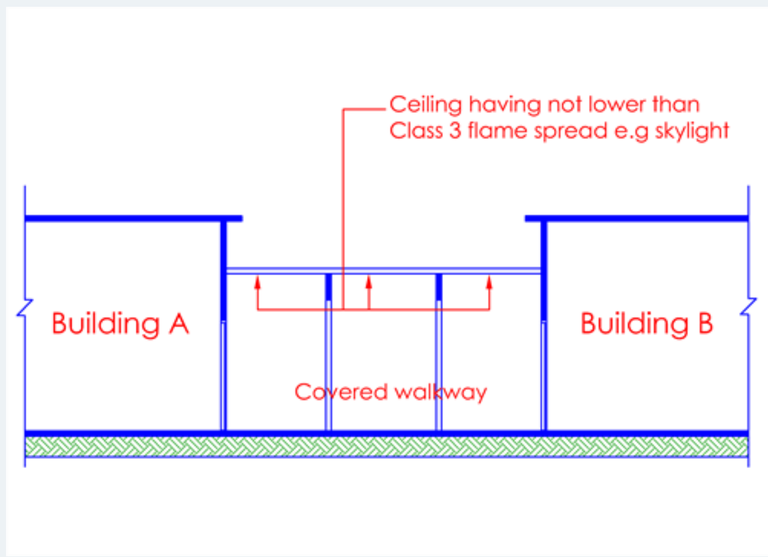


Figure 3.13.5b.(3) – 3

Covered linkway connecting 2 buildings

In-addition to the above, ceilings to balcony, verandah, open carport are also allowed to have not lower than Class 3 flame spread. The above relaxation is allowed as the ceilings are located at the periphery of the building where smoke and heat could easily be dispersed into the exterior air.

Any material, including gypsum board or plaster board, which satisfies the requirements under Cl.1.4.71 as non-combustible material is to be treated as acceptable under the above clause, regardless of the presence of the 0.5mm thick paper facing.

(4) The ceiling is that of a garage or outbuilding which (regardless of whether it forms part of a building or is a building which is attached to another building or wholly detached) has a floor area not exceeding 40m^2.

Explanation and Illustrations

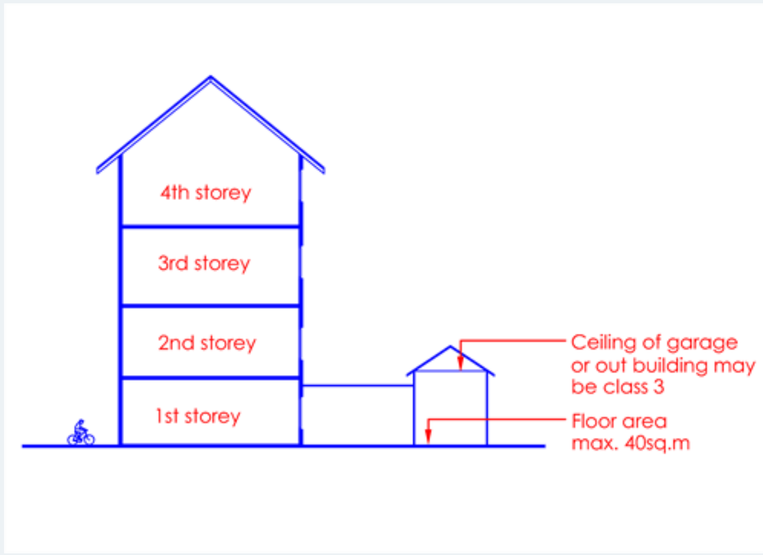


Figure 3.13.5b.(4) – 1

Finishes to ceilings in circulation space in the building shall have a surface flame spread rating of not lower than Class 0 as required for under *Table 3.13A*.

Finishes to ceiling of a room or compartment are permitted to have any class as permitted under *Table 3.13A*.

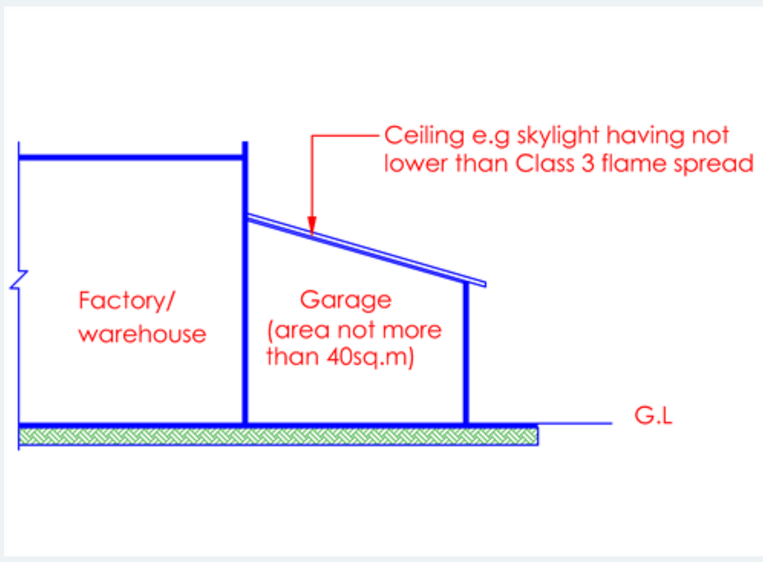


Figure 3.13.5b.(4) – 2

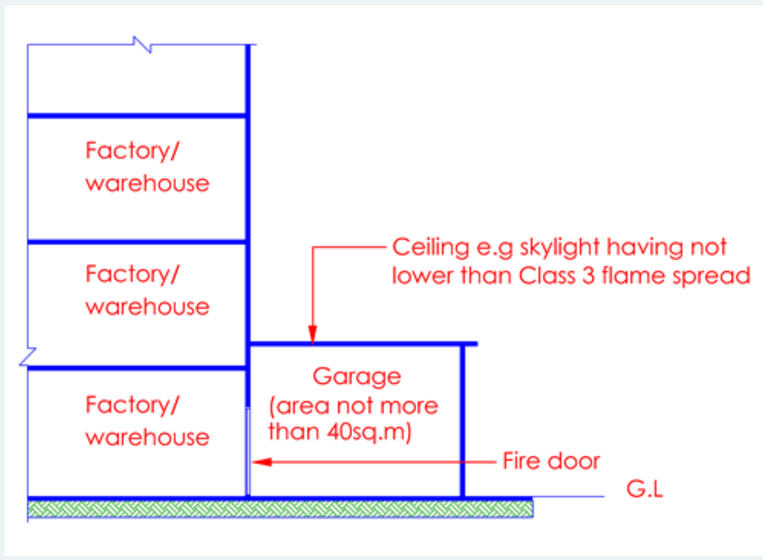


Figure 3.13.5b.(4) – 3

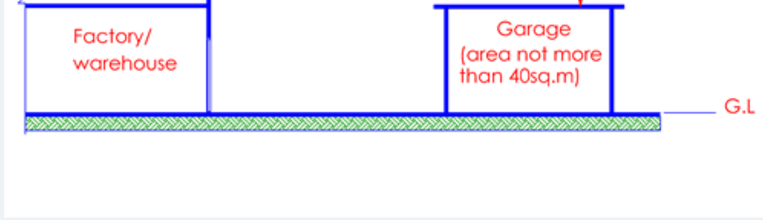


Figure 3.13.5b.(4) – 4

A garage or outbuilding can have ceiling not lower than Class 3 flame spread, provided the accessible floor area does not exceed 40m².

3.13.6 Exception

Explanation and Illustrations

(No illustration)

The above clause grants relaxation on the control of wall and ceiling finishes which are not more than 1.0mm thick mounted on non-combustible substrate, provided these finishes are not used in exit staircases and exit passageways. The main concern is that all protected routes meant for escape of occupants shall be kept free of combustible finishes. The above finishes include material such as gypsum board.

Non-combustible boards, for example gypsum boards, which meet the requirements of Cl.1.4.71 are allowed to be used for the construction of smoke-stop lobbies, exit staircases and exit passageways.

Wall and ceiling finishes in the form of thin sheet of not more than 1.0mm thickness mounted to a non-combustible substrate will not be subject to the requirement of surface spread of flame provisions, except for exit staircases and passageways.

3.13.7 Composite panel

Composite panel used as wall, ceiling or finishes shall comply with Cl.3.15.13.

CLAUSE 3.14 ROOFS

3.14.1 Roof construction

a. The surface of materials for roof covering and roof construction shall have a surface spread of flame rating not lower than Class 1, or Class A when tested in accordance with ASTM E108, except in the case of PG I and PG II, and in buildings that are protected throughout with automatic sprinkler system.

b. Composite panel used as roof covering shall comply with Cl.3.15.13.

c. Roof covering containing plastic shall comply *Cl.3.15.19c.(7)*.

Explanation and Illustrations

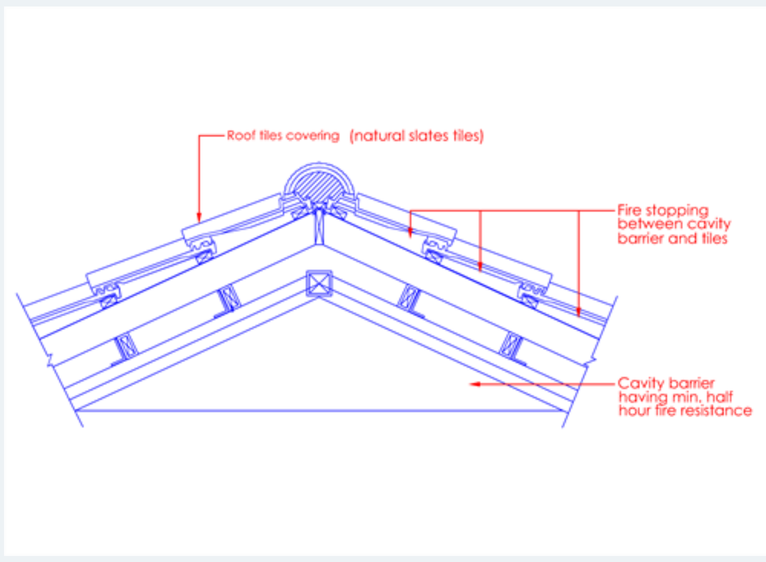


Figure 3.14.1a. - 1

Roof construction to buildings under PG I usually use timber rafters and purlins for tiled roofs. Rooflights of combustible materials are usually used for lighting purposes. Generally, buildings under PG I are small in area and low-rise. For semi-detached and terraced houses, the separating walls would be brought right-up to the underside of or above the roof coverings to prevent spread of fire.

Figure 3.14.1a. - 2

Roofs of building under PG II may consist of dome, flat, pitched roof and other types. Roof covering may include mixture of combustible and non-combustible materials, e.g. slate, clay tiles, glass, rigid plastic. It is quite common to find hardwood timber trusses, purlins etc. being used in the roof construction. The term “roof covering” is used to describe construction which may consist of one or more layers of material, but does not refer to the roof structure as a whole. Roofs which may have different construction can be broadly grouped under the following:

a. Roofs over common corridors and means of escape. As these areas are meant for escape, it would be preferable that they be constructed totally of non-combustible materials.

b. Roof over apartment/maisonette or penthouse units.

c. Roof over linkway between buildings.

d. Roof used as terrace or floor open-to-sky. The roof covering should be of non-combustible materials to eliminate any fire risk arising from a fire involving the covering.

e. Roof over balconies

Roof can also perform two functions:

a. to contain a fire or prevent its penetration from an external source; and

b. to ensure that the external covering does not contribute to spreading of fire so that an adjoining roof might be in danger.

RC roof would be able to satisfy the above functions. However, traditional roof coverings such as tile, slates, metal roofing sheets etc., combined with timber trusses/purlins and combustible insulation materials would have a greater tendency to allow spread of flame. Rigid plastic or thermoplastic materials such as polycarbonate shall not be used. Similarly, thatched roof shall also not be used. Traditionally, tile roof construction requires timber battens and purlins for securing the tiles. However, the risk of fire spread via such timber members is taken care of by the provision of separating wall between residential units.

3.14.2 Provision for buildings not exceeding four storeys

Combustible material can be used for roof construction for PG III, IV, V and VII buildings which satisfy the following requirements:

a. the building shall not exceed four storeys;

b. the roof space between the roof and the ceiling shall be sub-divided by cavity barriers where required to comply with the relevant provisions of Cl.3.11, and openings in cavity barriers shall be fire-stopped to comply with the requirements of Cl.3.12; and

Explanation and Illustrations

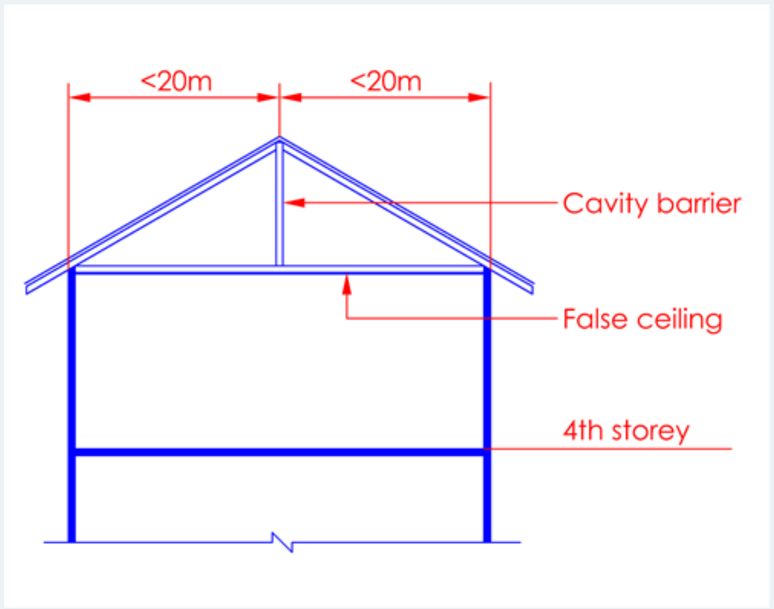


Figure 3.14.2b.

The provision of cavity area barrier is to prevent the spread of fire in the roof spaces. Any service penetration to the cavity barrier shall be fire-stopped.

The cavity barrier shall have minimum ½-hr fire resistance rating.

c. if the underside of the roof serves as the ceiling to a room or space, the elements of the underside of the roof shall comply with the relevant provisions of Cl.3.13 for restriction of spread of flame.

Explanation and Illustrations

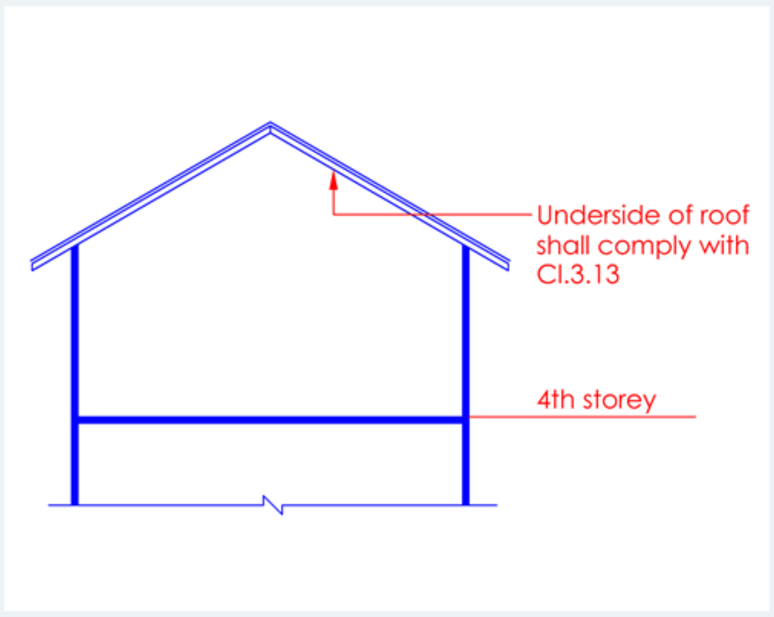
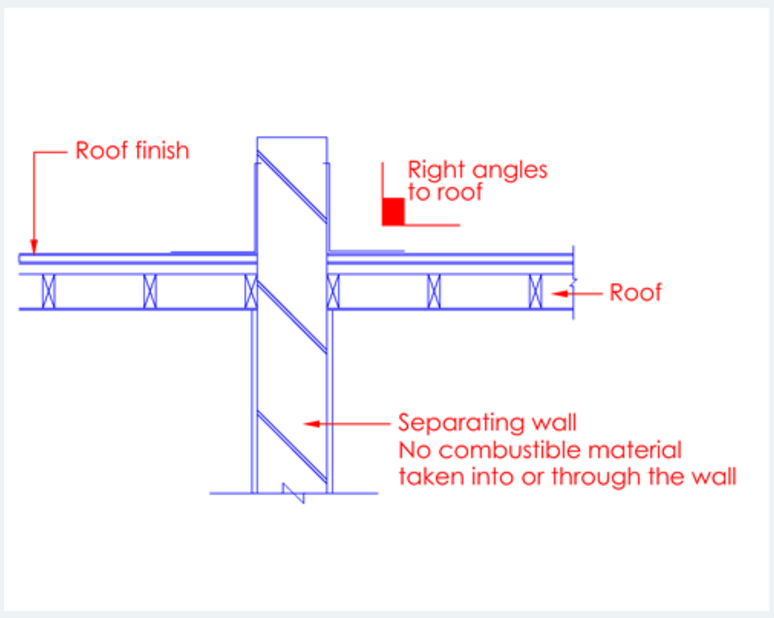


Figure 3.14.2c.

Where false ceiling is not provided, the underside of the roof would be considered as the ceiling to the space below. Hence, there is a need to control the surface flame spread of the exposed underside of the roof construction.

3.14.3 Roof junction with separating wall and compartment wall

Explanation and Illustrations



Section

Figure 3.14.3

At junctions where the roof meets with a separating wall or compartment wall, the roof construction shall comply with the relevant requirements under Cl.3.6.3 and Cl.3.7.4 respectively.

CLAUSE 3.15 MATERIALS FOR CONSTRUCTION

3.15.1 General

Materials used in the construction of building elements shall comply with the provisions stated under this section in addition to the performance requirements, such as fire resistance rating and limit to spread of flame, stipulated in other relevant sections of this Code.

3.15.2 Intumescent paint

Rationale

Intumescent paint is permissible for use as a passive fire protection system on structural steel. It is not applicable to industrial buildings as these buildings may contain harsh and/or adverse environment conditions that may affect the effective performance of intumescent paint applied on the structural steel.

Note

1. For building exceeds 24m in habitable height, a Fire Safety Report shall be submitted together with the plan.

2. A separate set of plans indicating the locations of the structural steel members coated with intumescent paint shall be included in the Fire Safety Report and Building Owner Fire Safety manual, where applicable.

Intumescent paint is allowed to be used for protection of structural steel members of all buildings provided all of the following requirements are complied with:

a. The paint shall be of a proprietary system that has been demonstrated to achieve the fire resistance performance as required in *BS 476 Part 20/ 21* or its equivalent, together with the specified weathering tests as specified in the *BS 8202: Part 2*.

b. Coating of intumescent paint onto structural steels, and subsequent maintenance shall conform to *BS 8202: Part 2*. Fire test for fire resistance performance shall be conducted on the specimens after the weather tests. The fire resistance rating of the tested specimen shall not diminish more than 25%, post- weathering tests.

c. A signage depicting the below minimum information shall be affixed at a conspicuous location:

(1) Name of supplier

(2) Fire resistance rating of the intumescent paint

(3) Date of painting

(4) Expected date of re-painting

(5) Caution note: "Caution – No other paint/coating shall be applied to the surfaces of the structural steel members protected by the intumescent paint system'

d. In buildings under PG VI and VIII, where there can be presence of corrosive atmosphere that can affect the effectiveness of intumescent paints for protection to structural steel members of buildings, such proposal shall be subjected to evaluation of the SCDF.

3.15.3 Flame retardant chemicals

Explanation and Illustrations

(No illustration)

1. It is recognised as an alternative means to protecting timber construction in buildings.

2. However, we have to understand the limitations on the use of flame retardant chemicals for upgrading of fire resistance and/or surface spread of flame rating of combustible materials. The limitations are as follows:

a. The chemicals may deteriorate after exposing to the environment for a long duration. After such, the fire resistance performance or the surface spread of flame rating may be adversely affected over time.

b. The inherent property of the flame-retardant chemical to resist fire spread may be affected when cleaning agent is constantly applied to the surface of the combustible material.

c. There is no specific method and control of treatment of the flame- retardant chemical. This would lead to poor performance as a result of shoddy construction of the materials.

d. There is no certainty on the duration for which the fire property in a material applied with such a chemical can last.

3. For buildings which are not under Conservation, the use of timber materials should be carefully considered and should be avoided where possible.

4. Building owners and occupiers should be made aware of the above mentioned limitations on the use of flame retardant chemicals. In the course of using the premises, building owners and occupiers shall not do anything to cause the retardant treatment to timber members to deteriorate.

5. For lining of walls and ceilings, and construction of mezzanine floor, flame retardant chemicals shall not be used to treat the timber members or other combustible materials to meet surface flame spread and fire resistance rating requirements respectively.

Flame retardant chemicals can be used for upgrading of fire resistance rating or surface spread of flame of timber or any combustible materials, subject to the following:

a. the chemical treatment process is part of the manufacturing process to produce the finished product;

b. the chemical treatment is by means of pressure impregnation conforming to *SS 572*, or the manufacturer's specification in accordance to the prototype test, for timber and other combustible materials, respectively; and

c. the treated materials/products have been subjected to a fire test, as required under *Cl 3.4.1* or *Cl 3.13.1*.

Note

The QP is responsible to inform the building owner and occupiers of the limitations on the use of flame retardant chemicals. In the course of using the premises, the building owner and occupiers shall not do anything to cause the retardant treatment to timber members to deteriorate.

3.15.4 Elements of structure

All elements of structure shall be constructed of non-combustible materials in addition to the relevant provisions as follows:

a. Cl.3.3 for fire resistance of elements of structure

b. Cl.3.5.1, Cl.3.5.2 & Cl.3.5.4 for external walls

c. *Cl.3.6.1a(3)*, *Cl.3.6.1b.* & Cl.3.6.5 for separating walls

d. *Cl.3.7.1c.*, *Cl.3.7.1d*, Cl.3.7.5 & Cl.3.7.6 for compartment walls and compartment floors

e. *Cl.3.8.2c.*, *Cl.3.8.4*, *Cl.3.8.7b.*, *Cl.3.8.8b.*, *Cl.3.8.8e*. and *Cl.3.8.9a.* for protected shafts

3.15.5 Protection of openings

Materials used for the protection of openings shall comply with the relevant provisions of Cl.3.9 of this Code for protection of openings.

3.15.6 Exit staircases

Exit staircases shall be constructed of non-combustible materials to comply with the provisions of Cl.3.10.1

3.15.7 Raised floors

Materials used for the construction of raised floors shall comply with the provisions of *Cl.3.11.8a.* and *Cl.3.11.8e.*.

3.15.8 Ceiling and ceiling supports

a. Materials used for construction of ceiling and its supports shall comply with *Table 3.13B*, except for supports that are required to comply with *Cl.3.11.9b.*.

b. Construction of ceilings and ceiling supports located within sprinkler-protected building shall comply with the provision of *Cl.3.11.10b.*.

3.15.9 Fire-stopping

Materials used for fire-stopping shall comply with the relevant provisions of Cl.3.12.2 and Cl.3.12.3.

3.15.10 Surfaces of walls and ceilings

Materials used on the surfaces of walls and ceilings are required to meet the requirements for restriction of spread of flame, and shall comply with the performance requirements as stipulated under Cl.3.13.

3.15.11 Roof construction

Materials used for roof construction shall comply with the provisions of Cl.3.14.1 & Cl.3.14.2.

3.15.12 Internal non-load-bearing walls

Explanation and Illustrations

(No illustration)

All the internal non-load-bearing walls in the residential units shall be constructed of non-combustible materials. Materials for surface finishes of all the walls, non-loading-bearing, separating and compartment walls shall comply with Cl.3.13.5 and *Cl.3.13.6*.

Internal non-load-bearing walls in buildings shall comply with *Table 3.13B* and the materials for surface finishes of internal non-load-bearing walls shall not be treated as part of the wall and shall comply with the relevant provisions of Cl.3.13.

3.15.13 Composite panel

Composite panels used for the construction of internal non-load-bearing walls, as cladding to external/ internal walls or as roof covering shall comply with all of the following criteria:

a. The outer layers shall be constructed of non-combustible material.

b. The core material (with aggregate thickness exceeding 1mm) of composite panel used for building interior shall meet the classification stipulated in *Table 3.13B*.

c. The composite panel used for external wall cladding shall be mounted against 1-hr fire-rated wall and shall comply with any of the following:

(1) Its core material shall meet at least:

(a) *BS 476 Part 4*, or

(b) *BS 476 Part 11*, or

(c) Class 0 flame-spread rating when tested in accordance with *BS 476 Part 6 & 7*, or

(d) Class B classified under *EN 13501-1*.

(2) The panel assembly shall comply with *NFPA 285*.

d. Composite panel containing plastic shall also comply with Cl.3.15.19.

3.15.14 Fire-rated glass

In buildings which are protected by an automatic sprinkler system, fire-rated glass can be used for the construction of compartment walls, compartment floors, enclosures of smoke-stop lobbies and fire lift lobbies, and protected shafts not containing exit staircase and fire lift, subject to the following:

a. the walls shall have the necessary fire resistance, including insulation, when subject to test under *BS 476 Part 20-23*; and

b. the doors shall have the necessary fire resistance, including insulation, when subject to test under *SS 332 or EN 1634-1*; and

c. the walls and doors shall meet the requirement of Class A for Impact performance when tested under *AS 2208* or Class 1 for Impact Level (drop height class) when tested under *EN 12600*.

3.15.15 Walls, ceilings, roof covering and finishes

Rationale

General plastic materials can readily ignite, hasten fire spread and emit toxic gases and significant amount of smoke.

Walls, ceilings, floor, roof and finishes shall not contain any plastic material, unless the plastic material complies with the requirements stipulated in Cl.3.15.19.

Exception:

a. Use of plastic materials as vertical screening/ divider of telecommunication equipment at non-habitable open-to-sky roof is permitted, provided the materials meet at least Class 2 rating classified under *BS 476: Part 7* or equivalent.

3.15.16 Separation of areas undergoing A&A works

Explanation and Illustrations

(No illustration)

To separate areas undergoing A/A works from other occupied spaces, non-combustible partition is permitted instead of fire rated construction. However, the non-combustible partition shall be brought to the underside of the floor slab to segregate both spaces. This will help to prevent spread of smoke and fire which may be originated from the A/A works.

For additions and alterations to existing buildings, non-combustible partitions shall be used for separation of areas undergoing A&A works from other occupied areas of the building.

3.15.17 Partition for toilet cubicles

Materials with surface flame spread rating of not lower than Class 2 shall be used for the construction of partition for toilet cubicles. If the material used is of Class 3 surface flame spread rating, total exposed surface area of the partitions within the toilet shall not be more than 60m².

3.15.18 Timber floors

The use of timber floors is allowed under the following situations, provided it is protected to achieve the fire resistance rating required of the element of structure or compartment:

a. for an attic within residential units under PG I and II, or

b. in buildings designated for conservation where the timber floors are required to be retained, but subject to compliance with requirements stipulated under Cl.9.9.1, or

c. in buildings built before 1969 under Cl.9.9.1

3.15.19 Use of plastics in building construction

a. General

(1) *Tables 3.15A*, *3.15B* and *3.15C* list the relevant fire test standards and acceptance criteria concerning the use of plastics for various building applications. *Tables 3.15D* to *3.15K* stipulate whether fire tests are exempted or required, depending on the situation, as well as the situations in which the use of plastics is disallowed regardless of the fire test results. The use plastics for wall, ceiling, roof covering, floor and related finishes is only allowed if the conditions stated are met.

(2) For each test category, only one fire test is needed to demonstrate the acceptable fire risk level.

(3) Fire retardants are also allowed to be used to enhance the fire performance of plastics for building construction provided the retardants are applied in suppliers' factories according to the retardants' respective standards. Accelerated weathering tests will also be required to assess the effect of weather on fire retardants applied on external building applications.

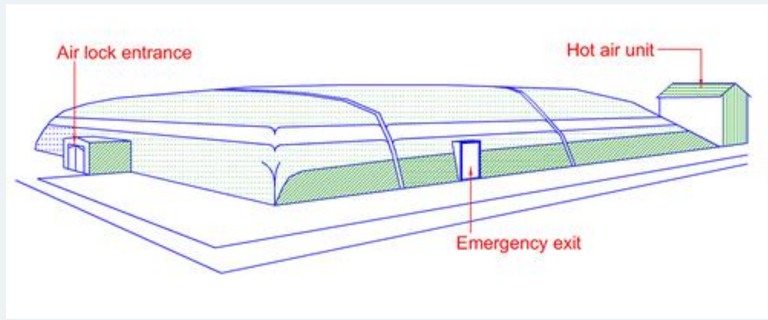
b. Acceptable fire tests and corresponding acceptance criteria

(1) For plastic floor material/finishes, see *Table 3.15A*.

(2) For plastic wall and ceiling material/finishes, see *Table 3.15B*.

(3) For plastic roof covering, see *Table 3.15C*.

Explanation and Illustrations



Axonometric view

Figure 3.15.19a.(1) : Air-supported structure

a. There are various types of air supported or pneumatic building. Air supported structures are used for commercial and industrial applications, such as dining area, warehousing and manufacturing processes, for the agricultural and horticultural industries etc.

b. The membranes used for the air supported structures are usually nylon, plastic, PVC or polythene sheet material, which are combustible in a fire.

c. The main concerns are:

(1) the likelihood of the collapse of the roof owing to lack of pressure inside the structure or during times of emergency;

(2) the combustibility of the structure itself; and

(3) the collapse of the roof may cause panic and difficulties to occupants escaping during times of emergency.

d. In view of the above, proposal for air supported structure shall be evaluated separately and SCDF's consent shall be obtained before making building plan submission.

c. Conditions for the use of plastics in various building applications

(1) For plastic floor finishes (uncovered), see *Diagram 3.15.19c.(1)* and *Table 3.15D*.

(2) For plastic material cast into (embedded within) structural floor system, see *Diagram 3.15.19c.(2)* and *Table 3.15E*.

(3) For plastic floor finishes (covered), see *Diagram 3.15.19c.(3)* and *Table 3.15F*.

(4) For plastic wall or ceiling material/finishes, see *Diagram 3.15.19c.(4)* and *Table 3.15G*.

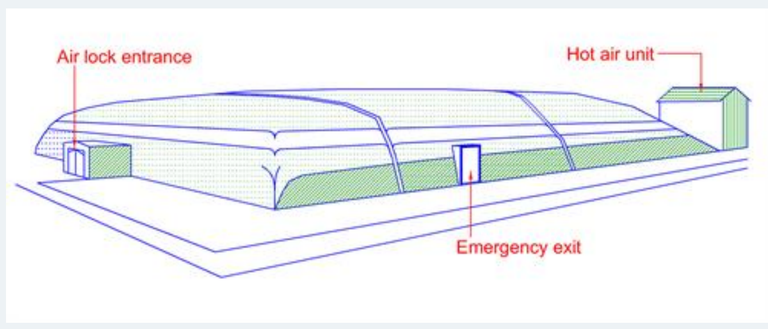
(5) For composite panel containing plastic used as wall or ceiling material/ finishes, see *Diagram 3.15.19c.(5)* and *Table 3.15H*.

(6) For plastic material embedded in masonry wall/ceiling, see *Diagram 3.15.19c.(6)* and *Table 3.15I*.

(7) For plastic roof covering, see Table 3.15J.

(8) For composite panel containing plastic used as roof covering, see *Table 3.15K*.

Explanation and Illustrations



Axonometric view

Figure 3.15.19a.(1) : Air-supported structure

a. There are various types of air supported or pneumatic building. Air supported structures are used for commercial and industrial applications, such as dining area, warehousing and manufacturing processes, for the agricultural and horticultural industries etc.

b. The membranes used for the air supported structures are usually nylon, plastic, PVC or polythene sheet material, which are combustible in a fire.

c. The main concerns are:

(1) the likelihood of the collapse of the roof owing to lack of pressure inside the structure or during times of emergency;

(2) the combustibility of the structure itself; and

(3) the collapse of the roof may cause panic and difficulties to occupants escaping during times of emergency.

d. In view of the above, proposal for air supported structure shall be evaluated separately and SCDF's consent shall be obtained before making building plan submission.

3.15.20 UPVC window frame

Window frames made partly or wholly of UPVC are allowed to be used in buildings provided they are listed under the product listing scheme and comply with the requirements stipulated in *Table 3.15.20*.

TABLE 3.15.20 : CONDITIONS OF INSTALLATION OF UPVC WINDOW FRAME

Building type	Installation height (measured from the level of fire engine accessway/access road)		Length of window	Length of masonry wall break between windows	
	Non-sprinkler-protected	Sprinkler-protected		Horizontal	Vertical
PG I	No restriction				
PG II	≤ 60m	No restriction	≤ 3m	≥ 1m	≥ 1.5m
PG III & VII	≤ 15m	≤ 24m	≤ 3m	≥ 1m	≥ 1.5m
PG IV, V, VI & VIII	≤ 15m	≤ 24m	≤ 5m	≥ 1m	≥ 1.5m

RELATED TABLES AND DIAGRAMS OF CHAPTER 3

TABLE 3.2A : SIZE LIMITATION OF BUILDING & COMPARTMENT

TABLE 3.2A : SIZE LIMITATION OF BUILDING & COMPARTMENT		
Compartments	**Maximum Floor Area**	**Maximum Cubical Extent**
(1)	**(2)**	**(3)**
Compartment below ground level (No compartment shall comprise more than one storey)	2000m²	7500m³
Compartments between average ground level and a height of 24m (No compartment shall comprise more than 3 storeys)	4000m²	15000m³
Compartments above a height of 24m from average ground level (No compartment shall comprise more than one storey)	2000m²	7500m³

TABLE 3.3A: Minimum Periods of Fire Resistance

TABLE 3.3A: Minimum Periods of Fire Resistance

Note:

In this Table -

“cubical extent” means the cubical extent of the building or, if the building is divided into compartments, the compartment of which the elements of structure forms part;

“floor area” means the floor area of each storey in the building or, if the building is divided into compartments, of each storey in the compartment of which the element of structure forms part;

“height” has the meaning assigned to that expression by Cl.3.3.1b.;

“NL” means No limit applicable.

“NR” means Not Relevant.

PART I : BUILDINGS OTHER THAN SINGLE STOREY BUILDINGS

Purpose Group	**Maximum Dimensions**			**Minimum period of fire resistance for elements of structure (*)/external wall/ compartment wall forming part of:**	
(1)	**Height** (m) (2)**	**Floor Area (m²) (3)**	**Cubical Extent (m³) (4)**	**Above ground Storey (hrs)(5)**	**Basement Storey (hrs) (6)**
PG I - Small residential					
House having not more than 3 storeys	NL	NL	NL	1	1
House having 4 storeys	NR	250	NR	1	1
	NL	NL	NL	1	2
House having more than 4 storeys	NL	NL	NL	1	2
PG II - Other residential					
Building or part (+) having not more than 2 storeys	NL	500	NR	1	1
	NL	NL	NL	1	2
Building or part (+) 3 storeys	NR	250	NR	1	1
	NL	NL	NL	1	2
Building having more than 3 storeys	28	3000	8500	1	2
	NL	NL	NL	2	2
PG III - Institutional	28	2000	NL	1	1
	NL	NL	NL	2	2
PG IV - Office	15	NL	3500	1	1
	28	5000	14000	1	2
	NL	NL	NL	2	2
PG V - Shop	15	NR	3500	1	1
	28	1000	7000	1	2
	NL	NL	NL	2	4
PG VI - Factory	15	NR	4250	1	1
	28	NR	8500	1	2
	NL	NL	NL	2	4
PG VII - Place of public resort	15	NR	3500	1	1
	28	1000	7000	1	2
	NL	NL	NL	2	2

PG VIII - Storage	15	NR	1700	1	1
	15	NR	3500	1	2
	28	NR	7000	2	4(b)
	NL	NL	NL	4(a)	4(b)

Note to Part I:

For the purpose of Cl 3.3.2 the period of fire resistance to be taken as being relevant to an element of structure is the period included in columns (5) or (6) in the line of entries which specifies the floor area with which there is conformity or, if there are two or more such lines, in the topmost of those lines.

(*) - A floor which is immediately over a basement storey shall be deemed to be an element of structure forming part of a basement storey.

(**) - Height for elements of structure referred to building height including basement. In the case of compartment wall/external wall, the height shall be based on the height of the wall between compartment floors.

(+) - The expression "part" means a part which is separated as described in Cl.3.3.1b..

(a) - For car parks that are sprinkler-protected and/ or ventilated in accordance with Cl.3.2.8, the minimum period of fire resistance for the element of structure is reduced to 2-hrs.

(b) - For single basement car parks that are sprinkler-protected, the minimum period of fire resistance for the element of structure is reduced to 2-hrs.

PART 2: SINGLE STOREY BUILDINGS

Purpose Group (1)	**Maximum Floor Area (m^2) (2)**	**Minimum period of fire resistance for elements of structure, external wall/ compartment wall (hrs) (3)**
PG I - Small residential	NL	1
PG II - Other residential	NL	1
PG III - Institutional	NL	1
PG IV - Office	NL	1
PG V - Shop	3000	1
	NL	2
PG VI - Factory	3000	1
	NL	2
PG VII - Place of public resort	3000	1
	NL	2
PG VIII - Storage	1000	1
	3000	2
	NL	4(a)

Note to Part 2:

For the purpose of Cl.3.3.2 the period of fire resistance to be taken as being relevant to an element of structure is the period included in column (3) in the line of entries which specifies the floor area with which there is conformity or, if there are two or more such lines, in the topmost of those lines

(a) - For car parks that are sprinkler-protected and/ or ventilated in accordance with Cl.3.2.8, the minimum period of fire resistance for the element of structure is reduced to 2-hrs.

TABLE 3.3B: REQUIREMENTS FOR SUSPENDED CEILING

TABLE 3.3B: REQUIREMENTS FOR SUSPENDED CEILING

Height of Building (1)	**Type of Floor (2)**	**Required Fire Resistance of Floor (3)**	**Description of Suspended Ceiling (4)**
Less than 15m	Non-compartment	1-hr or less	Surface of ceiling exposed within the cavity not lower than Class I surface flame spread rating.
	Compartment	Less than 1-hr	
	Compartment	1-hr	Surface of ceiling exposed within the cavity not lower than Class 0 surface flame spread rating; supports and fixing for the ceiling non-combustible.
	Any	More than 1-hr	Ceiling of non-combustible con- struction and jointless; supports and fixings for the ceiling non- combustible.
15m or more	Any	1-hr or less	Surface of ceiling exposed within the cavity not lower than Class 0 surface flame spread rating and jointless; supports and fixing for the ceiling non-combustible.
	Any	More than 1-hr	Ceiling of non-combustible con- struction and jointless; supports and fixings for the ceiling non- combustible

Note:
References to classes in the above table are to classes as specified in Cl.3.13
Where the space above a suspended ceiling is protected by an automatic sprinkler system it shall be exempted from the requirements for non-combustibility and surface spread of flame classification as specified in the above table provided the ceiling is not situated over an exit passageway, protected lobby or other required protected means of escape

TABLE 3.4A: SPECIFIC PROVISIONS OF TEST FOR FIRE RESISTANCE OF ELEMENTS OF STRUCTURE ETC.

TABLE 3.4A: SPECIFIC PROVISIONS OF TEST FOR FIRE RESISTANCE OF ELEMENTS OF STRUCTURE ETC.

Part of Building	**Minimum Provisions when Tested to BS 476: Part 20-23 (mins)**			**Method of Exposure**
	Stability	**Integrity**	**Insulation**	
1. Structural frame, beam or column	*	No requirement	No requirement	exposed faces
2. Load-bearing wall, Load-bearing wall which is not also an external wall, separating wall, compartment wall or protecting structure (See 4, 5, 6 or 7)	*	No requirement	No requirement	each side separately

3. Floors				
(a) floor in upper storey of a 2-storey dwelling house (but not over a garage)	30	15	15	from underside (Note 1)
(b) any other floor (including a compartment floor)	*	*	*	from underside (Note 1)
4. External walls				
(a) any part less than 1m from point on relevant boundary	*	*	*	each side separately
(b) any part of the wall of a building used for Assembly purposes which is 1m or more from the relevant boundary and is described in Note 2	*	*	15	from inside
	* (max. 60)	* (max. 60)	* (max. 60)	from outside
(c) any part 1m or more from the relevant boundary and is not a part de- scribed in (b) above	*	*	15	from inside
5. Separating wall	* (min. 60)	* (min. 60)	* (min. 60)	each side separately
6. Compartment wall	*	*	*	each side separately
7. Protecting structure (any part)	*	*	*	each side separately
8. Wall separating an attached or integral garage from a dwelling house	*	*	*	from garage side
9. Doors				
a. in a separating wall	No provision	+ (min. 60)	No provision***	each side separately when fitted in its frame
b. in a compartment wall, if it separates a flat or maisonette from a space in common use	No provision	30	No provision***	each side separately
c. in a compartment wall or compartment floor not described in (b) above	No provision	+	No provision***	each side separately
d. in a protecting structure situated wholly or partly above the level of the adjoining ground in a building used for flats, other residential, assembly or office purposes	No provision	30	No provision***	each side separately
e. in a protecting structure not described in (d) above	No provision	** (min. 30)	No provision***	each side separately
f. any other door (including a door in a cavity barrier and a door between a dwelling house and garage)	No provision	30	No provision***	each side separately when fitted in its frame
10. Casing around a drainage system	30	30	30++	from outside
11. Cavity barriers				
a. cavity barrier 1m x 1m or larger	30	30	15	each side separately
b. any other cavity barrier	30	30	No provision	each side separately
c. ceiling	30	30	30	from underside

Modifications
++ - No provision for insulation if the casing is more than 50mm from any pipe in the enclosure (except a pipe passing through the casing)
Note:
* - Period of fire resistance as specified
** - Half the period of fire resistance for the wall or floor in which the door is situated
*** = This exemption does not apply to fire-rated glass door.
+ - Period of fire resistance for the wall or floor in which the door is situated
++ - No provision for insulation if the casing is more than 50mm from any pipe in the enclosure (except a pipe passing through the casing)
1 - A suspended ceiling should only be relied on to contribute to the fire resistance of the floor if the ceiling meets the appropriate provisions given in Table 3.3B

2 - Any part of the wall which is 7.5m or less above the ground, or above a roof or any other part of the building to which people have access, if the building has 2 or more storeys

TABLE 3.9A: MAXIMUM NOMINAL DIAMETER OF PIPES

TABLE 3.9A: MAXIMUM NOMINAL DIAMETER OF PIPES

Situation	**Pipe material and maximum nominal diameter (mm)**		
	Non-combustible material (1)	**Lead, aluminium or aluminium alloy, or UPVC (2)**	**Any other material**
When the pipes (include pipe supports) penetrate the structure enclosing a protected shaft which is not an exit stairway or lift shaft	150	100	40
Any other situation	150	100 (stack pipe) (3),(4),(5) 75 (branch pipe) (3),(4),(5)	40

Note:
(1) = A non-combustible material (such as for cast iron or steel pipes and the pipe supports with melting point of at least 1200°C) which if exposed to a temperature of 750°C will not soften nor fracture to the extent that flame or gases will pass through the wall of the pipe
(2) = UPVC pipes complying with BS 4514 or EN 1329-1
(3) = Within toilets, washrooms or external corridors, maximum diameter of UPVC pipes can be increased to double the size given in the above table
(4) = Within areas of fire risk, such as kitchens, and adjacent to escape routes, UPVC pipes shall be enclosed by construction having fire resistance rating of at least ½ hr
(5) = Where the size of UPVC pipes exceeds that specified under this clause, approved fire collar shall be fitted at all positions where such pipes pass through constructions required to act as a barrier to fire spread

TABLE 3.11A: MAXIMUM DIMENSIONS OF CAVITIES

TABLE 3.11A: MAXIMUM DIMENSIONS OF CAVITIES

Location of cavity	**Purpose Group of building or compartment**	***Class of surface exposed in cavity**	**Max. dimension in any direction**
Between roof and ceiling	I & II	any	no limit
	others	any	20m

Any other cavity	any	Class 0	20m+
	any	any	8m+
Note: * - excluding surface of any pipe, cable, conduit or insulation of any pipe + - shall not apply to raised floor under Cl.3.11.8			

TABLE 3.13A: MINIMUM FLAME-SPREAD CLASSIFICATION OF FINISHES TO WALL, COLUMN, BEAM AND CEILING

TABLE 3.13A: MINIMUM FLAME-SPREAD CLASSIFICATION OF FINISHES TO WALL, COLUMN, BEAM AND CEILING

Building Type	Non-sprinkler-protected Building								Sprinkler-protected Building							
	Room, compartment		Circulation space		Smoke- free /fire lift lobby		Exit stair- case & exit passageway		Room, compartment		Circulation space		Smoke- free /fire lift lobby		Exit stair- case & exit passageway	
	BS(2)	EN(2)	BS(2)	EN(2)	BS(2)	EN(2)	BS(2)	EN(2)	BS(2)	EN(2)	BS(2)	EN(2)	BS(2)	EN(2)	BS(2)	EN(2)
PG I - Small residential	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2	C	0	B
PG II - Other residential	NA	NA	0	B	0	B	NC	A2	NA	NA	NA	NA	2	C	0	B
PG III - Institutional	1	C	0	B	0	B	NC	A2	3	D(1)	3	D(1)	2	C	0	B
PG IV - Office	1	C	0	B	0	B	NC	A2	NA	NA	NA	NA	2	C	0	B
PG V - Shop	1	C	0	B	0	B	NC	A2	NA	NA	NA	NA	2	C	0	B
PG VI - Factory	1	C	0	B	0	B	NC	A2	NA	NA	NA	NA	2	C	0	B
PG VII - Place of public resort	1	C	0	B	0	B	NC	A2	NA	NA	NA	NA	2	C	0	B
PG VIII - Storage	1	C	0	B	0	B	NC	A2	NA	NA	NA	NA	2	C	0	B

Note:

NC = Non-combustible to comply with *BS 476 Pt 4*

NA = Not Applicable

(1) = Applies to detention facilities and healthcare, including hospital, old-aged homes, nursing homes for mentally or physically disabled patients

(2) = BS/ EN refers to the following test standards. Meeting an EN standard implies that the corresponding BS standard is complied with but not vice-versa

EN 13501-1		BS 476	
Classification	**Test Standards**	**Classification**	**Test Standards**
Class A1	EN ISO 1182 + EN ISO 1716	Non-combustibility (NC)	BS 476 Part 4
Class A2	[EN ISO 1182 or EN ISO 1716] + EN 13823	Limited combustibility (LC)	BS 476 Part 11
Class B	EN 13823 + EN ISO 11925-2	Class 0	BS 476 Part 6 & 7
Class C	EN 13823 + EN ISO 11925-2	Class 1	BS 476 Part 7
Class C	EN 13823 + EN ISO 11925-2	Class 2	BS 476 Part 7
Class D	EN 13823 + EN ISO 11925-2	Class 3	BS 476 Part 7
Class F	EN ISO 11925-2	Class 4	BS 476 Part 7

TABLE 3.13B: MINIMUM FLAME-SPREAD CLASSIFICATION OF MATERIAL CONSTRUCTION (HOMOGENOUS)*

TABLE 3.13B: MINIMUM FLAME-SPREAD CLASSIFICATION OF MATERIAL CONSTRUCTION (HOMOGENOUS)*

Building Type	Non-sprinkler-protected Building						Sprinkler-protected Building					
	Internal Non-load-bearing Wall and Ceiling				Roof(5) Covering, including Supports		Internal Non-load-bearing Wall and Ceiling				Roof(5) Covering, including Supports	
	Within Room, Compartment		Within Circulation Spaces(6)				Within Room, Compartment		Within Circulation Spaces(6)			
	BS(7)	EN(7)	BS(7)	EN(7)	BS(7)	EN(7)	BS(7)	EN(7)	BS(7)	EN(7)	BS(7)	EN(7)
PG I - Small residential	NA	NA	NA	NA	NA(2)	NA(2)	NA	NA	NA	NA	NA	NA
PG II - Other residential	NA	NA	LC(3)	A2	NA(2)	NA(2)	NA	NA	1	C	NA	NA
PG III - Institutional	0	B	LC(3)	A2	1	C(4)	1	C(1)	0	B(1)	2	C(1)(4)
PG IV - Office	0	B	LC(3)	A2	1	C(4)	2	C	1	C	2	C(4)
PG V - Shop	0	B	LC(3)	A2	1	C(4)	2	C	1	C	2	C(4)
PG VI - Factory	0	B	LC(3)	A2	1	C(4)	2	C	1	C	2	C(4)
PG VII - Place of public resort	0	B	LC(3)	A2	1	C(4)	2	C	1	C	2	C(4)
PG VIII - Storage	0	B	LC(3)	A2	1	C(4)	2	C	1	C	2	C(4)

Note:
(1) = Applies to detention facilities and healthcare, including hospital, nursing homes for handicapped, disabled, aged or persons with mental and/ or mobility impairment
(2) = Roof support can be of timber construction. Any use of plastic material for roof shall comply with the requirements in Cl.3.15.19c.(8)
(3) = Limited combustibility tested under BS 476 Part 11 or non-combustibility tested under BS 476 Part 4
(4) = Composite panel complying with ASTM E108 Class A is also acceptable
(5) = Applicable to composite panel roofing only. Refer to Cl.3.14.1 for other roofing materials
(6) = Including common corridor, passageway etc.
(7) = BS/EN refers to the test standards shown in the Note to Table 3.13A. Meeting an EN standard implies that the corresponding BS standard is com- plied with but not vice-versa
NA = Not Applicable
LC = Limited combustibility
* = When composite panels are used for the construction, the minimum flame-spread classification shall be applicable to the core material of the panels

TABLE 3.15A: FIRE TESTS AND ACCEPTANCE CRITERIA FOR CONSTRUCTION MATERIALS CONTAINING PLASTIC

TABLE 3.15A: PLASTIC FLOOR MATERIAL/ FINISHES

Test Category	Fire Risk	Applicable Fire Test Standards	Acceptance Criteria
A	Toxicity emission	EN 45545-2	CIT < 0.75
		EN 17084 Method 1 (25kw/m²)	CIT < 0.75
B	Smoke density	EN 13501-1	Smoke classification : s1 rating.
		EN 14041	
		EN ISO 9239-1	
		ASTM E662	Smoke density, Ds,max < 450
		NFPA 258	
		EN ISO 5659-2	Smoke density, Ds,max < 150
C	Flame spread	EN 13501-1	1. Sprinkler-protected premises (a) Sleeping occupancy : Class Cfl or better (b) Non-sleeping occupancy : Class Dfl or better 2. Non-sprinkler-protected premises (a) Sleeping occupancy : Class Bfl or better (b) Non-sleeping occupancy : Class Cfl or better
		EN 14041	
		EN ISO 9239-1	
		ASTM E648	Critical Radiant Flux (CRF) > 0.45 W/cm²
		NFPA 253	

TABLE 3.15B: FIRE TESTS AND ACCEPTANCE CRITERIA FOR CONSTRUCTION MATERIALS CONTAINING PLASTIC

TABLE 3.15B: PLASTIC WALL/ CEILING MATERIAL/ FINISHES

Test Category	Fire Risk	Applicable Fire Test Standards	Acceptance Criteria
D	Toxicity emission	EN 45545-2	CIT < 0.75
		EN 17084 Method 1 (50kw/m²)	CIT < 0.75
E	Smoke density	EN 13501-1	1. Smoke classification to be of s1 rating 2. Flaming droplet classification to be d0 rating
		EN ISO 5659-2	VOF_4 < 300 min
F	Flame spread	EN 13501-1	1. Internal wall finishes: to comply with Cl 3.13 2. External wall finishes: to comply with Cl 3.5
		BS 476-6/7	
		NFPA 285	To pass criteria in NFPA 285
Note: Test categories D and E are not required for external wall finishes			

TABLE 3.15C : PLASTIC ROOF COVERING MATERIAL

TABLE 3.15C : PLASTIC ROOF COVERING MATERIAL

Test Category	Fire Risk	Applicable Fire Test Standards	Acceptance Criteria
G	Toxicity emission	Not critical. Generally exposed to external.	
H	Smoke density	EN 13501-1	1. Generally not critical if exposed to external 2. If exposed as ceiling on the underside, then must meet requirements for ceiling (achieve s1-d0 rating)
J	Flame spread	EN 13501-5	Class BROOF
		BS 476-3	Class AA/AB/AC
		BS 476-7	Class 1
		ASTM E108	Class A

CONDITIONS FOR THE USE OF PLASTIC FLOOR FINISHES (UNCOVERED)

Diagram 3.15.19c.(1) : Plastic floor finishes overlaid on structural floor

TABLE 3.15D: UNCOVERED PLASTIC FLOOR FINISHES

TABLE 3.15D: UNCOVERED PLASTIC FLOOR FINISHES			
S/N	**Material Construction**	**Assessment**	**Remarks**
1	Non-combustible material	Allowed	No further fire test is required
2	Material thickness not exceeding 10mm	Allowed	1. No further fire test is required 2. For sprinkler-protected premises, material not exceeding 20mm can be exempted from the tests in Table 3.15A
3	Use in open-to-sky conditions	Allowed	No further fire test is required
4	Use in exit staircase/ exit passageways	Not allowed	Key escape routes shall be protected
5	Material thickness exceeding 10mm	Allowed with conditions	Allowed if pass test categories A, B and C in Table 3.15A

CONDITIONS FOR THE USE OF PLASTIC MATERIAL CAST INTO (EMBEDDED WITHIN) STRUCTURAL FLOOR SYSTEM

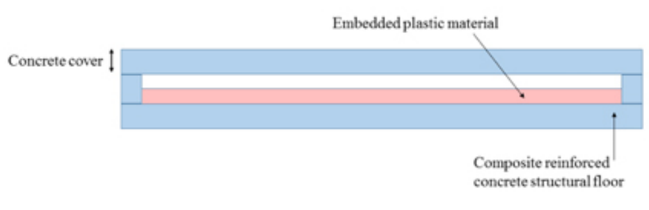


Diagram 3.15.19c.(2) : Plastic material embedded within masonry floor

TABLE 3.15E : PLASTICS EMBEDDED WITHIN MASONRY FLOOR

TABLE 3.15E : PLASTICS EMBEDDED WITHIN MASONRY FLOOR			
S/N	**Material construction**	**Assessment**	**Remarks**
1	Non-combustible material	Allowed	No further fire test is required
2	Material thickness not exceeding 10mm	Allowed	1. No further fire test is required 2. For sprinkler-protected premises, material not exceeding 20mm can be exempted from the tests in Table 3.15A
3	Use in open-to-sky conditions	Allowed	No further fire test is required
4	Use in exit staircase/exit passageways	Not allowed	Key escape routes shall be protected
5	Material thickness exceeding 10mm	Allowed with conditions	1. If masonry cover is less than 25mm thick, the material shall pass test categories A, B and C in Table 3.15A. 2. If masonry cover is at least 25mm thick all around the embedded plastic, tests in Table 3.15A are exempted. 3. The locations where embedded plastics are installed shall be clearly indicated on the plans

CONDITIONS FOR THE USE OF PLASTIC FLOOR FINISHES (COVERED)

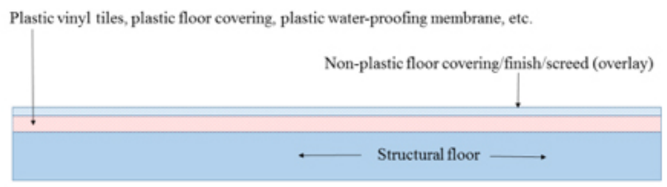


Diagram 3.15.19c.(3) : Plastic floor finishes laid on structural floor, and covered by a non-combustible overlay

TABLE 3.15F: COVERED PLASTIC FLOOR FINISHES

TABLE 3.15F: COVERED PLASTIC FLOOR FINISHES			
S/N	**Material Construction**	**Assessment**	**Remarks**
1	Non-combustible material	Allowed	No further fire test is required
2	Material thickness not exceeding 10mm	Allowed	1. No further fire test is required 2. For sprinkler-protected premises, material not exceeding 20mm can be exempted from the tests in Table 3.15A
3	Use in open-to-sky conditions.	Allowed	No further fire test is required
4	Use in exit staircase / exit passageways	Not allowed	Key escape routes shall be protected
5	Material thickness exceeding 10mm	Allowed with conditions	1. Allowed if pass test categories A, B and C in Table 3.15A 2. If the overlay is non-combustible and at least 25mm thick, test category C in Table 3.15A is exempted

CONDITIONS FOR THE USE OF PLASTIC WALL FINISHES OR CEILING FINISHES

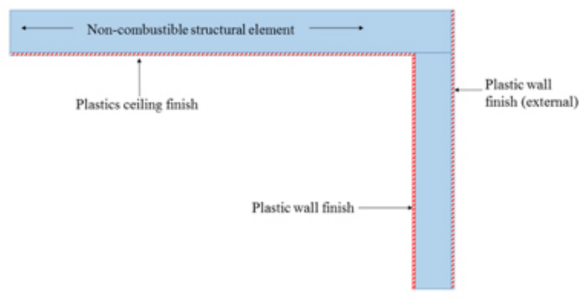


Diagram 3.15.19c.(4) : Plastic wall or ceiling material/ finishes installed internally/ externally

TABLE 3.15G: PLASTIC WALL OR CEILING MATERIAL/ FINISHES

TABLE 3.15G: PLASTIC WALL OR CEILING MATERIAL/ FINISHES			
S/N	**Material Construction**	**Assessment**	**Remarks**
1	Non-combustible material	Allowed	No further fire test required
2	Material thickness not exceeding 1mm	Allowed	No further fire test required
3	Use in exit staircase/exit passageways	Not allowed	Key escape routes shall be protected
4	Material thickness exceeding 1mm	Allowed with conditions	Allowed if pass test categories D, E and F in Table 3.15B, unless specifically exempted for external building applications

TABLE 3.15H: COMPOSITE PANEL WITH PLASTIC USED AS WALL OR CEILING MATERIAL/ FINISHES

TABLE 3.15H: COMPOSITE PANEL WITH PLASTIC USED AS WALL OR CEILING MATERIAL/ FINISHES			
S/N	**Material Construction**	**Assessment**	**Remarks**
1	Non-combustible plastic material	Allowed	No further fire test required
2	Plastic material thickness not exceeding 1mm	Allowed	No further fire test required
3	Use in exit staircase/ exit passageways	Not allowed	Key escape routes shall be protected
4	Plastic material thickness exceeding 1mm	Allowed with conditions	Allowed if pass test categories D, E and F in Table 3.15B, unless specifically exempted for external building applications

CONDITIONS FOR THE USE OF PLASTIC MATERIAL EMBEDDED IN MASONRY WALL/ CEILING

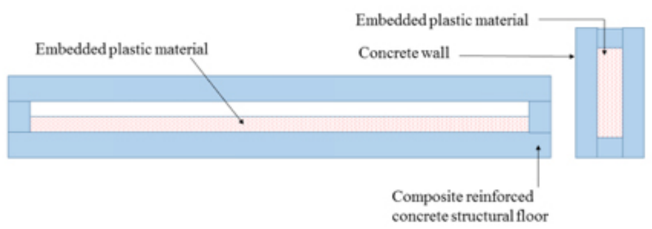


Diagram 3.15.19c.(6) : Plastic material embedded within wall/ ceiling

TABLE 3.15I: PLASTIC MATERIAL EMBEDDED IN MASONRY WALL/ CEILING

TABLE 3.15I: PLASTIC MATERIAL EMBEDDED IN MASONRY WALL/ CEILING			
S/N	**Material Construction**	**Assessment**	**Remarks**
1	Non-combustible material	Allowed	No further fire test required
2	Material thickness not exceeding 1mm	Allowed	No further fire test required
3	Use in exit staircase/ exit passageways	Not allowed	Key escape routes shall be protected
4	Material thickness exceeding 1mm	Allowed with conditions	1. If masonry cover is less than 25mm thick, the material shall pass test categories D, E and F in Table 3.15B 2. If masonry cover is at least 25mm thick all around the embedded plastic, tests in Table 3.15B are exempted 3. The locations where embedded plastics are installed shall be clearly indicated on the plans

CONDITIONS FOR THE USE OF PLASTIC ROOF COVERING

TABLE 3.15J : PLASTIC ROOF COVERING			
S/N	**Material Construction**	**Assessment**	**Remarks**
1	Non-combustible material	Allowed	No further fire test required
2	Material thickness not exceeding 1mm	Allowed	No further fire test required
3	Use in exit staircase/ exit passageways	Not allowed	Key escape routes shall be protected
4	Material thickness exceeding 1mm	Allowed with conditions	1. Allowed if pass test category J in Table 3.15C, as well as test category H in Table 3.15C if exposed on underside 2. Exempted from test categories H and if the requirements specified for skylights in Cl.3.13.5b.

CONDITIONS FOR THE USE OF COMPOSITE PANEL CONTAINING PLASTIC AS ROOF COVERING

TABLE 3.15K: COMPOSITE PANEL WITH PLASTIC USED AS ROOF COVERING			
S/N	**Material Construction**	**Assessment**	**Remarks**
1	Non-combustible plastic material	Allowed	No further fire test required
2	Plastic material thickness not exceeding 1mm	Allowed	No further fire test required
3	Use in exit staircase/ exit passageways	Not allowed	Key escape routes shall be protected

4	Plastic material thickness exceeding 1mm	Allowed with conditions	1. Allowed if pass test category J in Table 3.15C, as well as test category H in Table 3.15C if exposed on underside 2. Exempted from test categories H and J if the requirements specified for skylights in Cl.3.13.5b.

CONDITIONS FOR THE USE OF COMPOSITE PANEL WITH PLASTIC USED AS WALL FINISHES OR CEILING FINISHES

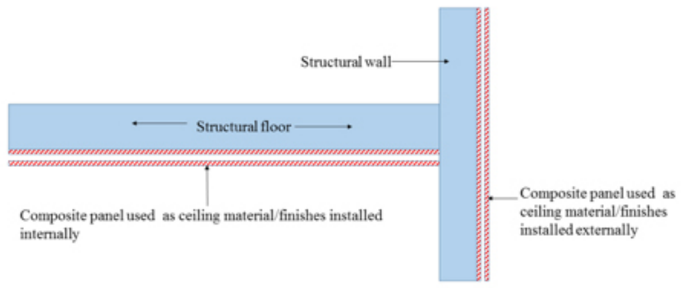


Diagram 3.15.19c.(5) : Composite panel with plastic used as wall or ceiling material/ finishes installed internally/ externally

ANNEX 3A

A1.0 General

In this Annex:

a. "Class 1 aggregate" means foamed slag, pumice, blast furnace slag, pelleted fly ash, crushed brick and burnt clay products (including expanded clay) well-burnt clinker and crushed limestone.

b. "Class 2 aggregate" means flint gravel, granite, and all crushed natural stones other than limestones.

c. Any reference to plaster means:

(1) in the case of an external wall 1m or more from the relevant boundary, plaster applied on the internal face only;

(2) in the case of any other wall, plaster applied on both faces;

(3) if to plaster of a given thickness on the external face of a wall, except in the case of a reference to vermiculite-gypsum plaster, rendering on the external face of the same thickness; and

(4) if to vermiculite-gypsum plaster, vermiculite-gypsum plaster of a mix within the range of 1½ to 2:1 by volume.

d. In the case of a cavity wall, the load is assumed to be on inner leaf only except for fire resistance period of 4-hrs.

e. Any material or type of construction and its method of preparation or application as referred to in the table, shall conform with the relevant provisions of the Building Control Act (Chapter 29) and the relevant Singapore Standard or Singapore Standard Code of Practice. In the absence of the aforementioned Standard or Code of Practice, the relevant British equivalent or other accepted standard or codes of practice shall be applicable.

A2.0 : WALLS

A2.0 : WALLS												
Construction and Materials	**Minimum thickness excluding plaster (in mm) for period of fire resistance of**											
	Load-bearing						**Non-load-bearing**					
	4 hrs	**3 hrs**	**2 hrs**	**1½ hrs**	**1 hr**	**½ hr**	**4 hrs**	**3 hrs**	**2 hrs**	**1½ hrs**	**1 hr**	**½ hr**
A2.1 -- Mansonry Construction												
1. Reinforced concrete, minimum concrete cover to main reinforcement of 25mm:												
(a) Unplastered (to comply with SS EN 1992–1–2)	-	-	-	-	-	-	-	-	-	-	-	-
(b) 12.5mm cement-sand plaster	180	-	100	100	75	75	-	-	-	-	-	-
(c) 12.5mm gypsum-sand plaster	180	-	100	100	75	75	-	-	-	-	-	-
(d) 12.5mm vermiculite-gypsum plaster	125	-	75	75	63	63	-	-	-	-	-	-
2. No-fines concrete of Class 2 aggregate:												
(a) 13mm cement-sand plaster	-	-	-	-	-	-	150	150	150	150	150	150
(b) 13mm gypsum-sand plaster	-	-	-	-	-	-	150	150	150	150	150	150
(c) 13mm vermiculite-gypsum plaster	-	-	-	-	-	-	150	150	150	150	150	150
3. Bricks of clay, concrete or sand-lime:												
(a) Unplastered	200	200	100	100	100	100	170	170	100	100	75	75
(b) 13mm cement-sand plaster	200	200	100	100	100	100	170	170	100	100	75	75
(c) 13mm gypsum-sand plaster	200	200	100	100	100	100	170	170	100	100	75	75
(d) 13mm vermiculite-gypsum or perlite-gypsum* plaster	100	-	100	100	100	100	100	-	100	100	75	75
4. Concrete blocks of Class 1 aggregate:												
(a) Unplastered	150	-	100	100	100	100	150	-	75	75	75	50
(b) 12.5mm cement-sand plaster	150	-	100	100	100	100	150	-	75	75	75	50
(c) 12.5mm gypsum-sand plaster	150	-	100	100	100	100	150	-	75	75	75	50
(d) 12.5mm vermiculite-gypsum plaster	100	-	100	100	100	100	75	-	75	62	50	50
5. Concrete blocks of Class 2 aggregate:												
(a) Unplastered	-	-	100	100	100	100	150	-	100	100	75	50
(b) 12.5mm cement-sand plaster	-	-	100	100	100	100	150	-	100	100	75	50
(c) 12.5mm gypsum-sand plaster	-	-	100	100	100	100	150	-	100	100	75	50
(d) 12.5mm vermiculite-gypsum plaster	100	-	100	100	100	100	100	-	75	75	75	50
6. Autoclaved aerated concrete blocks, density 475 - 1200 kg/m³	180	140	100	100	100	100	100	-	62	62	50	50
7. Hollow concrete blocks, one cell in wall thickness, of Class 1 aggregate:												
(a) Unplastered	-	-	100	100	100	100	150	-	100	100	100	75
(b) 12.5mm cement-sand plaster	-	-	100	100	100	100	150	-	100	75	75	75
(c) 12.5mm gypsum-sand plaster	-	-	100	100	100	100	150	-	100	75	75	75
(d) 12.5mm vermiculite-gypsum plaster	-	-	100	100	100	100	150	-	75	75	62	62
8. Hollow concrete blocks, one cell in wall thickness, of Class 2 aggregate:												
(a) Unplastered	-	-	-	-	-	-	150	-	150	125	125	125

(b) 12.5mm cement-sand plaster	-	-	-	-	-	-	150	-	150	125	125	100
(c) 12.5mm gypsum-sand plaster	-	-	-	-	-	-	150	-	150	125	125	100
(d) 12.5mm gypsum-sand plaster	-	-	-	-	-	-	125	-	100	100	100	75
9. Cellular clay blocks not less than 50% solid												
(a) 12.5mm cement-sand plaster	-	-	-	-	-	-	-	-	-	-	100	75
(b) 12.5mm gypsum-sand plaster	-	-	-	-	-	-	-	-	-	-	100	75
(c) 12.5mm vermiculite-gypsum plaster	-	-	-	-	-	-	200	-	100	100	100	62
10. Cavity wall with outer leaf of bricks or blocks of clay, composition, concrete or sand-lime, not less than 100mm thick and;												
(a) inner leaf of bricks or blocks of clay, composition, concrete or sand lime	100	100	100	100	100	100	75	-	75	75	75	75
(b) inner leaf of solid or hollow concrete bricks or blocks of Class 1 aggregate	100	100	100	100	100	100	75	-	75	75	75	75
11. Cavity wall with outer leaf of cellular clay blocks as 9 above and inner leaf of autoclaved aerated concrete blocks, density 480-1200 kg/m³	150	140	100	100	100	100	75	75	75	75	75	75
Note: * - Perlite-gypsum plaster to clay bricks only												

A2.0 : WALLS	
Construction and Materials	**Period of Fire Resistance hrs**
A2.2 - Framed and Composite Construction (non-load-bearing)	
1. Steel frame with external cladding of 16mm rendering on metal lathing and internal lining of autoclaved aerated concrete blocks, density 480-1120 kg/m³ of thickness of –	
(a) 50mm	2
(b) 62mm	3
(c) 75mm	4
2. Steel frame with external cladding of 100mm concrete blocks and internal lining of 16mm gypsum plaster on metal lathing	4
3. Steel frame with external cladding of 16mm rendering on metal lathing and internal lining of 16mm gypsum plaster on metal lathing	1
4. Steel or timber frame with facings on each side of -	
(a) metal lathing with cement-sand or gypsum plaster of thickness of-	
(1) 19mm	1
(2) 12.5mm	½
(b) metal lathing with vermiculite-gypsum or perlite-gypsum plaster of thickness of-	
(1) 25mm	2
(2) 19mm	1½
(3) 12.5mm	1
(c) 9.5mm plasterboard with gypsum plaster of thickness of 5mm	½
(d) 9.5mm plasterboard with vermiculite-gypsum of thickness of-	
(1) 25mm	2
(2) 16mm	1½
(3) 10mm	1
(4) 5mm	½
(e) 12.5mm plasterboard	
(1) unplastered	½
(2) with gypsum plaster of thickness of 12.5mm	1
(f) 12.5mm plasterboard with vermiculite-gypsum plaster of thickness of-	
(1) 25mm	2
(2) 16mm	1 ½
(3) 10mm	1
(g) 19mm plasterboard (or two layers of 9.5mm fixed to break joint) without finish	1
(h) 19mm plasterboard for two layers of 9.5mm with vermiculite-gypsum plaster of thickness of-	
(1) 16mm	2
(2) 10mm	1 ½
(i) 12.5mm fibre insulating board with gypsum plaster of thickness of 12.5mm	½
(j) 25mm wood wool slabs with gypsum plaster of thickness of 12.5mm	1
5. Compressed straw slabs in timber frames finished on both faces with gypsum plaster of thickness of 5mm	1

6. Plasterboard 9.5mm cellular core partition-	
(a) unplastered	½
(b) 12.5mm gypsum plaster	½
(c) 22mm vermiculite-gypsum plaster	2
7. Plasterboard 12.5mm cellular core partition-	
(a) unplastered	½
(b) 12.5mm gypsum plaster	1
(c) 16mm vermiculite-gypsum plaster	2
8. Plasterboard 19mm finished on both faces with 16mm gypsum plaster	1
9. Plasterboard 12.5mm bonded with neat gypsum plaster to each side of 19mm plasterboard	1
10. Three layers of 19mm plasterboard bonded with heat gypsum plaster	2
11. Wood wool slab with 12.5mm rendering or plaster of thickness of-	
(a) 75mm	2
(b) 50mm	1
12. Compressed straw slabs, with 75mm by 12.5mm wood cover strips to joints, of thickness of 50mm	½
Note : * - The presence of a combustible vapour barrier within the thickness of these constructions shall not be regarded as affecting these periods of fire resistance	

A2.0 : WALLS	
Construction and Materials	**Period of Fire Resistance hrs**
A2.3 - External walls (non-loadbearing) more than 1m from the relevant boundary	
1. Steel frame with external cladding of non-combustible sheets and internal lining of-	
(a) 12.5mm cement-sand or gypsum plaster on metal lathing	4
(b) two layers of 9.5mm plasterboard	½
(c) 9.5mm plasterboard finished with gypsum plaster of thickness of 12.5mm	½
(d) 12.5mm plasterboard finished with 5mm gypsum plaster	½
(e) 50mm compressed straw slabs	½
(f) 50mm compressed straw slabs finished with 5mm gypsum plaster	2
2 *Timber frame with external cladding of 10mm cement-sand or cement-lime rendering and internal lining of-	
(a) 16mm gypsum plaster on metal lathing	1
(b) 9.5mm plasterboard finished with12.5 mm gypsum plaster	1
(c) 12.5mm plasterboard finished with 5mm gypsum plaster	1
(d) 50mm compressed straw slabs	1
(e) aerated concrete blocks	1
(1) 50mm	3
(2) 62mm	4
(3) 75mm	4
(4) 100mm	4
3 Timber frame with external cladding of 100mm clay, concrete or sand-lime bricks of blocks, finished internally with 16mm gypsum plaster on metal lathing	4
4. *Timber frame with external cladding of weather boarding or 9.5 mm plywood and internal lining of-	
(a) 16mm gypsum plaster on metal lathing	½
(b) 9.5mm plasterboard finished with 12.5mm gypsum plaster	½
(c) 12.5mm plasterboard finished with 5mm gypsum plaster	½
(d) 50mm compressed straw slabs	½
(e) aerated concrete blocks-	
(1) 50mm	3
(2) 62mm	4
(3) 75mm	4
(4) 100mm	4
Note: * - The presence of a combustible vapour barrier within the thickness of these constructions shall not be regarded as affecting these periods of fire resistance	

A3.0: REINFORCED CONCRETE BEAMS

A3.0: REINFORCED CONCRETE BEAMS						
Description	**Minimum Dimension (mm) of Concrete to give a Fire Resistance of:-**					
	4 hrs	**3 hrs**	**2 hrs**	**1 ½ hrs**	**1 hr**	**½ hr**
1 Siliceous aggregate concrete:						
(a) average concrete cover to main reinforcement	65*	55*	45*	35	25	15
(b) beam width	280	240	180	140	110	80
2. As (1) with cement or gypsum plaster 15mm thick on light mesh reinforcement						
(a) average concrete cover to main reinforcement	50*	40	30	20	15	15
(b) beam width	250	210	170	110	85	70
3. As (1) with vermiculite/ gypsum plaster+ 15mm thick:						
(a) average concrete cover to main reinforcement	25	15	15	15	15	15
(b) beam width	175	145	125	85	60	60
4. Light weight aggregate concrete:						
(a) average concrete cover to main reinforcement	50	45	35	30	20	15
(b) beam width	250	200	160	130	100	80
Note: * - Supplementary reinforcement, to hold the concrete cover in position, may be necessary + - Vermiculite/ gypsum plaster should have a mix ratio in the range of 1 ½ - 2: 1 by volume						

A4.0: PRESTRESSED CONCRETE BEAMS

A4.0: PRESTRESSED CONCRETE BEAMS						
Description	**Minimum Dimension (mm) of Concrete to give a Fire Resistance of:-**					
	4 hrs	**3 hrs**	**2 hrs**	**1 ½ hrs**	**1 hr**	**½ hr**
1 Siliceous aggregate concrete:						
(a) average concrete cover to tendons	100*	85*	65*	50*	40	25
(b) beam width	280	240	180	140	110	80
2. As (1) with vermiculite concrete slabs 15mm thick , used as permanent shuttering:						
(a) average concrete cover to tendons	75*	60	45	35	25	15
(b) beam width	210	170	125	100	70	70
3. As (2) but with 25mm thick slabs:						
(a) average concrete cover to tendons	65	50	35	25	15	15
(b) beam width	180	140	100	70	60	60
4. As (1) with 15mm thick gypsum plaster with light mesh reinforcement:						
(a) average concrete cover to tendons	90*	75	50	40	30	15
(b) beam width	250	210	170	110	85	70
5. As (1) with vermiculite/gypsum plaster+ 15m thick:						
(a) average concrete cover to tendons	75*	60	45	30	25	15
(b) beam width	170	145	125	85	60	60
6. As (5) but with 25mm thick coating:						
(a) average concrete cover to tendons	50	45	30	25	15	15
(b) beam width	140	125	85	70	60	60
7. Lightweight aggregate concrete:						
(a) average concrete cover to tendons	80	65	50	40	30	20
(b) beam width	250	200	160	130	100	80
Note: * - Supplementary reinforcement, to hold the concrete cover in position, may be necessary + - Vermiculite/gypsum plaster should have a mix ratio in the range of 1 ½ - 2: 1 by volume						

A5.0: REINFORCED CONCRETE COLUMNS

A5.0: REINFORCED CONCRETE COLUMNS						
Description	**Minimum Dimension (mm) of Concrete to give a Fire Resistance of:-**					
	4 hrs	**3 hrs**	**2 hrs**	**1½ hrs**	**1 hr**	**½ hr**
A5.1 - All Face Exposed						
1. Siliceous aggregate concrete:						
(a) without additional protection	450	400	300	250	200	150
(b) with cement or gypsum plaster 15mm thick on light mesh reinforcement	300	275	225	150	150	150

(c) with vermiculite/ gypsum plaster*	275	225	200	150	120	120
2. Limestone aggregate concrete or siliceous aggregate:						
(a) concrete with supplementary reinforcement in concrete cover	300	275	225	200	190	150
3. Lightweight aggregate concrete	300	275	225	200	150	150
A5.2 - One Face Exposed						
1. Siliceous aggregate concrete						
(a) without additional protection	180	150	100	100	75	75
(b) with vermiculite/ gypsum plaster* 15mm thick on exposed faces	125	100	75	75	65	65
Note: + - Vermiculite/gypsum plaster should have a mix ratio in the range of 1 ½ - 2: 1 by volume						

A6.0: STRUCTURAL STEEL

A6.0: STRUCTURAL STEEL						
A6.1 - Encased Steel Stanchions (Mass per metre not less than 45kg)						
Description	**Minimum Thickness (mm) of Protection for a Fire Resistance of:**					
	4 hrs	**3 hrs**	**2 hrs**	**1 ½ hrs**	**1 hr**	**½hr**
A. Solid Protection* (Unplastered)						
1. Concrete not leaner than 1:2:4 mix with natural aggregates-						
(a) concrete not assumed to be load- bearing reinforced+	50	-	25	25	25	25
(b) concrete assumed to be load-bearing, reinforced in accordance with SS EN 1992 and SS EN 1994	75	-	50	50	50	50
2. Solid bricks of clay, composition or sand-lime	100	75	50	50	50	50
3. Solid blocks of foamed slag or pumice concrete reinforced+ in every horizontal joint	75	60	50	50	50	50
4. Sprayed vermiculite-cement	-	-	38	32	19	12.5
B. Hollow Protection++						
1. Solid bricks of clay, composition or sandlime reinforced in every horizontal joint, unplastered	115	-	50	50	50	50
2. Solid blocks of foamed slag or pumice concrete reinforced+ in every horizontal joint, unplastered	75	-	50	50	50	50
3. Metal lathing with gypsum or cement- lime plaster of thickness of -	-	-	38§	25	19	12.5
4. Metal lathing:-						
(a) with vermiculite-gypsum or perlite-gypsum plaster of thickness of	50§	-	19	16	12.5	12.5
(b) spaced 25mm from flanges with vermiculite-gypsum or perlite-gypsum plaster of thickness of	44	-	19	12.5	12.5	12.5
5. Gypsum plasterboard with 1.6mm wire binding at 100mm pitch -						
(a) 9.5mm Plasterboard with gypsum plaster of thickness of	-	-	-	-	12.5	12.5
(b) 19mm Plasterboard with gypsum plaster of thickness of	-	-	12.5	10	7	7
6. Gypsum plasterboard with 1.6mm wire binding at 100mm pitch-						
(a) 9.5mm plasterboard with vermiculite-gypsum plaster of thickness of	-	-	16	15	10	10
(b) 19mm plasterboard with vermiculite-gypsum plaster of thickness of	38§	-	20	13	10	10
7. Vermiculite-cement slabs of 4:1 mix reinforced with wire mesh and finished with plaster skim. Slabs of thickness of	63	-	25	25	25	25
Note: * - Solid protection means a casing which is bedded close to the steel without intervening cavities and with all joints in that casing made full and solid + - Reinforcement shall consist of steel binding wire not less than 2.3mm in thickness, or a steel mesh weighing not less than 0.48 kg/m². In concrete protection, the spacing of that reinforcement shall not exceed 150mm in any direction ++ - Hollow protection means that there is a void between the protective material and the steel. All hollow protection to columns shall be effectively sealed at each floor level § - Light mesh reinforcement required 12.5mm to 19mm below surface unless special corner beads are used						

A6.2 - Encased Steel Beams (Mass per metre not less than 30kg)

A6.2 - Encased Steel Beams (Mass per metre not less than 30kg)						
Description	**Minimum Thickness (mm) of Protection for a Fire Resistance of :**					
	4 hrs	**3 hrs**	**2 hrs**	**1½ hrs**	**1 hr**	**½ hr**
A. Solid Protection+ (Unplastered)						
1. Concrete not leaner than 1:2:4 mix with natural aggregates-						
(a) concrete not assumed to be load- bearing, reinforced++	75	50	25	25	25	25
(b) concrete assumed to be load-bearing, reinforced in accordance with SS EN 1992 and SS EN 1994	75	75	50	50	50	50
2. Sprayed vermiculite - cement	-	-	38	32	19	12.5
B. Hollow Protection++						
1. Metal lathing -						
(a) with cement-lime plaster of thickness of	-	-	38	25	19	12.5
(b) with gypsum plaster of thickness of	-	-	22	19	16	12.5

(c) with vermiculite-gypsum or perlite-gypsum plaster of thickness of	32	-	12.5	12.5	12.5	12.5
2. Gypsum plasterboard with 1.6mm wire binding at 100mm pitch-						
(a) 9.5mm plasterboard with gypsum plaster of thickness of	-	-	-	-	12.5	12.5
(b) 19 mm plasterboard with gypsum plaster of thickness of	-	-	12.5	10	7	7
3. Plasterboard with 1.6mm wire at 100m pitch -						
(a) 9.5mm plaster nailed to wooden cradles finished with gypsum plaster of thickness of	-	-	-	-	-	12.5
(b) 9.5mm plasterboard with vermiculite -gypsum plaster of thickness of	-	-	16	15	10	10
(c) 19mm plasterboard with vermiculite-gypsum plaster of thickness of	32	-	10	10	7	7
(d) 19mm plasterboard with gypsum plaster of thickness of	-	-	20	13	10	10
4. Vermiculite-cement slabs of 4:1 mix reinforced with wire mesh and finished with plaster skim. Slabs of thickness of	63	-	25	25	25	25
5. Gypsum-sand plaster 12.5mm thick applied to heavy duty (Type B as designated in EN 13168) Wood wool slabs of thickness of	-	-	50	38	38	38
Note: * - Hollow protection means that there is a void between the protective materials and the steel. All hollow protection to columns shall be effectively sealed at each floor level + - Solid protection means a casing which is bedded close to the steel without intervening cavities and with all joints in that casing made full and solid ++ - Reinforcement shall consist of steel binding wire not less than 2.3mm in thickness, or a steel mesh weighing not less than 0.48 kg/m². In concrete protection, the spacing of that reinforcement shall not exceed 150mm in any direction § - Light mesh reinforcement required 12.5mm to 19mm below surface unless special corner beads are used						

A7.0: STRUCTURAL ALUMINIUM

A7.0: STRUCTURAL ALUMINIUM						
Description	**Minimum Thickness (mm) of Protection for a Fire Resistance of :**					
	4 hrs	**3 hrs**	**2 hrs**	**1½ hrs**	**1 hr**	**½ hr**
A7.1 - Solid Protection*						
1. Sprayed vermiculite-cement	-	-	-	-	44	19
A7.2 - Hollow Protection+						
1. Metal lathing with vermiculite-gypsum or perlite-gypsum plaster of thickness of	-	-	32	22	16	12.5
2. Metal lathing finished with neat gypsum plaster of thickness of	-	-	-	-	19	12.5
3. Gypsum plasterboard 19mm thick with 1.6 mm wire binding at 100mm pitch finished with gypsum-vermiculite plaster of thickness of	-	-	22	16	10	10
Note: * - Solid protection means a casing which is bedded close to the alloy without intervening cavities and with all joints in that casing made full and solid + - Hollow protection means that there is a void between the protected material and the alloy. All hollow protection to columns shall be effectively sealed at each floor level						

A8.0: TIMBER FLOORS

A8.0: TIMBER FLOORS			
Construction and materials	**Minimum Thickness (mm) of Protection for a Fire Resistance of:**		
	1 hr	**½ hr**	**modified++ ½ hr**
1. Plain edge boarding on timber joists not less than 38mm wide with ceiling of -			
(a) timber lath and plaster - thickness of plaster	-	16	16
(b) timber lath and plaster with plaster of minimum thickness of 16mm covered on underside with plasterboard of thickness	-	12.5	-
(c) metal lathing and plaster - thickness of plaster			
(1) gypsum	-	16	-
(2) vermiculite	-	12.5	-
(d) one layer of plasterboard of thickness	-	-	12.5
(e) one layer of plasterboard of minimum thickness of 9.5mm finished with gypsum plaster of thickness	-	-	12.5
(f) one layer of plasterboards of minimum thickness of 12.5mm finished with gypsum plaster of thickness	-	12.5	-
(g) two layers of plasterboard of total thickness	-	25	19
(h) one layer of fibre insulating board of minimum thickness of 9.5mm finished with gypsum plaster of thickness	-	5	-
(i) one layer of fibre insulating board of minimum thickness of 12.5mm finished with gypsum plaster of thickness	-	-	12.5
(j) wood wool slab 25mm thick finished with gypsum plaster of thickness	-	5	-
2. Tongued and grooved boarding of not less than 16mm (finished) thickness* on timber joists not less than 38 mm wide ceiling of -			
(a) timber lath and plaster - thickness of plaster	-	-	16
(b) timber lath and plaster with plaster of minimum thickness of 16mm covered on underside with plasterboard of thickness	-	9.5	-
(c) metal lathing and plaster - thickness of plaster			
(1) gypsum	22	16	-
(2) vermiculite	12.5	12.5	-
(d) one layer of plasterboard of thickness	-	-	9.5
(e) one layer of plasterboard of minimum thickness of 9.5mm finished with-			

(1) gypsum plaster of thickness	-	12.5	-
(2) vermiculite-gypsum plaster of thickness	12.5	-	-
(f) one layer of plasterboards of minimum thickness of 12.5mm finished with gypsum plaster of thickness	-	5	-
(g) two layers of plasterboard of total thickness	-	22	-
(h) one layer of fibre insulating board of minimum thickness of 9.5mm finished with gypsum plaster of thickness	-	-	5
(i) wood wool slab 25mm thick finished with -			
(1) gypsum plaster of thickness	-	5	-
(2) vermiculite - gypsum plaster of thickness	10	-	-
3. Tongued and grooved boardings of not less than 21mm (finished) thickness* on timber joists not less than			
(a) timber lath and plaster - thickness of plaster	-	16	-
(b) metal lathing and plaster - thickness of plaster	-	16	-
(c) one layer of plasterboard of thickness	-	-	9.5
(d) one layer of plasterboard of minimum thickness of 9.5mm finished with -			
(1) gypsum plaster of thickness	-	12.5	-
(2) vermiculite-gypsum plaster of thickness	12.5	-	-
(e) one layer of plasterboard of minimum thickness of 12.5mm finished with gypsum plaster of thickness	-	5	-
(f) two layers of plasterboard of total thickness	-	19	-
(g) one layer of fibre insulating board of thickness	-	-	12.5
(h) one layer of fibre insulating board of minimum thickness of 12.5mm finished with gypsum plaster of thickness	-	12.5	-
(i) wood wool slab 25mm thick finished with -			
(1) gypsum plaster of thickness	-	5	-
(2) vermiculite-gypsum plaster of thickness	10	-	-
Note: * - Or an equivalent thickness of wood chipboard ++ - The term “modified ½ hour” refers to the requirements specified in item 3(a) of Table 3.4A			

A9.0: REINFORCED CONCRETE FLOORS (SILICEOUS OR CALCAREOUS AGGREGATE)

A9.0: REINFORCED CONCRETE FLOORS (SILICEOUS OR CALCAREOUS AGGREGATE)							
Floor Construction		**Minimum Dimension (mm) to give Fire Resistance of :**					
		4 hrs	**3 hrs**	**2 hrs**	**1 ½ hrs**	**1 hr**	**½ hr**
Solid slab	Average cover to reinforcement	25	25	20	20	15	15
	Depth, overall+	150	150	125	125	100	100
Cored slabs in which the cores are circular or are higher than wide. Not less than 50% of the gross across section of the floor should be solid material	Average cover to reinforcement	25	25	20	20	15	15
	Thickness under cores	50	40	40	30	25	20
	Depth, overall+	190	175	160	140	110	100
Hollow box section with one or more longitudinal cavities which are wider than high	Average cover to reinforcement	25	25	20	20	15	15
	Thickness of bottom flange	50	40	40	30	25	20
	Depth, overall+	230	205	180	155	130	105
Ribbed floor with hollow infill blocks of clay, or inverted T-section beams with hollow infill blocks of concrete or clay. A floor in which less than 50% of the gross cross section is solid material must be provided with a 15mm plaster coating on soffit	Average cover to reinforcement	25	25	20	20	15	15
	Width or rib, or beam, at soffit	125	100	90	80	70	50
	Depth, overall+	190	175	160	140	110	100
Upright T-section	Average bottom cover to reinforcement	65*	55*	45*	35	25	15
	Side cover to reinforcement	65	55	45	35	25	15
	Least width or down-standing leg	150	140	115	90	75	60
	Thickness of flange+	150	150	125	125	100	90

Inverted channel sections with radius at intersection of soffits with top of leg not exceeding depth of section	Average bottom cover to reinforcement	65*	55*	45*	35	25	15
	Side cover to reinforcement	40	30	25	20	15	10
	Least width or down-standing leg	75	70	60	45	40	30
	Thickness at crown+	150	150	125	125	100	90
Inverted channel sections or U-sections with radius at intersection of soffits with top of leg exceeding depth of section	Average bottom cover to reinforcement	65*	55*	45*	35	25	15
	Side cover to reinforcement	40	30	25	20	15	10
	Least width or down-standing leg	70	60	50	40	35	25
	Thickness at crown+	150	150	100	100	75	65
Note: * - Supplementary reinforcement, to hold the concrete cover in position, may be necessary + - Non-combustible screeds and finishes may be included in these dimensions							

A10.0: PRESTRESSED CONCRETE FLOORS (SILICEOUS OR CALCAREOUS AGGREGATE)

A10.0: PRESTRESSED CONCRETE FLOORS (SILICEOUS OR CALCAREOUS AGGREGATE)							
Floor Construction		**Minimum Dimension (mm) to give Fire Resistance of :**					
		4 hrs	**3 hrs**	**2 hrs**	**1 ½ hrs**	**1 hr**	**½ hr**
Solid slab	Average cover to reinforcement	65*	50*	40	30	25	15
	Depth, overall+	150	150	125	125	100	90
Cored slabs in which the cores are circular or are higher than wide. Not less than 50% of the gross across section of the floor should be solid material	Average cover to reinforcement	65*	50*	40	30	25	15
	Thickness under cores	50	40	40	30	25	20
	Depth, overall+	190	175	160	140	110	100
Hollow box section with one or more longitudinal cavities which are wider than high	Average cover to reinforcement	65*	50*	40	30	25	15
	Thickness of bottom flange	65	50	40	30	25	25
	Depth, overall+	230	205	180	155	130	105
Ribbed floor with hollow infill blocks of clay, or inverted T-section beams with hollow infill blocks of concrete or clay. A floor in which less than 50% of the gross cross section is solid material must be provided with a 15mm plaster coating on soffit	Average cover to reinforcement	65*	50*	40	30	25	15
	Width or rib, or beam, at soffit	125	100	90	80	70	50
	Depth, overall+	190	175	160	140	110	100
Upright T-section	Average bottom cover to reinforcement	100*	85*	65*	50*	40	25
	Side cover to reinforcement	100	85	65	50	40	25
	Least width or down-standing leg	250	200	150	110	90	60
	Thickness of flange+	150	150	125	125	100	90
Inverted channel sections with radius at intersection of soffits with top of leg not exceeding depth of section	Average bottom cover to reinforcement	100*	85*	65*	50*	40	25
	Side cover to reinforcement	50	45	35	25	20	10
	Least width or down-standing leg	125	100	75	55	45	30
	Thickness at crown+	150	150	125	125	100	90
Inverted channel sections or U-sections with radius at intersection of soffits with top of leg exceeding depth of section	Average bottom cover to reinforcement	100*	85*	65*	50*	40	25
	Side cover to reinforcement	50	45	35	25	20	15
	Least width or down-standing leg	110	90	70	50	45	30
	Thickness at crown+	150	150	125	125	100	90
Note: * - Supplementary reinforcement, to hold the concrete cover in position, may be necessary + - Non-combustible screeds and finishes may be included in these dimensions							

A11.0: GLAZING

A11.0: GLAZING

Construction and materials	Minimum Thickness (mm) of Glazing for a Period of:-	
	1 hr	½ hr
1. Glass, in direct combination with metal, the melting point of which is not lower than 982.2°C, in square not exceeding 0.015m² in area		
Thickness of glass	-	6.35
2. Glass reinforced with wire not less than 0.46mm in diameter laid to a square mesh measuring 12.70mm from centre to centre of wire, and electrically welded at the intersections, or laid to a hexagonal mesh measuring 25.40mm across the flat side		
Thickness of glass	-	6.35
In windows, doors , borrowed lights, lanterns and skylights, glass complying with paragraphs 1 or 2 of this Table shall be fixed with wood or metal beads or with a glazing compound in conjunction with sprigs or clips in panels not exceeding 0.372m ² in area in timber frames (fixed shut) having a minimum width and thickness of 44.45mm clear of rebates		
3. Glass reinforced with wire as in paragraph 2 of this Table, in windows, doors, borrowed lights, lanterns and skylights, fixed with metal beads in panels not exceeding 1.115m² in metal frames (fixed shut) all metal having a melting point not lower than 982.2oC, the thickness of glass	6.35	6.35
4. Glass bricks or blocks in walls		
Laid in cement / lime / sand mortar with light wire reinforcing mesh in every third horizontal joint in a panel not exceeding 2.438m in width or height set along the sides and head into recesses in the surrounding non-combustible construction. The depth of such recessed shall be not less than 25.40mm, the glass blocks extending into the recesses to a depth of 12.70mm and bedded upon layer of glass fibre. A non-hardening mastic shall be used to fill the spaces between the sides of the recesses and the faces of the panels	-	98.43
Note: In this Table the absence of a figure in a period column indicated that glazing described is not acceptable for the period applicable to that column		

ANNEX 3B

B1.0 CALCULATION OF PERMITTED LIMITS OF UNPROTECTED AREAS

B1.1 The permitted limit of unprotected areas in any side of a building or compartment shall be calculated by reference to the requirements of B2.0.

B1.2 For the purposes of this Annex, the expression 'unprotected area' has the meaning ascribed to it by Cl.1.4.110, but in calculating the size of unprotected areas or the permitted limit of unprotected areas, the following provisions shall apply –

a. where any area of an external wall is an unprotected area, only because it has combustible material attached to it as cladding, the area of that unprotected area shall be deemed to be half the area of such cladding;

b. when unprotected openings in the same compartment are recessed at a distance or an angle to the plane of reference, the width of the unprotected opening can be reduced accordingly when projected to the plane of reference based on *Table 3* and *Table 4*. However, such reduction is not applicable to the following:

(1) Concave building profile or the like where a specific point on the receiving panel receives radiation from more than one source.

(2) When the unprotected opening is along a continuous circular profile where its size and angle cannot be determined.

c. no account shall be taken of any of the following:

(1) an unprotected area which does not exceed 0.1m^2 and which is not less than 1.5m from any other unprotected area in the same side of the building or compartment (unless that other falls within (3) below);

(2) one or more unprotected areas having an area (or, if more than one, the aggregate area) not exceeding 1m^2 and not less than 4m from any other unprotected area in the same side of the building or compartment (except any such area as is specified in (1) above);

(3) an unprotected area in any part of an external wall which forms part of a protected shaft;

(4) an unprotected area in the side of a building not divided into compartments, if the area is not less than 28m above any ground adjoining that side of the building.

B2.0 Rules of calculation by reference to an enclosing rectangle

B2.1 The conditions of this Part of this Annex shall be satisfied if a building or compartment is so situated that no point on the relevant boundary is either between the relevant plane of reference and the side of the building or compartment or at a distance from the relevant plane of reference which is less than the distance specified in the Tables to this Part of this Annex, according to the purpose group of the building or compartment, the dimensions of the enclosing rectangle and the unprotected percentage. Linear interpolation to determine the setback distance using *Table 1 & 2* is permitted, provided the unprotected percentage falls between 20% and 100%.

B2.2 For the purpose of this Part of this Annex:

a. "relevant boundary" means as defined in Cl.1.4.89 and for the purpose of this calculation is either parallel to the side of the building under consideration or at an angle of not more than 80° with that side;

b. "plane of reference" means any vertical plane which touches the side or some part of the side of a building or compartment but which (however far extended) does not pass within the structure of such building or compartment (and for this purpose, any balcony, coping or similar projection shall be deemed not to be part either of that side or of the structure); and the relevant plane of reference shall in each case be taken as that most favourable in that respect to the person erecting the building;

c. "enclosing rectangle" means the smallest rectangle on the relevant plane of reference which would:

(1) enclose all the outer edge of any unprotected area of the building or, if the building is divided into compartments, of the compartment (other than any of an unprotected area which is at an angle of more than 80° to the plane of reference the outer edges being for this purpose projected on the plane of reference by line perpendicular to such plane;

(2) have two horizontal sides; and

(3) have height and width falling within those listed in the Tables to this Part of this Annex.

d. "unprotected percentage" means the percentage of the area of the enclosing rectangle which is equal to the aggregate of the unprotected areas taken into account in calculating the enclosing rectangle and as projected on it.

TABLE 1: BUILDINGS OR COMPARTMENTS OF PG I, PG II, PG III, PG IV, PG VII & PG VIII (for Open-sided Car Parking Decks only)

Enclosing Rectangle		Distance (m) from Relevant Boundary for Unprotected Percentage not exceeding								
Ht.	**Width**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
3 metres	3m	1.0	1.0	1.0	1.5	1.5	1.5	2.0	2.0	2.0
	6m	1.0	1.0	1.5	2.0	2.0	2.0	2.5	2.5	3.0
	9m	1.0	1.0	1.5	2.0	2.5	2.5	3.0	3.0	3.5
	12m	1.0	1.5	2.0	2.0	2.5	3.0	3.0	3.5	3.5
	15m	1.0	1.5	2.0	2.5	2.5	3.0	3.5	3.5	4.0
	18m	1.0	1.5	2.0	2.5	2.5	3.0	3.5	4.0	4.0
	21m	1.0	1.5	2.0	2.5	3.0	3.0	3.5	4.0	4.5
	24m	1.0	1.5	2.0	2.5	3.0	3.5	3.5	4.0	4.5
	27m	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.0	4.5
	30m	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.0	4.5
	40m	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.0	5.0
	No limit	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.0	5.0

6 metres	3m	1.0	1.0	1.5	2.0	2.0	2.0	2.5	2.5	3.0
	6m	1.0	1.5	2.0	2.5	3.0	3.0	3.5	4.0	4.0
	9m	1.0	2.0	2.5	3.0	3.5	4.0	4.5	4.5	5.0
	12m	1.5	2.5	3.0	3.5	4.0	4.5	5.0	5.0	5.5
	15m	1.5	2.5	3.0	4.0	4.5	5.0	5.5	5.5	6.0
	18m	1.5	2.5	3.5	4.0	4.5	5.0	5.5	6.0	6.5
	21m	1.5	2.5	3.5	4.0	5.0	5.5	6.0	6.5	7.0
	24m	1.5	2.5	3.5	4.5	5.0	5.5	6.0	7.0	7.0
	27m	1.5	2.5	3.5	4.5	5.0	6.0	6.5	7.0	7.5
	30m	1.5	2.5	3.5	4.5	5.0	6.0	6.5	7.0	8.0
	40m	1.5	2.5	3.5	4.5	5.5	6.5	7.0	8.0	8.5
	50m	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.0	9.0
	60m	1.5	2.5	3.5	5.0	5.5	6.5	7.5	8.5	9.5
	80m	1.5	2.5	3.5	5.0	6.0	7.0	7.5	8.5	9.5
	100m	1.5	2.5	3.5	5.0	6.0	7.0	8.0	8.5	10.0
	No limit	1.5	2.5	3.5	5.0	6.0	7.0	8.0	8.5	10.0
9 metres	3m	1.0	1.0	1.5	2.0	2.5	2.5	3.0	3.0	3.5
	6m	1.0	2.0	2.5	3.0	3.5	4.0	4.5	4.5	5.0
	9m	1.5	2.5	3.5	4.0	4.5	5.0	5.5	5.5	6.0
	12m	1.5	3.0	3.5	4.5	5.0	5.5	6.0	6.5	7.0
	15m	2.0	3.0	4.0	5.0	5.5	6.0	6.5	7.0	7.5
	18m	2.0	3.5	4.5	5.0	6.0	6.5	7.0	8.0	8.5
	21m	2.0	3.5	4.5	5.5	6.5	7.0	7.5	8.5	9.0
	24m	2.0	3.5	5.0	5.5	6.5	7.5	8.0	9.0	9.5
	27m	2.0	3.5	5.0	6.0	7.0	7.5	8.5	9.5	10.0
	30m	2.0	3.5	5.0	6.0	7.0	8.0	9.0	9.5	10.5
	40m	2.0	3.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5
	50m	2.0	4.0	5.5	6.5	8.0	9.0	10.0	11.5	12.5
	60m	2.0	4.0	5.5	7.0	8.0	9.5	11.0	11.5	13.0
	80m	2.0	4.0	5.5	7.0	8.5	10.0	11.5	12.5	13.5
	100m	2.0	4.0	5.5	7.0	8.5	10.0	11.5	12.5	14.5
	120m	2.0	4.0	5.5	7.0	8.5	10.0	11.5	12.5	14.5
	No limit	2.0	4.0	5.5	7.0	8.5	10.5	12.0	12.5	15.0
12 metres	3m	1.0	1.5	2.0	2.0	2.5	3.0	3.0	3.5	3.5
	6m	1.5	2.5	3.0	3.5	4.0	4.5	5.0	5.0	5.5
	9m	1.5	3.0	3.5	4.5	5.0	5.5	6.0	6.5	7.0
	12m	1.5	3.5	4.5	5.0	6.0	6.5	7.0	7.5	8.0
	15m	2.0	3.5	5.0	5.5	6.5	7.0	8.0	8.5	9.0
	18m	2.5	4.0	5.0	6.0	7.0	7.5	8.5	9.0	10.0
	21m	2.5	4.0	5.5	6.5	7.5	8.5	9.0	10.0	10.5
	24m	2.5	4.5	6.0	7.0	8.0	8.5	9.5	10.5	11.5
	27m	2.5	4.5	6.0	7.0	8.0	9.0	10.5	11.0	12.0
	30m	2.5	4.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5
	40m	2.5	5.0	6.5	8.0	9.5	10.5	12.0	12.0	14.0
	50m	2.5	5.0	7.0	8.5	10.0	11.0	13.0	14.0	15.0
	60m	2.5	5.0	7.0	9.0	10.5	12.0	13.5	14.5	16.0
	80m	2.5	5.0	7.0	9.0	11.0	13.0	14.5	16.0	17.0
	100m	2.5	5.0	7.5	9.5	11.5	13.5	15.0	16.5	18.0
	120m	2.5	5.0	7.5	9.5	11.5	13.5	15.0	17.0	18.5
	No limit	2.5	5.0	7.5	9.5	12.0	14.0	15.5	17.0	19.0

15 metres	3m	1.0	1.5	2.0	2.5	2.5	3.0	3.5	3.5	4.0
	6m	1.5	2.5	3.0	4.0	4.5	5.0	5.5	5.5	6.0
	9m	2.0	3.0	4.0	5.0	5.5	6.0	6.5	7.0	7.5
	12m	2.0	3.5	5.0	5.5	6.5	7.0	8.0	8.5	9.0
	15m	2.0	4.0	5.5	6.5	7.0	8.0	9.0	9.5	10.0
	18m	2.5	4.5	6.0	7.0	8.0	8.5	9.5	10.5	11.0
	21m	2.5	5.0	6.5	7.5	8.5	9.5	10.5	11.0	12.0
	24m	3.0	5.0	6.5	8.0	9.0	10.0	11.0	12.0	13.0
	27m	3.0	5.5	7.0	8.5	9.5	10.5	11.5	12.5	13.5
	30m	3.0	5.5	7.5	8.5	10.0	11.0	12.0	13.5	14.0
	40m	3.0	6.0	8.0	9.5	11.0	12.5	13.5	15.0	16.0
	50m	3.5	6.0	8.5	10.0	12.0	13.5	15.0	16.5	17.5
	60m	3.5	6.5	8.5	10.5	12.5	14.0	15.5	17.0	18.0
	80m	3.5	6.5	9.0	11.0	13.5	15.0	17.0	18.5	20.0
	100m	3.5	6.5	9.0	11.5	14.0	16.0	18.0	19.5	21.5
	120m	3.5	6.5	9.0	11.5	14.0	16.5	18.5	20.5	22.5
	No limit	3.5	6.5	9.0	12.0	14.5	17.0	19.0	21.0	23.0
18 metres	3m	1.0	1.5	2.0	2.5	2.5	3.0	3.5	4.0	4.0
	6m	1.5	2.5	3.5	4.0	4.5	5.0	5.5	6.0	6.5
	9m	2.0	3.5	4.5	5.0	6.0	6.5	7.0	8.0	8.5
	12m	2.5	4.0	5.0	6.0	7.0	7.5	8.5	9.0	10.0
	15m	2.5	4.5	6.0	7.0	8.0	8.5	9.5	10.5	11.0
	18m	2.5	5.0	6.5	7.5	8.5	9.5	11.0	11.5	13.0
	21m	3.0	5.5	7.0	8.0	9.5	10.5	11.5	12.5	13.0
	24m	3.0	5.5	7.5	8.5	10.0	11.0	12.0	13.0	14.0
	27m	3.5	6.0	8.0	9.0	10.5	11.5	12.5	13.5	14.5
	30m	3.5	6.5	8.0	9.5	11.0	12.0	13.5	14.5	15.5
	40m	4.0	7.0	9.0	11.0	12.0	13.5	15.0	16.5	17.5
	50m	4.0	7.0	9.5	11.5	13.0	15.0	16.5	18.0	19.0
	60m	4.0	7.5	10.0	12.0	14.0	16.0	17.5	19.5	20.5
	80m	4.0	7.5	10.0	13.0	15.0	17.0	19.0	21.0	22.5
	100m	4.0	7.5	10.0	13.5	16.0	18.0	20.5	22.5	24.0
	120m	4.0	7.5	10.0	14.0	16.5	19.0	21.0	23.5	25.5
	No limit	4.0	8.0	10.0	14.0	17.0	19.5	22.0	24.0	26.5
21 metres	3m	0.5	1.5	2.0	2.5	3.0	3.0	3.5	4.0	4.5
	6m	1.5	2.5	3.5	4.0	5.0	5.5	6.0	6.5	7.0
	9m	2.0	3.5	4.5	5.5	6.5	7.0	7.5	8.5	9.0
	12m	2.5	4.0	5.5	6.5	7.5	8.5	9.0	10.0	10.5
	15m	2.5	5.0	6.5	7.5	8.5	9.5	10.5	11.0	12.0
	18m	3.0	5.5	7.0	8.0	9.5	10.5	11.5	12.5	13.0
	21m	3.0	6.0	7.5	9.0	10.5	11.0	12.5	13.5	14.0
	24m	3.5	6.0	8.0	9.5	10.5	12.0	13.0	14.0	15.0
	27m	3.5	6.5	8.5	10.0	11.5	13.0	14.0	15.0	16.0
	30m	4.0	7.0	9.0	10.5	12.0	13.0	14.5	16.0	16.5
	40m	4.5	7.5	10.0	12.0	13.5	15.0	16.5	18.0	19.0
	50m	4.5	8.0	11.0	13.0	14.5	16.5	18.0	20.0	21.0
	60m	4.5	8.5	11.5	13.5	15.5	17.5	19.5	21.0	22.5
	80m	4.5	8.5	12.0	14.5	17.0	19.0	21.0	23.5	25.0
	100m	4.5	9.0	12.0	15.5	18.0	20.5	22.5	25.0	27.0
	120m	4.5	9.0	12.0	16.0	18.5	21.5	23.5	26.5	28.5
	No limit	4.5	9.0	12.0	16.0	19.0	22.0	25.0	26.5	29.5

24 metres	3m	0.5	1.5	2.0	2.5	3.0	3.5	3.5	4.0	4.5
	6m	1.5	2.5	3.5	4.5	5.0	5.5	6.0	7.0	7.0
	9m	2.0	3.5	5.0	5.5	6.5	7.5	8.0	9.0	9.5
	12m	2.5	4.5	6.0	7.0	8.0	8.5	9.5	10.5	11.5
	15m	3.0	5.0	6.5	8.0	9.0	10.0	11.0	12.0	13.0
	18m	3.0	5.5	7.5	8.5	10.0	11.0	12.0	13.0	14.0
	21m	3.5	6.0	8.0	9.5	10.5	12.0	13.0	14.0	15.0
	24m	3.5	6.5	8.5	10.0	11.5	12.5	14.0	15.0	16.0
	27m	4.0	7.0	9.0	11.0	12.5	13.5	15.0	16.0	17.0
	30m	4.0	7.5	9.5	11.5	13.0	14.0	15.5	17.0	18.0
	40m	4.5	8.5	11.0	13.0	14.5	16.0	18.0	19.0	20.5
	50m	5.0	9.0	12.0	14.0	16.0	17.5	19.5	21.0	22.5
	60m	5.0	9.5	12.5	15.0	17.0	19.0	21.0	23.0	24.5
	80m	5.0	10.0	13.5	16.5	18.5	21.0	23.5	25.5	27.5
	100m	5.0	10.0	13.5	17.0	20.0	22.5	25.0	27.5	29.5
	120m	5.5	10.0	13.5	17.5	20.5	23.5	26.5	29.0	31.0
	No limit	5.5	10.0	13.5	18.0	21.0	24.0	27.5	30.0	32.5
27 metres	3m	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.0	4.5
	6m	1.5	2.5	3.5	4.5	5.0	6.0	6.5	7.0	7.5
	9m	2.0	3.5	5.0	6.0	7.0	7.5	8.5	9.5	10.0
	12m	2.5	4.5	6.0	7.0	8.0	9.0	10.5	11.0	12.0
	15m	3.0	5.5	7.0	8.5	9.5	10.5	11.5	12.5	13.5
	18m	3.5	6.0	8.0	9.0	10.5	11.5	12.5	13.5	14.5
	21m	3.5	6.5	8.5	10.0	11.5	13.0	14.0	15.0	16.0
	24m	3.5	7.0	9.0	11.0	12.5	13.5	15.0	16.0	17.0
	27m	4.0	7.5	10.0	11.5	13.0	14.0	16.0	17.0	18.0
	30m	4.0	8.0	10.0	12.0	13.5	15.0	17.0	18.0	19.0
	40m	5.0	9.0	11.5	14.0	15.5	17.5	19.0	20.5	22.0
	50m	5.5	9.5	12.5	15.0	17.0	19.0	21.0	22.5	24.0
	60m	5.5	10.5	13.5	16.0	18.5	20.5	22.5	24.5	26.5
	80m	6.0	11.0	14.5	17.5	20.5	22.5	25.0	27.5	29.5
	100m	6.0	11.0	15.5	19.0	21.5	24.5	27.0	30.0	32.0
	120m	6.0	11.5	15.5	19.5	22.5	26.0	28.5	32.0	34.0
	No limit	6.0	11.5	15.5	20.0	23.5	27.0	29.5	33.0	35.0

TABLE 2: BUILDINGS OR COMPARTMENTS OF PG V, PG VI, & PG VIII (see Table 1 for Open-sided Car Parking Decks)

TABLE 2: BUILDINGS OR COMPARTMENTS OF PG V, PG VI, & PG VIII (see Table 1 for Open-sided Car Parking Decks)										
Enclosing Rectangle		**Distance (m) from Relevant Boundary for Unprotected Percentage not exceeding**								
Ht.	**Width**	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**100%**
3 metres	3m	1.0	1.5	2.0	2.0	2.5	2.5	2.5	3.0	3.0
	6m	1.5	2.0	2.5	3.0	3.0	3.5	3.5	4.0	4.0
	9m	1.5	2.5	3.0	3.5	4.0	4.0	4.5	5.0	5.0
	12m	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	5.5
	15m	2.0	2.5	3.5	4.0	4.5	5.0	5.5	6.0	6.0
	18m	2.0	2.5	3.5	4.0	5.0	5.0	6.0	6.5	6.5
	21m	2.0	3.0	3.5	4.5	5.0	5.5	6.0	6.5	7.0
	24m	2.0	3.0	3.5	4.5	5.0	5.5	6.0	7.0	7.5
	27m	2.0	3.0	4.0	4.5	5.5	6.0	6.5	7.0	7.5
	30m	2.0	3.0	4.0	4.5	5.5	6.0	6.5	7.5	8.0
	40m	2.0	3.0	4.0	5.0	5.5	6.5	7.0	8.0	8.5
	50m	2.0	3.0	4.0	5.0	6.0	6.5	7.5	8.0	9.0
	60m	2.0	3.0	4.0	5.0	6.0	7.0	7.5	8.5	9.5
	80m	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	9.5
	No limit	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0

6 metres	3m	1.5	2.0	2.5	3.0	3.0	3.5	3.5	4.0	4.0
	6m	2.0	3.0	3.5	4.0	4.5	5.0	5.5	5.5	6.0
	9m	2.5	3.5	4.5	5.0	5.5	6.0	6.5	7.0	7.0
	12m	3.0	4.0	5.0	5.5	6.5	7.0	7.5	8.0	8.5
	15m	3.0	4.5	5.5	6.0	7.0	7.5	8.0	9.0	9.0
	18m	3.5	4.5	5.5	6.5	7.5	8.0	9.0	9.5	10.0
	21m	3.5	5.0	6.0	7.0	8.0	9.0	9.5	10.0	10.5
	24m	3.5	5.0	6.0	7.0	8.5	9.5	10.0	10.5	11.0
	27m	3.5	5.0	6.5	7.5	8.5	9.5	10.5	11.0	12.0
	30m	3.5	5.0	6.5	8.0	9.0	10.0	11.0	12.0	12.5
	40m	3.5	5.5	7.0	8.5	10.0	11.0	12.0	13.0	14.0
	50m	3.5	5.5	7.5	9.0	10.5	11.5	13.0	14.0	15.0
	60m	3.5	5.5	7.5	9.5	11.0	12.0	13.5	15.0	16.0
	80m	3.5	6.0	7.5	9.5	11.5	13.0	14.5	16.0	17.5
	100m	3.5	6.0	8.0	10.0	12.0	13.5	15.0	16.5	18.0
	120m	3.5	6.0	8.0	10.0	12.0	14.0	15.5	17.0	19.0
	No limit	3.5	6.0	8.0	10.0	12.0	14.0	16.0	18.0	19.0
9 metres	3m	1.5	2.5	3.0	3.5	4.0	4.0	4.5	5.0	5.0
	6m	2.5	3.5	4.5	5.0	5.5	6.0	6.5	7.0	7.0
	9m	3.5	4.5	5.5	6.0	6.5	7.5	8.0	8.5	9.0
	12m	3.5	5.0	6.0	7.0	7.5	8.5	9.0	9.5	10.5
	15m	4.0	5.5	6.5	7.5	8.5	9.5	10.0	11.0	11.5
	18m	4.5	6.0	7.0	8.5	9.5	10.0	11.0	12.0	12.5
	21m	4.5	6.5	7.5	9.0	10.0	11.0	12.0	13.0	13.5
	24m	5.0	6.5	8.0	9.5	11.0	12.0	13.0	13.5	14.5
	27m	5.0	7.0	8.5	10.0	11.5	12.5	13.5	14.5	15.0
	30m	5.0	7.0	9.0	10.5	12.0	13.0	14.0	15.0	16.0
	40m	5.5	7.5	9.5	11.5	13.0	14.5	15.5	17.0	17.5
	50m	5.5	8.0	10.0	12.5	14.0	15.5	17.0	18.5	19.5
	60m	5.5	8.0	11.0	13.0	15.0	16.5	18.0	19.5	21.0
	80m	5.5	8.5	11.5	13.5	16.0	17.5	19.5	21.5	23.0
	100m	5.5	8.5	11.5	14.5	16.5	18.5	21.0	22.5	24.5
	120m	5.5	8.5	11.5	14.5	17.0	19.5	21.5	23.5	26.0
	No limit	5.5	8.5	11.5	15.0	17.5	20.0	22.5	24.5	27.0
12 metres	3m	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	5.5
	6m	3.0	4.0	5.0	5.5	6.5	7.0	7.5	8.0	8.5
	9m	3.5	5.0	6.0	7.0	7.5	8.5	9.0	9.5	10.5
	12m	4.5	6.0	7.0	8.0	9.0	9.5	11.0	11.5	12.0
	15m	5.0	6.5	8.0	9.0	10.0	11.0	12.0	13.0	13.5
	18m	5.0	7.0	8.5	10.0	11.0	12.0	13.0	14.0	14.5
	21m	5.5	7.5	9.0	10.5	12.0	13.0	14.0	15.0	16.0
	24m	6.0	8.0	9.5	11.5	12.5	14.0	15.0	16.0	16.5
	27m	6.0	8.0	10.5	12.0	13.5	14.5	16.0	17.0	17.5
	30m	6.5	8.5	10.5	12.5	14.0	15.0	16.5	17.5	18.5
	40m	6.5	9.5	12.0	14.0	15.5	17.5	18.5	20.0	21.0
	50m	7.0	10.0	13.0	15.0	17.0	19.0	20.5	23.0	23.0
	60m	7.0	10.5	13.5	16.0	18.0	20.0	21.5	23.5	25.0
	80m	7.0	11.0	14.5	17.0	19.5	21.5	23.5	26.0	27.5
	100m	7.5	11.5	15.0	18.0	21.0	23.0	25.5	28.0	30.0
	120m	7.5	11.5	15.0	18.5	22.0	24.0	27.0	29.5	31.5
	No limit	7.5	12.0	15.5	19.0	22.5	25.0	28.0	30.5	34.0

15 metres	3m	2.0	2.5	3.5	4.0	4.5	5.0	5.5	6.0	6.0
	6m	3.0	4.5	5.5	6.0	7.0	7.5	8.0	9.0	9.0
	9m	4.0	5.5	6.5	7.5	8.5	9.5	10.0	11.0	11.5
	12m	5.0	6.5	8.0	9.0	10.0	11.0	12.0	13.0	13.5
	15m	5.5	7.0	9.0	10.0	11.5	12.5	13.5	14.5	15.0
	18m	6.0	8.0	9.5	11.0	12.5	13.5	14.5	15.5	16.5
	21m	6.5	8.5	10.5	12.0	13.5	14.5	16.0	16.5	17.5
	24m	6.5	9.0	11.0	13.0	14.5	15.5	17.0	18.0	19.0
	27m	7.0	9.5	11.5	13.5	15.0	16.5	18.0	19.0	20.0
	30m	7.5	10.0	12.0	14.0	16.0	17.0	18.5	20.0	21.0
	40m	8.0	11.0	13.5	16.0	18.0	19.5	21.0	22.5	23.5
	50m	8.5	12.0	15.0	17.5	19.5	21.5	23.0	25.0	26.0
	60m	8.5	12.5	15.5	18.0	21.0	23.5	25.0	27.0	28.0
	80m	9.0	13.5	17.0	20.0	23.0	25.5	28.0	30.0	31.5
	100m	9.0	14.0	18.0	21.5	24.5	27.5	30.0	32.5	34.5
	120m	9.0	14.0	18.5	22.5	25.5	28.5	31.5	34.5	37.0
	No limit	9.0	14.5	19.0	23.0	27.0	30.0	34.0	36.0	39.0
18 metres	3m	2.0	2.5	3.5	4.0	5.0	5.0	6.0	6.5	6.5
	6m	3.5	4.5	5.5	6.5	7.5	8.0	9.0	9.5	10.0
	9m	4.5	6.0	7.0	8.5	9.5	10.0	11.0	12.0	12.5
	12m	5.0	7.0	8.5	10.0	11.0	12.0	13.0	14.0	14.5
	15m	6.0	8.0	9.5	11.0	12.5	13.5	14.5	15.5	16.5
	18m	6.5	8.5	11.0	12.0	13.5	14.5	16.0	17.0	18.0
	21m	7.0	9.5	11.5	13.0	14.5	16.0	17.0	18.0	19.5
	24m	7.5	10.0	12.0	14.0	15.5	16.5	18.5	19.5	20.5
	27m	8.0	10.5	12.5	14.5	16.5	17.5	19.5	20.5	21.5
	30m	8.0	11.0	13.5	15.5	17.0	18.5	20.5	21.5	22.5
	40m	9.0	12.0	15.0	17.5	19.5	21.5	23.5	25.0	26.0
	50m	9.5	13.0	16.5	19.0	21.5	23.5	26.0	27.5	29.0
	60m	10.0	14.0	17.5	20.5	23.0	26.0	27.5	29.5	31.0
	80m	10.0	15.0	19.0	22.5	26.0	28.5	31.0	33.5	35.0
	100m	10.0	16.0	20.5	24.0	28.0	31.0	33.5	36.0	38.5
	120m	10.0	16.5	21.0	25.5	29.5	32.5	35.5	39.0	41.5
	No limit	10.0	17.0	22.0	26.5	30.5	34.0	37.0	41.0	43.5
21 metres	3m	2.0	3.0	3.5	4.5	5.0	5.5	6.0	6.5	7.0
	6m	3.5	5.0	6.0	7.0	8.0	9.0	9.5	10.0	10.5
	9m	4.5	6.5	7.5	9.0	10.0	11.0	12.0	13.0	13.5
	12m	5.5	7.5	9.0	10.5	12.0	13.0	14.0	15.0	16.0
	15m	6.5	8.5	10.5	12.0	13.5	14.5	16.0	16.5	17.5
	18m	7.0	9.5	11.5	13.0	14.5	16.0	17.0	18.0	19.5
	21m	7.5	10.0	12.5	14.0	15.5	17.0	18.5	20.0	21.0
	24m	8.0	10.5	13.0	15.0	16.0	18.0	20.0	21.0	22.0
	27m	8.5	11.5	14.0	16.0	18.0	19.0	21.0	22.5	23.5
	30m	9.0	12.0	14.5	16.5	18.5	20.5	22.0	23.5	25.0
	40m	10.0	13.5	16.5	19.0	21.5	23.0	25.5	27.0	28.5
	50m	11.0	14.5	18.0	21.0	23.5	25.5	28.0	30.0	31.5
	60m	11.5	15.5	19.5	22.5	25.5	28.0	30.5	32.5	33.5
	80m	12.0	17.0	21.0	25.0	28.5	31.5	34.0	36.5	38.5
	100m	12.0	18.0	22.5	27.0	31.0	34.5	37.0	40.0	42.0
	120m	12.0	18.5	23.5	28.5	32.5	36.5	39.5	43.0	45.5
	No limit	12.0	19.0	25.0	29.5	34.5	38.0	41.5	45.5	48.0

24 metres	3m	2.0	3.0	3.5	4.5	5.0	5.5	6.0	7.0	7.5
	6m	3.5	5.0	6.0	7.0	8.5	9.5	10.0	10.5	11.0
	9m	5.0	6.5	8.0	9.5	11.0	12.0	13.0	13.5	14.5
	12m	6.0	8.0	9.5	11.5	12.5	14.0	15.0	16.0	16.5
	15m	6.5	9.0	11.0	13.0	14.5	15.5	17.0	18.0	19.0
	18m	7.5	10.0	12.0	14.0	15.5	16.5	18.5	19.5	20.5
	21m	8.0	10.5	13.0	15.0	16.5	18.0	20.0	21.0	22.0
	24m	8.5	11.5	14.0	16.0	18.0	19.5	21.0	22.5	24.0
	27m	9.0	12.5	15.0	17.0	19.0	20.5	21.5	24.0	25.5
	30m	9.5	13.0	15.5	18.0	20.0	21.5	23.5	25.0	26.5
	40m	11.0	14.5	18.0	20.5	23.0	25.0	27.5	29.0	30.5
	50m	12.0	16.0	19.5	22.5	25.5	27.5	30.0	32.0	33.5
	60m	12.5	17.0	21.0	24.5	27.5	30.0	32.5	35.0	36.5
	80m	13.5	18.5	23.5	27.5	31.0	34.5	37.0	39.5	41.5
	100m	13.5	20.0	25.0	29.5	33.5	37.0	40.0	43.0	45.5
	120m	13.5	20.5	26.5	31.0	36.0	39.5	43.0	46.5	49.0
	No limit	13.5	21.0	27.5	32.5	37.5	42.0	45.5	49.5	52.0
27 metres	3m	2.0	3.0	4.0	4.5	5.5	6.0	6.5	7.0	7.5
	6m	3.5	5.0	6.5	7.5	8.5	9.5	10.5	11.0	12.0
	9m	5.0	7.0	8.5	10.0	11.5	12.5	13.5	14.5	15.0
	12m	6.0	8.0	10.5	12.0	13.5	14.5	16.0	17.0	17.5
	15m	7.0	9.5	11.5	13.5	15.0	16.5	18.0	19.0	20.0
	18m	8.0	10.5	12.5	14.5	16.5	17.5	19.5	20.5	21.5
	21m	8.5	11.5	14.0	16.0	18.0	19.0	21.0	22.5	23.5
	24m	9.0	12.5	15.0	17.0	19.0	20.5	22.5	24.0	25.5
	27m	10.0	13.0	16.0	18.0	20.0	22.0	24.0	25.5	27.0
	30m	10.0	13.5	17.0	19.0	21.0	23.0	25.0	26.5	28.0
	40m	11.5	15.5	19.0	22.0	24.5	26.5	29.0	30.5	32.5
	50m	12.5	17.0	21.0	24.0	27.0	29.5	32.0	34.5	36.0
	60m	13.5	18.5	22.5	26.5	29.5	32.0	35.0	37.0	39.0
	80m	14.5	20.5	25.0	29.5	33.0	36.5	39.5	42.0	44.0
	100m	15.5	21.5	27.0	32.0	36.5	40.5	43.0	46.5	48.5
	120m	15.5	22.5	28.5	34.0	39.0	43.0	46.5	50.5	53.0
	No limit	15.5	23.5	29.5	35.0	40.5	44.5	48.5	52.0	55.5

TABLE 3: Percentage of the Width of the Unprotected Openings upon their Projection onto the Plane of Reference (in view of distance of the openings from the place of reference)

TABLE 3

Percentage of the Width of the Unprotected Openings upon their Projection onto the Plane of Reference (in view of distance of the openings from the plane of reference)

	DISTANCE TO REFERENCE PLANE																								
Width of Unprotected Opening*	1m	2m	3m	4m	5m	6m	7m	8m	9m	10m	11m	12m	13m	14m	15m	16m	17m	18m	19m	20m	21m	22m	23m	24m	25m	26m	27m
3m	72%	54%	41%	33%	28%	24%	21%	18%	16%	15%	13%	12%	11%	11%	10%	9%	9%	8%	8%	7%	7%	7%	6%	6%	6%	6%	6%
6m	85%	72%	62%	54%	47%	41%	37%	33%	30%	28%	25%	24%	22%	21%	19%	18%	17%	16%	15%	15%	14%	13%	13%	12%	12%	11%	11%
9m	90%	80%	72%	65%	59%	54%	49%	45%	41%	38%	36%	33%	31%	29%	28%	26%	25%	24%	22%	21%	21%	20%	19%	18%	17%	17%	16%
15m	94%	88%	82%	77%	72%	68%	64%	60%	57%	54%	51%	48%	46%	43%	41%	40%	38%	36%	35%	33%	32%	31%	30%	29%	28%	27%	26%
21m	95%	91%	87%	83%	79%	75%	72%	69%	66%	63%	61%	58%	56%	54%	51%	50%	48%	46%	44%	43%	41%	40%	39%	38%	36%	35%	34%
27m	96%	93%	90%	86%	83%	80%	77%	75%	72%	70%	67%	65%	63%	61%	59%	57%	55%	54%	52%	50%	49%	48%	46%	45%	44%	43%	41%
30m	97%	94%	90%	88%	85%	82%	79%	77%	74%	72%	70%	68%	66%	64%	62%	60%	58%	57%	55%	54%	52%	51%	49%	48%	47%	46%	45%
40m	98%	95%	93%	90%	88%	86%	84%	82%	80%	78%	76%	74%	73%	71%	69%	68%	66%	65%	63%	62%	60%	59%	58%	57%	55%	54%	53%
50m	98%	96%	94%	92%	90%	89%	87%	85%	84%	82%	80%	79%	77%	76%	74%	73%	72%	70%	69%	68%	66%	65%	64%	63%	62%	61%	60%
60m	98%	97%	95%	94%	92%	90%	89%	88%	86%	85%	83%	82%	81%	79%	78%	77%	76%	74%	73%	72%	71%	70%	69%	68%	67%	66%	65%
70m	99%	97%	96%	94%	93%	92%	90%	89%	88%	87%	86%	84%	83%	82%	81%	80%	79%	78%	76%	75%	74%	73%	72%	71%	70%	70%	69%
80m	99%	98%	96%	95%	94%	93%	92%	90%	89%	88%	87%	86%	85%	84%	83%	82%	81%	80%	79%	78%	77%	76%	75%	74%	74%	73%	72%
90m	99%	98%	97%	96%	95%	94%	93%	92%	90%	90%	89%	88%	87%	86%	85%	84%	83%	82%	81%	80%	79%	78%	78%	77%	76%	75%	74%
100m	99%	98%	97%	96%	95%	94%	93%	92%	91%	90%	90%	89%	88%	87%	86%	85%	84%	84%	83%	82%	81%	80%	80%	79%	78%	77%	77%
110m	99%	98%	97%	96%	96%	95%	94%	93%	92%	91%	90%	90%	89%	88%	87%	87%	86%	85%	84%	83%	83%	82%	81%	81%	80%	79%	78%
120m	99%	98%	98%	97%	96%	95%	94%	94%	93%	92%	91%	90%	90%	89%	88%	88%	87%	86%	85%	85%	84%	83%	83%	82%	81%	81%	80%

Table 3

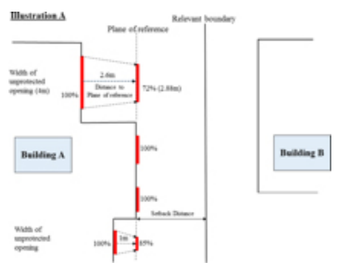


Illustration A (Enlarged)

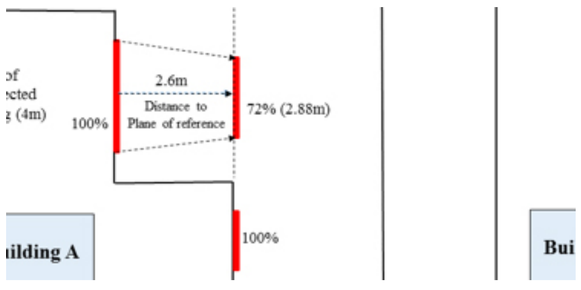


TABLE 3 - (cont'd) Percentage of the Width of the Unprotected Openings upon their Projection onto the Plane of Reference (in view of distance of the openings from the plane of reference)																												
		DISTANCE TO REFERENCE PLANE																										
		28m	29m	30m	31m	32m	33m	34m	35m	36m	37m	38m	39m	40m	41m	42m	43m	44m	45m	46m	47m	48m	49m	50m	51m	52m	53m	54m
Width of Unprotected Opening*	3m	5%	5%	5%	5%	5%	5%	4%	4%	4%	4%	4%	4%	4%	4%	4%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%
	6m	11%	10%	10%	10%	9%	9%	9%	9%	8%	8%	8%	8%	7%	7%	7%	7%	7%	7%	6%	6%	6%	6%	6%	6%	6%	6%	6%
	9m	16%	15%	15%	14%	14%	13%	13%	13%	12%	12%	12%	11%	11%	11%	11%	10%	10%	10%	10%	9%	9%	9%	9%	9%	9%	8%	8%
	15m	25%	24%	24%	23%	22%	22%	21%	21%	20%	19%	19%	19%	18%	18%	17%	17%	17%	16%	16%	16%	15%	15%	15%	14%	14%	14%	14%
	21m	33%	32%	32%	31%	30%	29%	28%	28%	27%	26%	26%	25%	25%	24%	24%	23%	23%	22%	22%	21%	21%	21%	20%	20%	19%	19%	19%
	27m	40%	39%	38%	37%	37%	36%	35%	34%	33%	33%	32%	31%	31%	30%	29%	29%	28%	28%	27%	27%	26%	26%	25%	25%	24%	24%	24%
	30m	43%	42%	41%	40%	40%	39%	38%	37%	36%	35%	35%	34%	33%	33%	32%	31%	31%	30%	30%	29%	29%	28%	28%	27%	27%	26%	26%
	40m	52%	51%	50%	49%	48%	47%	46%	45%	45%	44%	43%	42%	41%	41%	40%	39%	39%	38%	37%	37%	36%	36%	35%	35%	34%	34%	33%
	50m	59%	58%	57%	56%	55%	54%	53%	52%	51%	50%	50%	49%	48%	47%	47%	46%	45%	45%	44%	43%	43%	42%	41%	41%	40%	40%	39%
	60m	64%	63%	62%	61%	60%	59%	58%	57%	57%	56%	55%	54%	54%	53%	52%	51%	51%	50%	49%	49%	48%	47%	47%	46%	46%	45%	45%
	70m	68%	67%	66%	65%	64%	63%	63%	62%	61%	60%	59%	59%	58%	57%	57%	56%	55%	55%	54%	53%	53%	52%	51%	51%	50%	50%	49%
	80m	71%	70%	69%	68%	68%	67%	66%	65%	65%	64%	63%	63%	62%	61%	60%	60%	59%	58%	58%	57%	57%	56%	55%	55%	54%	54%	53%
	90m	74%	73%	72%	71%	71%	70%	69%	68%	68%	67%	66%	66%	65%	64%	64%	63%	62%	62%	61%	61%	60%	59%	59%	58%	58%	57%	57%
	100m	76%	75%	74%	74%	73%	72%	72%	71%	70%	70%	69%	68%	68%	67%	66%	66%	65%	65%	64%	63%	63%	62%	62%	61%	61%	60%	60%
	110m	78%	77%	76%	76%	75%	74%	74%	73%	72%	72%	71%	71%	70%	69%	69%	68%	68%	67%	67%	66%	65%	65%	64%	64%	63%	63%	62%
	120m	79%	79%	78%	77%	77%	76%	76%	75%	74%	74%	73%	73%	72%	72%	71%	70%	70%	69%	69%	68%	68%	67%	67%	66%	66%	65%	65%

Table 3 (Cont)

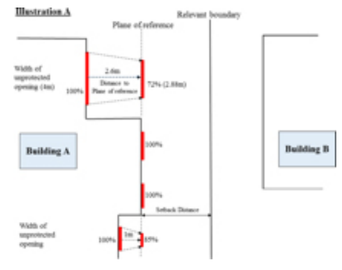


Illustration A (Enlarged)

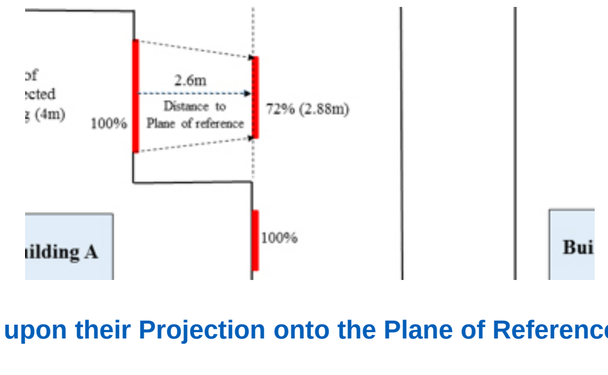


TABLE 4: Percentage of the Width of the Unprotected Openings upon their Projection onto the Plane of Reference (in view of distance of the openings from the plane of reference)

TABLE 4 **Percentage of the Width of the Unprotected Openings upon their Projection onto the Plane of Reference (in view of distance of the openings from the plane of reference)**																	
Angle of unprotected opening to reference plane*	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°
Actual percentage of unprotected opening width on reference plane	96%	91%	87%	83%	78%	74%	70%	66%	62%	58%	54%	50%	46%	43%	39%	36%	32%	29%

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
3.10.2	2 Mar 2020	2 Mar 2020	Clarification	The exit staircase shall be separated from other parts of the building by a masonry structure or drywall complying with Cl.3.8.7b. which shall have fire resistance for not less than the period required by Cl.3.3 for elements of structure.	2 Mar 2020
3.11.8a	10 May 2019	10 May 2019	Change in requirements	The supporting structure shall be constructed of non-combustible materials having a melting point of at least 800°C.	10 May 2019
3.13.3d	10 May 2019	10 May 2019	Change in requirements	Class 3 - Surface of medium flame spread. This refers to surfaces on which during the first 1½ mins of test, the spread of flame does not exceed 265mm and during the first 10 mins of test is not more than 710mm under the relevant test conditions.	10 May 2019
3.15.14	1 Sep 2021	1 Mar 2022	Revised/ Clarification	Fire-rated glass In buildings which are protected by an automatic sprinkler system, fire-rated glass can be used for the construction of compartment walls, compartment floors, enclosures of containing exit staircase and fire lift, subject to the following: a. when subject to test under BS 476 Part 20-23; and b. the walls and doors shall meet the requirement of Class A for Impact performance when tested under BS 6206 and EN 12600 or AS 2208.	1 Sep 2021
3.15.15	1 Sep 2024	1 Sep 2024	Relaxation	3.15.15 Walls, ceilings, roof covering and finishes Walls, ceilings, floor, roof and finishes shall not contain any plastic material, unless the plastic material complies with the requirements stipulated in Cl.3.15.19.	1 Mar 2024
3.2.5c.	25 Aug 2023	25 Aug 2023	Revised/Clarifications	3.2.5c. Floor over a basement Any floor immediately over a basement storey if such storey: (1) forms part of a building or compartment of PG II to VIII, or (2) has an area exceeding 100m² except that in the case of a building or compartment of PG IV, V and VII, the SCDF can consent to exemption from the above requirements provided: (a) the building is fitted throughout with an automatic sprinkler system in compliance with the requirements in Chapter 6; and (b) if the building comprises more than one basement storey, the floor at first basement storey level is constructed as a compartment floor.	25 Aug 2023
3.2.5f.	25 Aug 2023	25 Aug 2023	Revised/Clarifications	3.2.5f. Kitchen In an eating establishment where a kitchen is required for the preparation of food and where open-flame cooking appliances are used, the following requirements shall be complied with: (1)	25 Aug 2023
3.2.6	25 Aug 2023	25 Aug 2023	Revised/Clarifications	3.2.6 Provision for atrium spaces The SCDF can consent to modify the requirements under Cl.3.2.1 and Cl.3.2.4a. of this Code for the design of atrium spaces in a building provided all the following conditions are complied with: a. ..... b. Occupancy within the floor space of the atrium meets with the specification for low or ordinary hazard content.	25 Aug 2023
3.2.7	15 Sep 2020	15 Sep 2020	Reinstatement of past requirements	Buildings of high hazard occupancy a. half of the sizes given in Table 3.2A and each compartment shall comprise one storey only. b. used for the bulk storage of goods or substances of highly combustible nature c. The type of storage materials or substances shall not include the following: (1) (2) sub-clauses a., b., c. and d. of Cl.1.4.67.	15 Sep 2020
3.3.3	25 Aug 2023	25 Aug 2023	Revised/Clarifications	3.3.3 Exemption for non-load-bearing external walls The requirement on fire resistance in Cl.3.3.2 shall not apply to: a.	25 Aug 2023
3.5.7b.(3) to (5)	10 May 2019	10 May 2019	Change in requirements	3.5.7b.(5) canopies over private enclosed spaces or balconies in PG II buildings, provided that the canopy is constructed of non-combustible material .	10 May 2019
3.5.9 (dated 25 Aug 2023)	25 Aug 2023	25 Aug 2023	Revised/Clarifications	3.5.9 Separation of residential floor façade (Relocated to Cl.9.2.1b.(3))	25 Aug 2023
3.5.9(dated 15 Sep 2020)	15 Mar 2021	15 Mar 2021	Revised & Relocated	Separation of residential floor facade The facade of residential floors above 24m habitable height shall be separated from each other by: a. a 1-hr fire-rated spandrel of at least 1.5m in height, or b. a 1-hr fire-rated horizontal projection that extends at least 600mm from the building.	15 Sep 2020
3.6.1a.(1)	2 Mar 2025	2 Mar 2025	Revised	Requirements of separating walls a. Every separating wall shall: (1) height between the buildings it separates, including roofs, and basements and shall be without openings, except where permitted under Cl.3.6.2; (2)	2 Sep 2024
3.6.1b	10 May 2019	10 May 2019	Change in requirements	Cl.3.6.1a.(1) need not be applied to wall between car porches of buildings under PG I. For terrace-houses, this exception shall not apply if the unprotected opening of the car porch fails to comply with the setback distance requirements from the other lot boundary.	10 May 2019

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
3.7.7a.	1 Mar 2023	1 Mar 2023	Revised/Clarifications	Use of fire shutter a. General A fire shutter is permitted to be used as compartment wall, except for the fire compartmentation of Fire Command Centre (FCC) and means of escape, which include exit staircases, smoke-free lobbies/fire lift lobbies, internal exit passageways, etc. b.	1 Mar 2023
3.7.8 (dated 15 Sep 2020)	15 Mar 2021	15 Mar 2021	Revised	Exit directional signage on fire shutter and smoke curtain Exit directional signage marked with an arrow and the word “EXIT” shall be prominently painted /pasted on fire shutters/smoke curtains to redirect building occupants to the nearest exits if the activated shutters visually obscure the building exit and/or directional signs. The signage shall be reflective and the letters at least 100mm in height.	15 Sep 2020
3.8.1	15 Sep 2020	15 Sep 2020	Revised	Purpose of protected shaft A protected shaft shall not be used for any purpose additional to those given as defined under Cl.1.4.82. All services such as, pipe/duct installation shall not be located inside a protected staircase. Likewise, no washroom is allowed to be located inside protected staircase.	15 Sep 2020
3.8.6c.	1 Mar 2021	1 Sep 2021	Revised/Clarification	Nil	1 Mar 2021
3.8.7a (dated 2 Mar 2025)	2 Mar 2025	2 Mar 2025	Relaxation/Revised	Protected shaft containing exit staircase. a. A protected shaft which contains an exit staircase shall not contain any services e.g., pipes, cables, ducts, etc., that are not solely serving the same exit staircase (even if the services are protected with fire-rated dry construction), except for: (1) cut-off sprinkler and pipe for that staircase; (2) UPVC or cast-iron rainwater downpipes serving the roof directly above the exit staircase, and not routed through anywhere outside the staircase; (3) rising mains; and (4) metal water supply pipe and water tap not exceeding 50mm in diameter.	2 Sep 2024
3.9.3c(1)	10 May 2019	10 May 2019	Change in requirements	The following conditions shall be complied with for penetration of pipes stipulated under Cl.3.9.3b.: (1) For non-sprinkler-protected area, pipe supports within 3m from the pipe penetration shall be strengthened such that the tensile stress generated on the supports shall not exceed 10N/mm² and will not be softened or fracture when exposed to temperature of 800°C. For sprinkler-protected area, the pipe supports and pipe penetrations shall be protected by the sprinkler	10 May 2019
3.9.7	15 Sep 2020	15 Sep 2020	Clarification	Services running inside and/or passing through fire lift lobby and smoke-free lobby Air ducts, sanitary pipes, gas pipes, electrical conduits/cable tray, and other services, excluding lifts shall not be permitted to run inside and/or pass through: a. b. unless all these services are protected with a 1-hr fire resistance rating enclosure, or separated with a 1-hr fire resistance ceiling from the said lobby. If these services are required for the operation of the above lobbies, they need not be separately protected. However, this requirement need not complied with if the smoke-free approach is through an external corridor.	15 Sep 2020
3.9.7 (dated 2 Mar 2025)	2 Mar 2025	2 Mar 2025	Relaxation/Revised	Services running inside and/ or passing through fire lift lobby and smoke-free lobby a. Air ducts, sanitary pipes, gas pipes, electrical conduits/ cable trays, and other services e.g., fan coil units, ventilation fans (essential or non- essential) are permitted to locate, run inside and/ or pass through a fire lift or smoke-free lobby provided all these services are protected with a 1-hr fire resistance rating enclosure, or separated with a 1-hr fire resistance ceiling from the said lobby. b. For cablings/ pipings of firefighting or fire protection systems serving or running through the above lobbies, and for other services that are required for operation of the above lobbies during fire emergency, e.g., lighting, mechanical ventilation systems, these need not be separately protected. c. Exception	2 Sep 2025
3.9.7 (dated 25 Aug 2023)	25 Aug 2023	25 Aug 2023	Revised/Clarifications	3.9.7 Services running inside and/ or passing through fire lift lobby and smoke-free lobby Air ducts, sanitary pipes, gas pipes, electrical conduits/ cable trays, and other services e.g. fan coil units, ventilation fans (essential or non-essential) excluding lifts shall not be permitted to locate, run inside and/ or pass through: a. fire lift lobbies, or b. smoke-free lobbies. Unless all these services are protected with a 1-hr fire resistance rating enclosure, or separated with a 1-hr fire resistance ceiling from the said lobby. For cablings/ pipings of firefighting or fire protection systems serving or running through the above lobbies, and for other services that are required for operation of the above lobbies during fire emergency, e.g. lighting, mechanical ventilation system, they need not be separately protected. However, this requirement need not complied with if the smoke-free approach is through an external corridor.	25 Aug 2023
4.2.3f.	25 Aug 2023	25 Aug 2023	Revised/Clarifications	4.2.3f. Exemption The provision of fire access openings shall not be applicable to buildings under PG I and II, including building of non-residential ancillary usage (such as gyms, club rooms, etc.) in a residential building.	25 Aug 2023
Table 3.15A	2 Sep 2024	2 Sep 2024	Clarification	Existing Table 3.15A, Table 3.15B, Table 3.15C & Table 9.8.2c.(2)	2 Sep 2024
Table 3.15B	2 Sep 2024	2 Sep 2024	Clarification	Existing Table 3.15A, Table 3.15B, Table 3.15C & Table 9.8.2c.(2)	2 Sep 2024

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
Table 3.15C	2 Sep 2024	2 Sep 2024	Clarification	Existing Table 3.15A, Table 3.15B, Table 3.15C & Table 9.8.2c.(2)	2 Sep 2024

CLAUSE 4.1 GENERAL

The purpose of this Chapter is to make provision for space around buildings to enable effective external firefighting operations.

CLAUSE 4.2 PROVISION FOR EXTERNAL ACCESS TO BUILDING FOR FIREFIGHTING AND ACCESSIBILITY OF SITE TO FIREFIGHTING APPLIANCES

4.2.1 General

a. Fire engine accessways/ fire engine access roads shall be provided to ensure site accessibility for firefighting appliances.

b. Fire engine accessways shall have an adequate clear width for the deployment of firefighting appliances, in accordance with the habitable height and the type of building, as stipulated in *Table 4.2A*, *Table 4.2B* and *Table 4.2C*.

c. Fire engine access roads shall have a clear width of at least 4m.

d. Fire access openings shall be provided along the external walls of buildings fronting the fire engine accessway to provide access into the building for firefighting and rescue operations.

4.2.2 Fire engine accessway and fire engine access road

a. Provision

(1) PG I and II buildings

Explanation and Illustrations

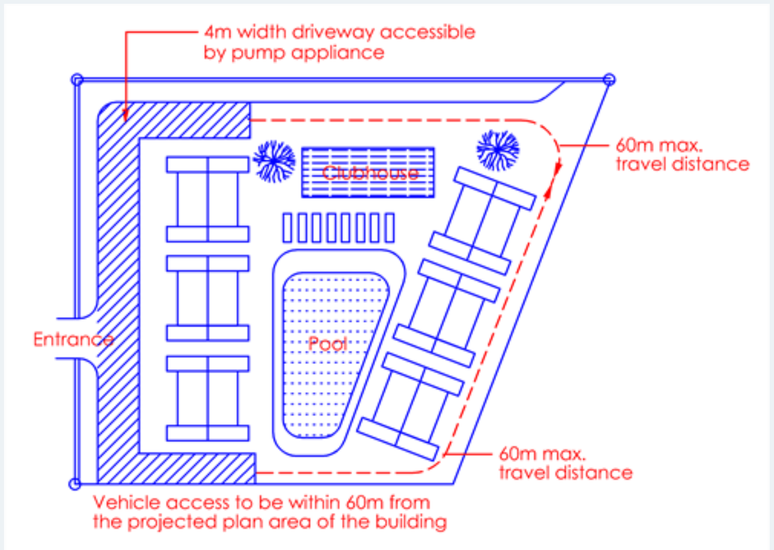


Figure 4.2.2a.(1)

The measurement of the travel distance shall be the line of travel located outside the building, and shall not traverse across open sided porches or 1st storey void deck. The travel distance is the distance that a firefighter would traverse while carrying a portable ladder or equipment.

A fire engine accessway is not required for the following buildings, however, a fire engine access road for access by firefighting appliances shall be provided to within a travel distance of 60m of every point on the projected plan area of the following buildings:

(a) PG I buildings;

(b) PG II buildings of habitable height not exceeding 10m; and

(c) Cluster housing.

(2) Non-residential standalone buildings within PG II development

Non-residential standalone buildings, such as clubhouses, car parks, etc. (excluding guardhouses and substations) that are located within a PG II housing development, shall comply with *Cl.4.2.2a.(4)*, *Cl.4.2.2a.(5)*, *Cl.4.2.2a.(6)* or *Cl.4.2.2a.(7)*, depending on the habitable heights and usage of the buildings.

(3) PG II buildings exceeding 10m habitable height

For a building under PG II that exceeds the habitable height of 10m, all of the following shall be complied with:

(a) A fire engine accessway/ fire engine access road shall be provided within a travel distance of 18m to the entrance of all exit staircases where the landing valves (dry or wet riser) are provided in accordance with *Cl.6.2.2b.*.

Rationale

The reason for specifying fire engine accessways/access roads to be located within 18m of all exit staircases installed with dry riser is to reduce the distance that firefighters needs to travel to get to the landing valve. This will effectively reduce the time taken by the firefighters to tackle the fire and conduct rescue operation.

Explanation and Illustrations

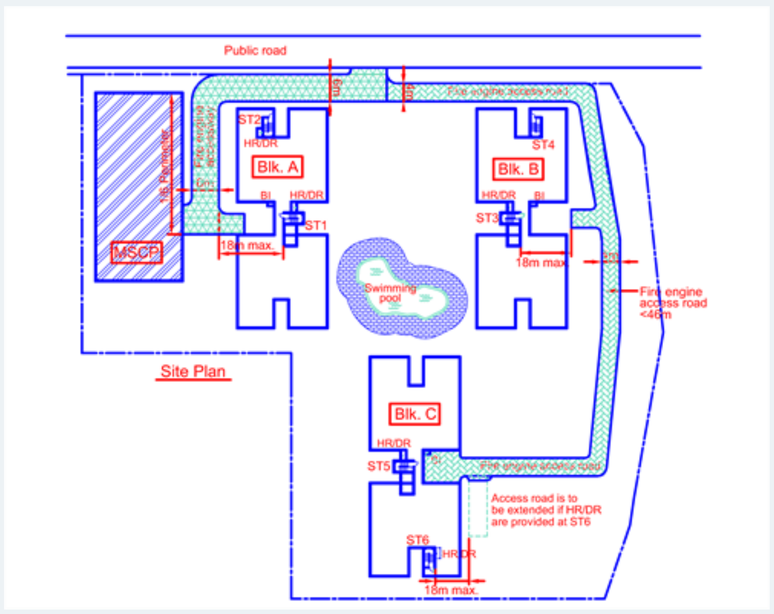


Figure 4.2.2a.(3)(a)

Blk. A, B & C exceeded 10m in habitable height, fire engine access road is within 18m from entrance ST1, ST3 & ST5 where dry risers are located fire engine access road is to be extended to ST2, ST4 & ST6 if dry riser is provided for these staircases due to insufficient coverage of the first.

As multi-storey car park is classified under PG VIII, fire engine accessway is required to comply with *Cl.4.2.2a.(2)*.

(b) A fire engine accessway of at least ¼ length of perimeter (minimum 15m), whichever is greater, shall be provided to access at least one façade of each block. This is to facilitate rescue with direct access to unit windows (excluding exit staircase, smoke-free approach to exit staircase). For the purpose of computing the extent of perimeter for fire engine accessway, only the external facade perimeters of residential units are required to be included. Common areas such as corridors/ lobbies, lift/ service shafts, exit staircase, landscape

areas, etc., can be omitted from the computation.

(c) The fire engine accessway shall be designed to meet the specifications stipulated in *Table 4.2A*, *Table 4.2D* and *Table 4.2E*.

(4) PG III, IV, V & VII buildings not exceeding 10m habitable height

For buildings under PG III, IV, V and VII not exceeding the habitable height of 10m, a fire engine accessway is not required. However, a fire engine access road for access by firefighting appliances shall be provided to within a travel distance of 45m of every point on the projected plan area of the building.

(5) Basement

In the case of a basement, the fire engine accessway/ fire engine access road shall be provided to within a travel distance of 18m to the entrance of all exit staircases where the landing valves (dry or wet riser) are provided in accordance with *Cl.6.2.2b.*. The measurement of 18m shall be between the fire engine accessway/ fire engine access road and the entrance of exit staircase.

(6) PG III, IV, V & VII buildings exceeding 10m habitable height

Explanation and Illustrations

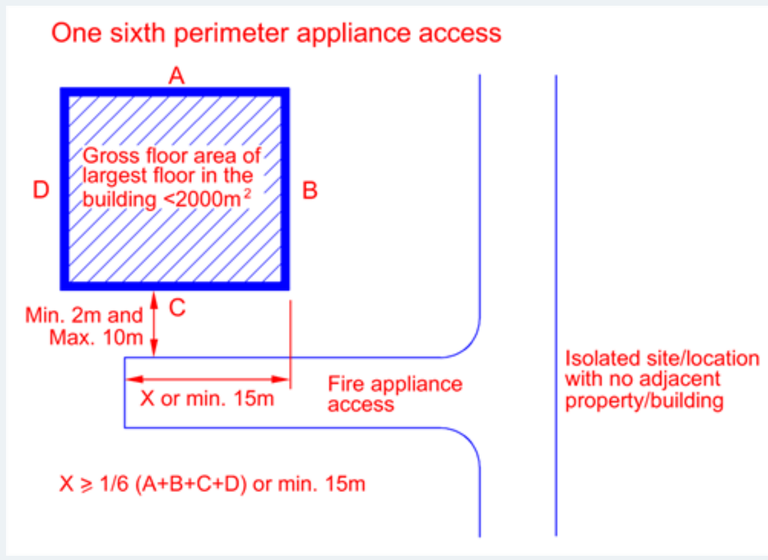


Figure 4.2.2a.(6) – 1

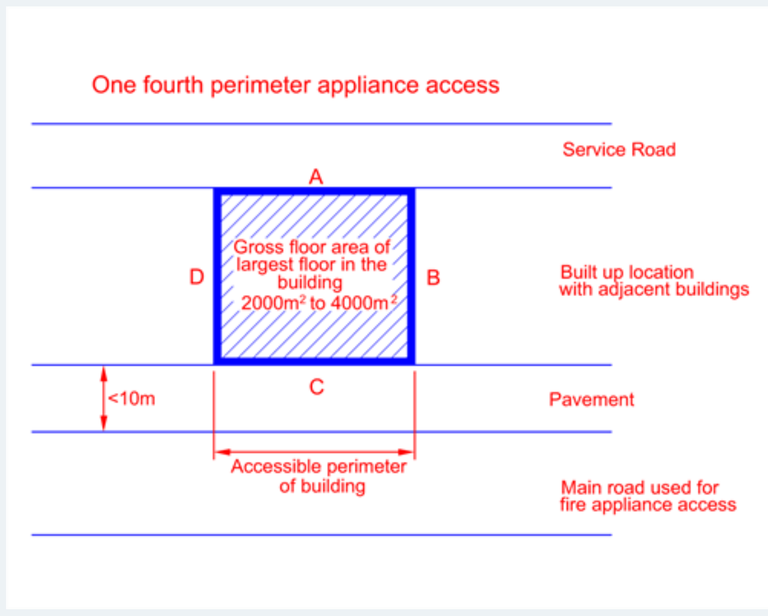


Figure 4.2.2a.(6) - 2

In the event the service road (Minimum 6m) is accessible by firefighting appliances and the building volume exceeds 2000m² but is less than 4000m², then

$A + C \geq \frac{1}{4} (A + B + C + D)$

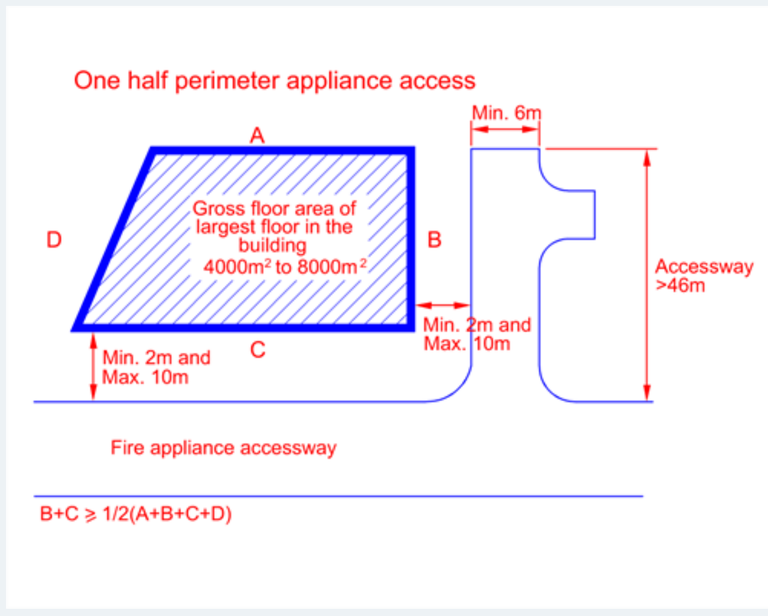


Figure 4.2.2a.(6) - 3

For buildings under PG III, IV, V and VII exceeding the habitable height of 10m, a fire engine accessway shall be located directly below the fire access openings to provide direct reach to the designated fire access panels. The required length of fire engine accessway shall be computed based on the largest Accessible Floor Area (AFA) of any aboveground floors as follows:

(a) for interconnected floors, including basements connected to aboveground floors, the AFA shall be the aggregate AFA of all the interconnected floors, or

(b) for buildings with more than one group of interconnected floors, the AFA shall be taken as the largest of the aggregate floor areas among the groups of interconnected floors.

TABLE 4.2.2a.(6) : LENGTH OF FIRE ENGINE ACCESSWAY FOR PG III, IV, V & VII BUILDINGS		
AFA (m²)	**Required length of perimeter**	
	Non-sprinkler-protected	**Sprinkler-protected**
≤ 2000	⅙ (at least 15m)	⅙ (at least 15m)
> 2000 & ≤ 4000	¼	
> 4000 & ≤ 8000	½	¼

> 8000 & ≤ 16000	¾	½
> 16000 & ≤ 32000	island site	¾
>32000		island site

(7) PG VI and VIII buildings

For buildings under PG VI and VIII, a fire engine accessway shall be provided for firefighting appliances. The required length of the fire engine accessway shall be calculated based on the following gross cubical extent of the building (excluding basement) as follows:

TABLE 4.2.2a.(7) : LENGTH OF FIRE ENGINE ACCESSWAY FOR PG VI & VIII BUILDINGS		
Cubicle Extent (m³)	**Required length of perimeter**	
	Non-sprinkler-protected	**Sprinkler-protected**
≤ 28400	⅙ (at least 15m)	⅙ (at least 15m)
> 28400 & ≤ 56800	¼	
> 56800 & ≤ 85200	½	¼
> 85200 & ≤ 113600	¾	¼
> 113600 & ≤ 170400	island site	½
> 170400 & ≤ 227200		¾
>227200		island site

Explanation and Illustrations

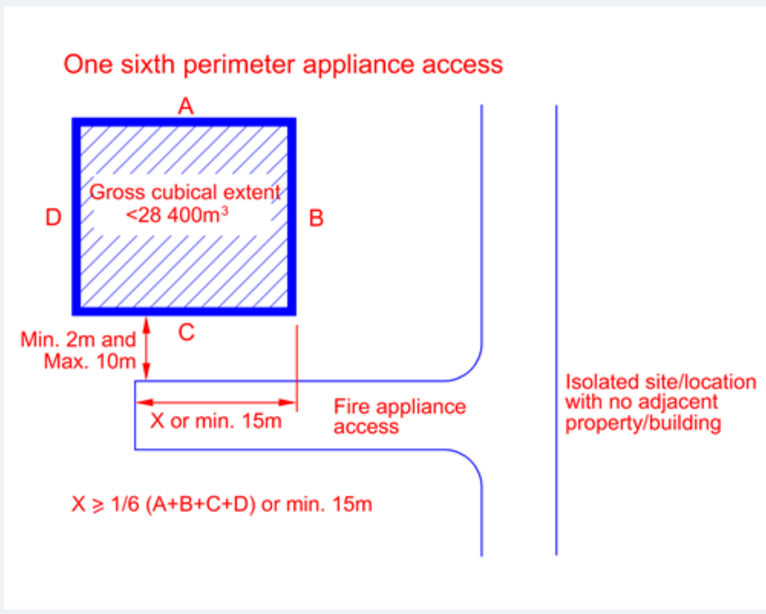


Figure 4.2.2a.(7) - 1

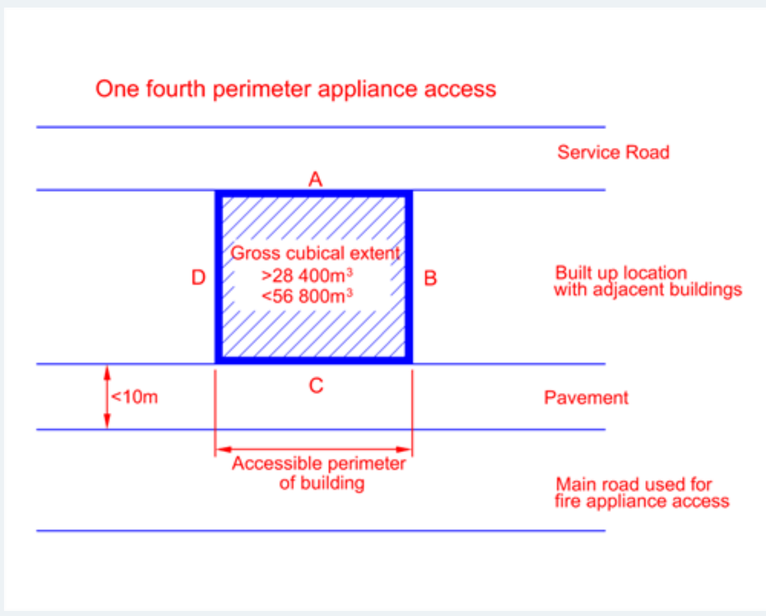


Figure 4.2.2a.(7) - 2

In the event the service road (minimum 6m) is accessible by firefighting appliances and the building volume exceeds 28400m^3 but is less than 56800m^3, then

$$A + C \geq ¼ (A + B + C + D)$$

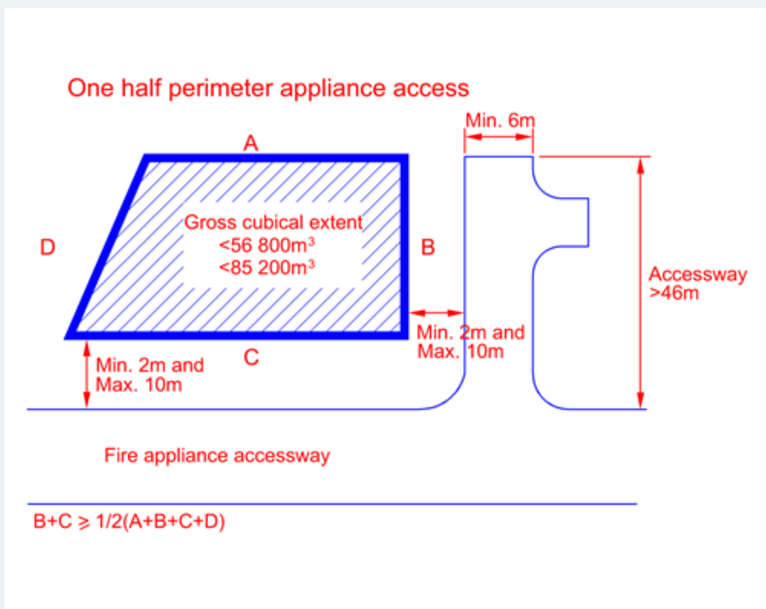


Figure 4.2.2a.(7) - 3

a. The fire loads in industrial premises are much higher and fires could be more complex in nature, scale and magnitude compared to commercial buildings. Larger compartment sizes are

common in such buildings especially in process and storage areas. The high rack storage of materials creates a large volume of combustibles.

b. It is important to note that for industrial buildings, the gross cubical extent is used for the calculation of the extent of fire engine accessway required.

c. Sprinkler-protected buildings

For buildings protected by an automatic sprinkler system, the cubical extent of the buildings can be doubled.

(8) Mixed-use buildings

(a) Where the non-residential component of the building occupies only the lower portion of the building, the measurement of habitable height for determining the provisions of a fire engine accessway/fire engine access road shall be based on the non- residential component of the building.

(b) For mixed-use buildings without PG II usage, the length of fire engine accessway shall be computed based on the following, whichever is larger:

(i) the gross cubical extent of the PG VI or VIII usages; or

(ii) the larger compartmented floor area, for purpose groups other than PG VI and VIII.

(c) For mixed-use buildings with PG II usage, the length of fire engine accessway for mixed-use buildings shall be computed based on *Cl.4.2.2a.(6)* above. In addition, *Cl.4.2.2a.(3)* shall also be complied with.

b. Width of fire engine accessway

The width of fire engine accesssway shall be as specified in *Table 4.2A*, *Table 4.2B* and *Table 4.2C*. Such fire engine accessway shall be able to accommodate the entry and manoeuvring of firefighting appliances, and extended ladder firefighting appliances, with turntable and/or hydraulic platforms.

c. Location

The fire engine accessway shall be positioned so that the nearer edge shall be at least 2m or at most 10m from the centre position of the fire access opening, measured horizontally.

Exception:

(1) The horizontal distance can be extended to at most 13m, provided the height between the fire engine accessway and centre position of the following is not more than 20m:

(a) fire access openings, or

(b) windows of PG II residential units.

d. Gradients of fire engine accessway/ fire engine access road

The fire engine accessway shall be laid on a level platform. If on an incline, the gradient shall not exceed 1:15. A fire engine access road shall be laid on an incline not exceeding a gradient of 1:8.3.

e. Turning facilities

(1) A dead end fire engine accessway/ fire engine access road shall not exceed 46m in length. If exceeding 46m, it shall be provided with cul-de-sac turning facility as shown in *Diagram 4.2.2e*.

(2) The U-turn radii for firefighting appliances on a fire engine accessway/ fire engine access road shall comply with the requirements as shown in *Diagram 4.2.2e*.

f. Overhead clearance

An overhead structure shall only be permitted over a fire engine accessway/fire engine access road subject to all of the following (see *Diagram 4.2.2f*):

Rationale

The restrictions of maximum 10m width of the overhead structure (e.g. link bridge) and the 20m separation distance between them is to ensure adequate openings for smoke ventilation, thus minimising risk of smoke accumulation under such structures. It also serves to provide visual cues to drivers of firefighting appliances that it is safe to travel through the space under the overhead structure.

(1) the overhead clearance for passage of firefighting appliances shall be at least 4.5m;

Explanation and Illustrations

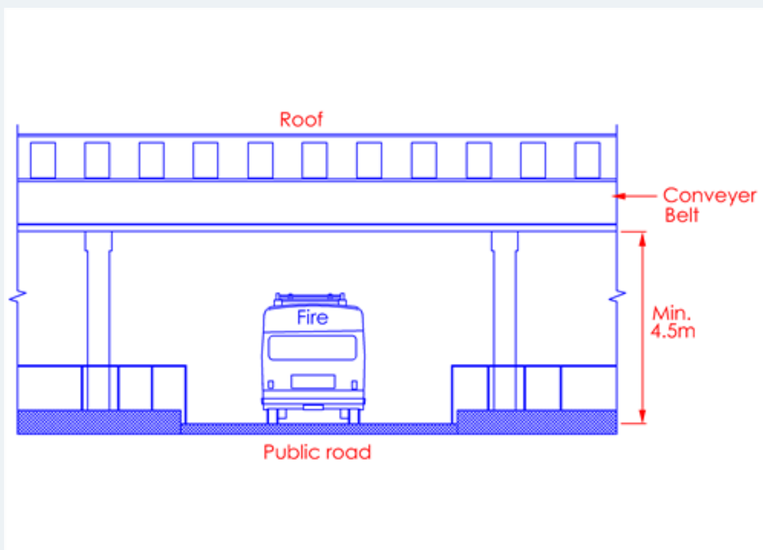


Figure 4.2.2f.(1)

Overhead obstruction to fire engine accessway could be entrance gate, conveyor belts, pipe racks or bridges connecting buildings etc.. Public road can be used as fire engine accessway by firefighting appliance, provided the edge of the public road to the facade of the building where access openings are located shall not exceed 10m.

(2) the width of the overhead structure shall not be more than 10m;

(3) where more than one overhead structure spans across the fire engine accessway/ fire engine access road, the separation distance between two adjacent overhead structures shall be at least 20m apart;

(4) the length of the end-stretch of the fire engine accessway/ fire engine access road shall be at least 20m with no overhead structure; and

(5) the length of fire engine accessway required for the building shall exclude the stretch of fire engine accessway with the overhead structure.

g. Public road

Public roads can serve as a fire engine accessway, provided the location of such public roads is in compliance with the requirements of distance from fire access openings.

Explanation and Illustrations

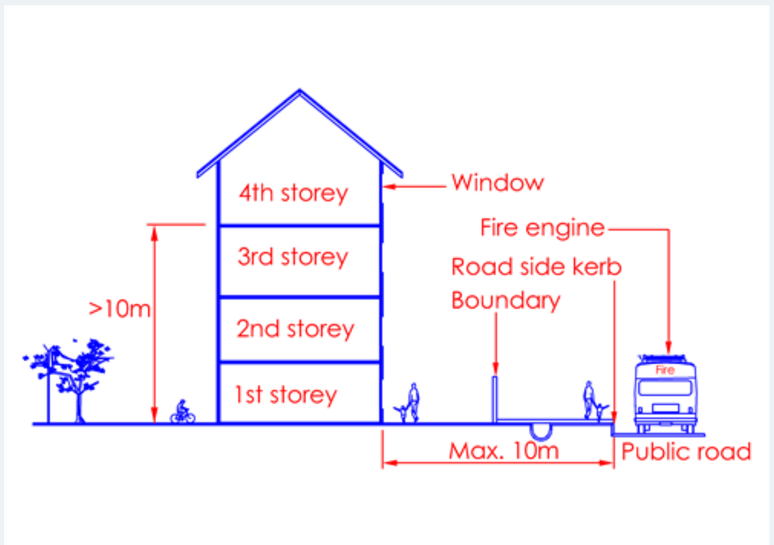


Figure 4.2.2g.

Elevation of building to the edge of road kerb shall not exceed 10m, in order to permit external firefighting and rescue from the firefighting appliance parked on public road.

h. Obstruction

Fire engine accessways/ fire engine access roads shall be kept clear of obstructions at all times. Plants, trees or other fixtures shall not obstruct the path between the fire engine accessway and fire access openings.

Exception

(1) Where an access control system for unmanned building (exclude PG I building) such as a barrier, sliding/ swing gate, etc. is provided at the entrance into the development, such systems

(a) shall automatically open upon detection of firefighting appliances (such as In-vehicle Unit (IU) for emergency vehicles) or activation of the building fire alarm, and shall remain open until the access control system has been manually reset; and

(b) shall be arranged to open automatically from a fail-safe manual override device located 1.2m above the floor and within 1.5m facing the external side of the development, with the manual override device readily accessible and clearly identified by a sign that reads “Emergency Release”.

(2) For manned building, the barrier at the entrance into the development shall be immediately opened/removed upon building’s fire alarm activation.

Explanation and Illustrations

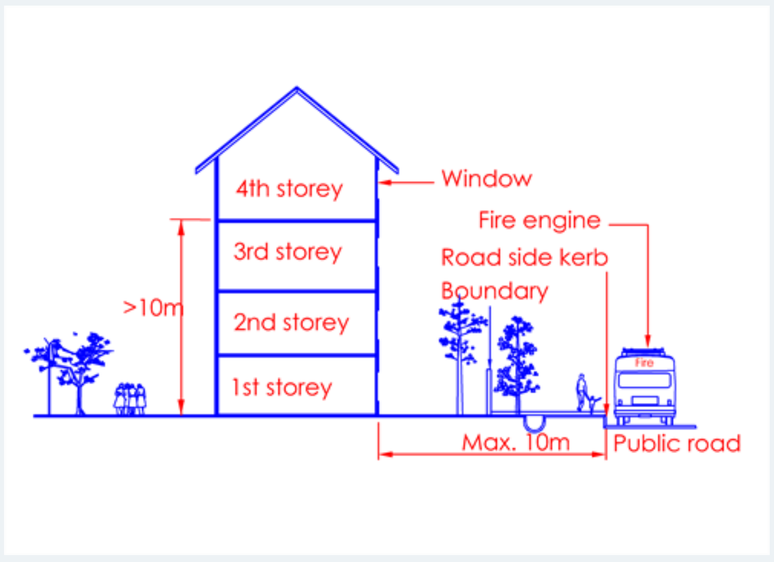


Figure 4.2.2h. - 1

Trees causing obstruction to external rescue and firefighting.

Note : There is no requirement to provide fire engine accessway and fire access opening to buildings under PG I.

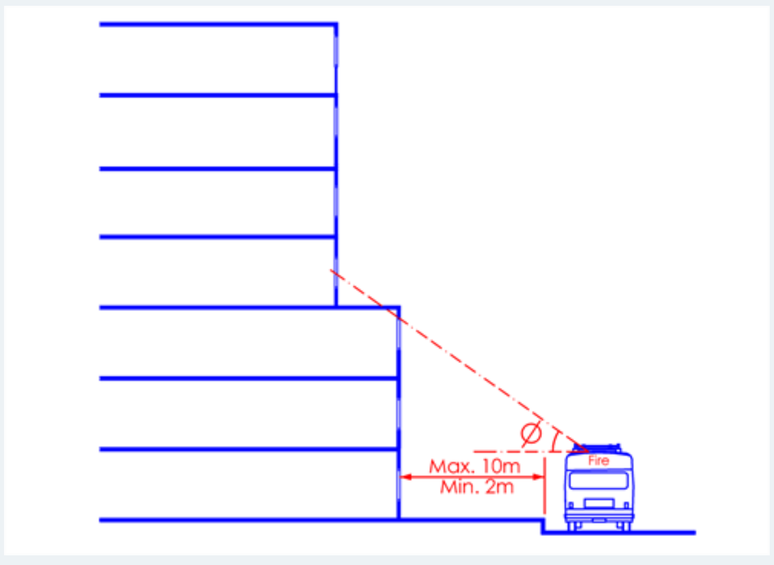


Figure 4.2.2h. - 2

The podium edge is obstructing the reach of the boom of firefighting appliance to 4th storey. Other obstructions could be roadside trees, entrance porch etc.. To allow full extension of aerial ladders at a safe climbing or elevation angle Ø of 60 to 80 degrees, sufficient space is needed to position the firefighting appliance.

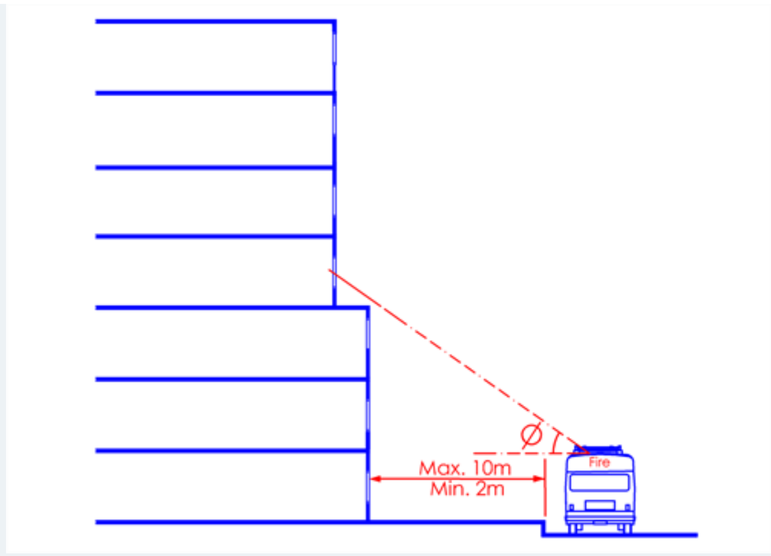


Figure 4.2.2h. - 3

Tower block is relocated nearer to the edge of the podium base to avoid obstruction to the boom of firefighting appliance.

The firefighting appliance shall be located at least 2m, but not more than 10m away from the external wall or façade (including any overhead obstruction) of the building. If the firefighting appliance is located within 2m from the building, the aerial ladder when set-up would fall outside the safe working limit i.e. the inclination of the ladder would be too steep.

If the firefighting appliance is located more than 10m from the building, the effective reach of the aerial ladder would be reduced.

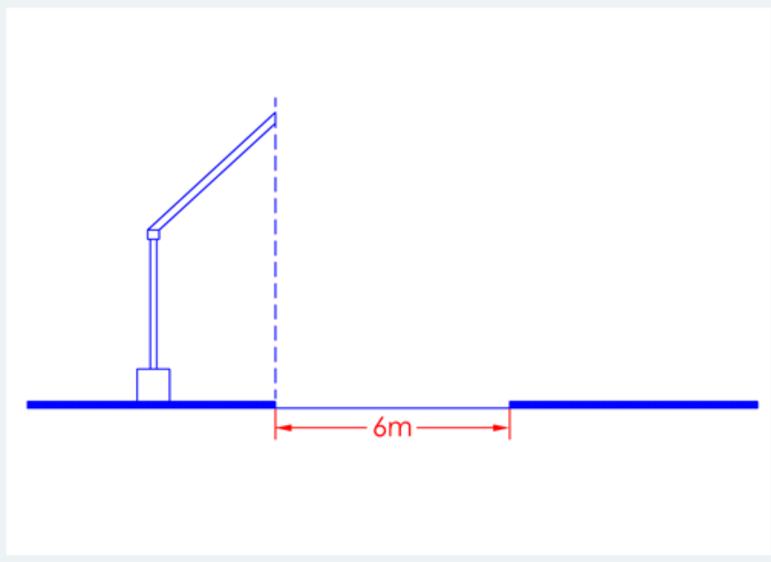


Figure 4.2.2h. - 4 : Security barrier

The security barrier, when lifted up, shall not obstruct the fire engine accessway.

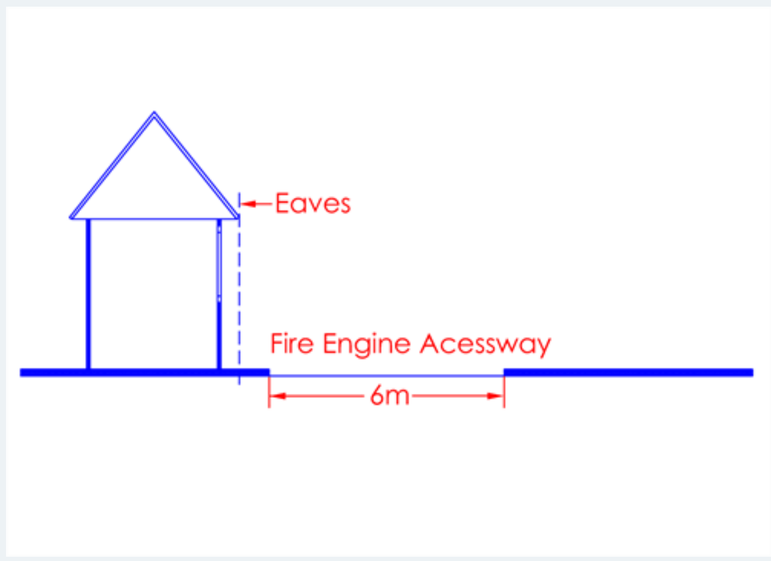


Figure 4.2.2h. - 5 : Security post / guard house

Eaves of the security post/guard house shall not project into the fire engine accessway.

i. Marking of fire engine accessway and fire engine access road

(1) All fire engine accessway/ fire engine access road shall be marked, except where public roads are designated as fire engine accessway/ fire engine access road.

(2) Metalled/ non-metalled or paved/ non-paved surface fire engine accessways/ fire engine access roads shall be marked with reflective white or yellow strips of size not less than 100mm (W) x 400mm (L), or white or yellow road stud reflectors of size not less than 100mm (W) x 100mm (L) x 18mm (H). The markings or reflectors shall be visible at all times and shall be provided on both sides of the fire engine accessways/ fire engine access roads at an alternate interval of not more than 5m. Markings or reflectors shall also mark all corners and turning corners of the fire engine accessway. See *Diagram 4.2.2i.(2) -1 & 2*.

Rationale

The markings serve to guide our firefighters at a fire incident site where the fire engine accessways/access roads are not prominent and/or inconspicuous under poor lighting condition. The sign posts serve to indicate the maximum loading capacity and zone of the fire engine accessways/ access roads. They also serve to remind the public to keep the fire engine accessways/access roads clear of obstruction at all times.

Explanation and Illustrations

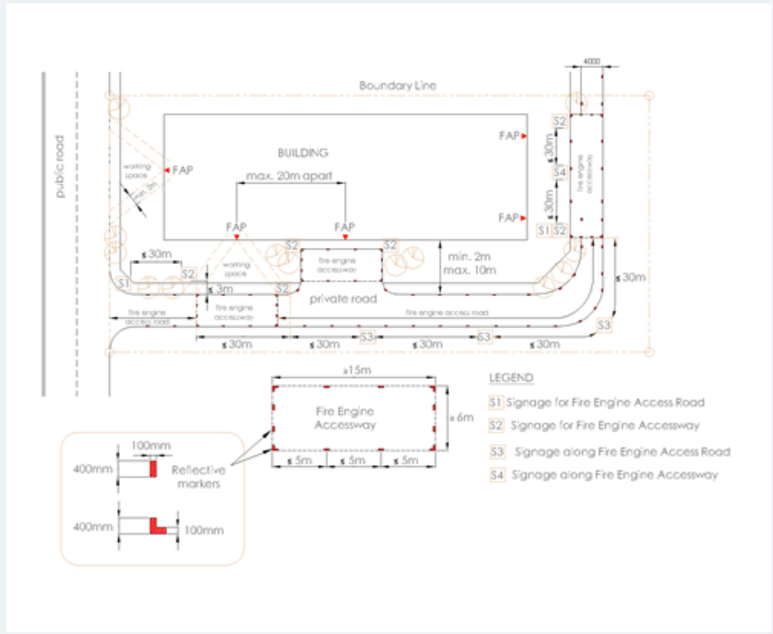


Figure 4.2.2i. : Marking of fire engine accessway/access road

Fire engine accessways/access roads, which are specially designated for operation of the firefighting appliances, should be marked with signs to prevent unauthorised parking of other vehicles. They should be properly highlighted with contrasting colours to its surrounding for better visibility and easy identification by the responding firefighting crew.

Reflective material should also be used to demarcate the fire engine accessway space. This would help the firefighters to locate it readily when responding to a fire incident at night. It is also important to note that firefighting appliance is set up at the designated fire engine accessway, especially so when it could be located over 'suspended' or 'cantilevered' slabs over basement etc. to prevent damage to building structures, if otherwise operated elsewhere.

(3) A sign with white background and red pictogram with upper case wording of not less than 70mm in height shall be provided at the start, junction, and end of a fire engine accessway/ fire engine access road. The height measured from the ground to the lowest point of the sign shall be between 2.3m and 2.4m. The sign shall be reflective, visible and unobstructed at all times and shall be positioned adjacent to the fire engine accessway/ fire engine access road. For locations where there are more than one of such signs, the signs can be placed on the same post. See *Diagram 4.2.2i.(3)*.

Rationale

The markings serve to guide our firefighters at a fire incident site where the fire engine accessways/access roads are not prominent and/or inconspicuous under poor lighting condition. The sign posts serve to indicate the maximum loading capacity and zone of the fire engine accessways/ access roads. They also serve to remind the public to keep the fire engine accessways/access roads clear of obstruction at all times.

Explanation and Illustrations

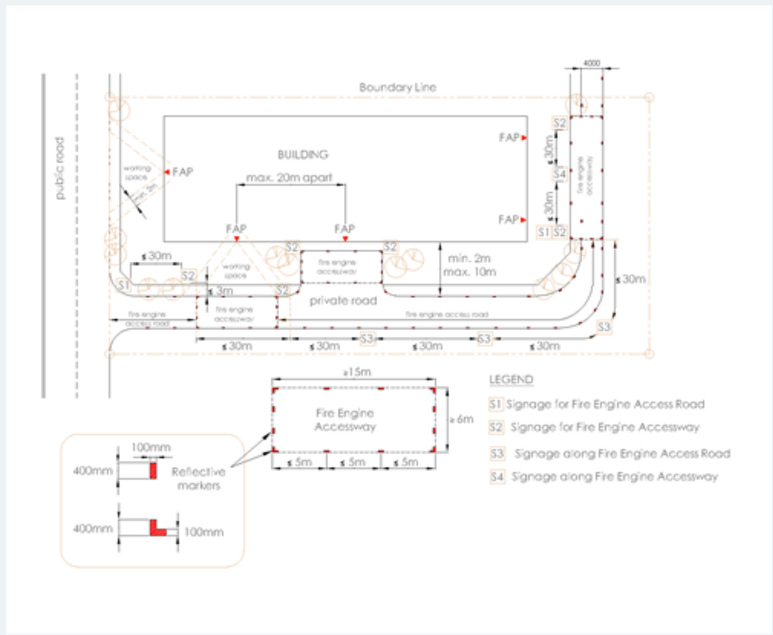


Figure 4.2.2i. : Marking of fire engine accessway/access road

Fire engine accessways/access roads, which are specially designated for operation of the firefighting appliances, should be marked with signs to prevent unauthorised parking of other vehicles. They should be properly highlighted with contrasting colours to its surrounding for better visibility and easy identification by the responding firefighting crew.

Reflective material should also be used to demarcate the fire engine accessway space. This would help the firefighters to locate it readily when responding to a fire incident at night. It is also important to note that firefighting appliance is set up at the designated fire engine accessway, especially so when it could be located over 'suspended' or 'cantilevered' slabs over basement etc. to prevent damage to building structures, if otherwise operated elsewhere.

j. Design of fire engine accessway and fire engine access road

(1) Fire engine accessway sizes

The minimum width, length and turning radii of a fire engine accessway shall be in accordance with *Table 4.2A*, *Table 4.2B* and *Table 4.2C* and *Diagram 4.2.2e*. *Diagram 4.2.2j(1) – 1 to 3* shows the relationship between the fire engine accessway and parked firefighting appliance with its front and rear jacks extended.

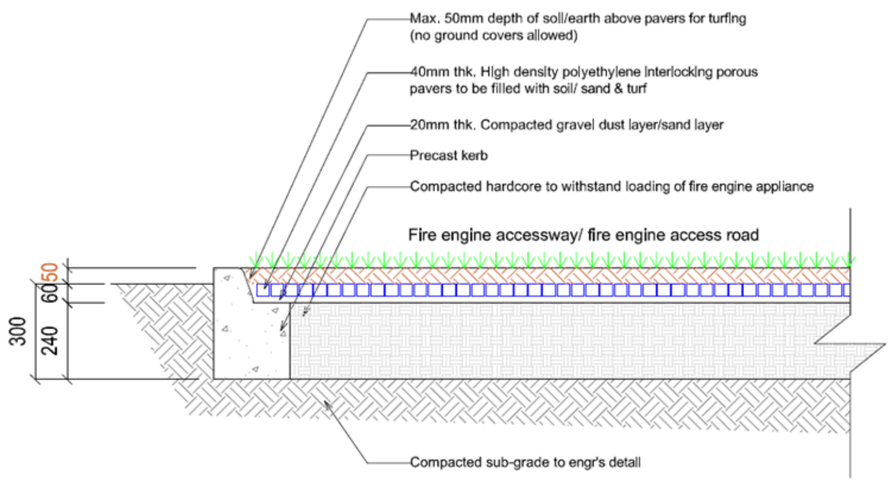
(2) Fire engine accessways and fire engine access roads, which can be on suspended slabs, metalled/ non-metalled roads, paved/ non-paved surfaces, ground laid with strengthened perforated slabs, etc., shall be designed to withstand both stationary and axle loading capacity of firefighting appliances respectively as stipulated in *Table 4.2D* and *Table 4.2E*. Where a fire engine access road is used for linking fire engine accessway, its loading and turning radius shall comply with the specifications for fire engine accessway.

k. Ancillary usage of fire engine accessway/ fire engine access road

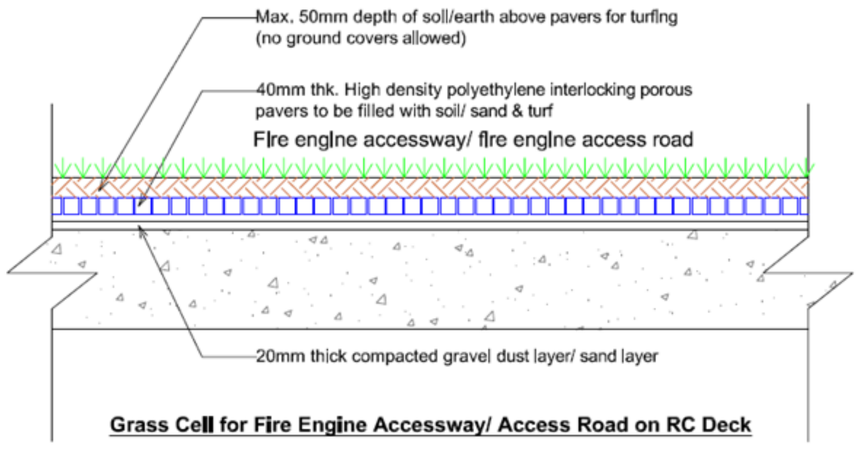
Fire engine accessway/ fire engine access road shall not be turned into other usages such as pond, water features, car parking lots (including loading & unloading), etc. Turfing of fire engine accessway/fire engine access road is only permitted on the straight stretch of the fire engine accessway/ fire engine access road with gradient not exceeding 1:15. For such turfing, the depth of the soil/ earth above the grass cell pavers shall not exceed 50mm in height. The grass cell pavers shall be designed to withstand both stationary and axle loading capacity of firefighting appliances in accordance with *Cl.4.2.2j*.

Explanation and Illustrations

A max. depth of 50mm soil/ earth above the grass cells/ pavers/ interlocking tiles is permitted.



Grass Cell for Fire Engine Accessway/ Access Road on Soil



Grass Cell for Fire Engine Accessway/ Access Road on RC Deck

Note: The above is a typical design of a turfed fire engine access driveway. Similar to concrete or paved road that serves as fire engine access, the PE (Civil) shall certify and ensure that the loading capacity of the turfed fire engine access is in accordance with the prevailing Fire Code.

Note for turfed fire engine access driveway

l. Bi-directional fire engine accessway/ fire engine access road

For buildings with vehicular entries/ exits that provides bi-directional access, both directions shall be designed with sufficient turning radius and width to allow firefighting appliances to manoeuvre along the fire engine accessway/ fire engine access road in the intended traffic direction as shown in *Diagram 4.2.2l*.

4.2.3 Fire access opening to building for firefighting

a. Provision

Fire access openings shall be provided on the external wall for external firefighting and rescue operations. This can include unobstructed external wall openings, windows, balcony doors, glazed wall panels and access panels. There shall be a minimum clearance area of 3.5m in width and 2.5m in height around the fire access opening, and with minimum clearance distance of 1.1m measured below the lower edge of the fire access opening, and 400mm measured above the upper edge of the fire access opening. Windows, doors, wall panels or access panels shall be readily openable from the inside and outside, unless fitted with non-laminated and breakable glazing (e.g., float, annealed or heat strengthened glass). The inside and outside of fire access openings shall be unobstructed at all times during the occupancy of the building. There shall be no furniture or any other obstruction within 1m from the fire access openings at the landing inside the building.

Rationale

The purpose of providing fire access openings is to enable firefighters to gain access into the building from the exterior to rescue any trapped occupants and to facilitate external firefighting. Fire access openings shall not be located at exit staircases or smoke-stop/fire lift lobbies as these areas can be accessed through more conventional means.

Explanation and Illustrations

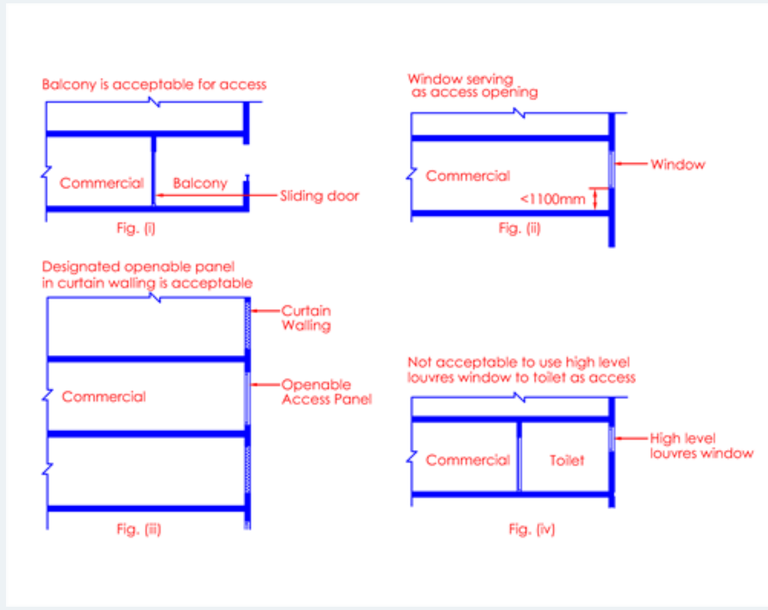


Figure 4.2.3a. – 1

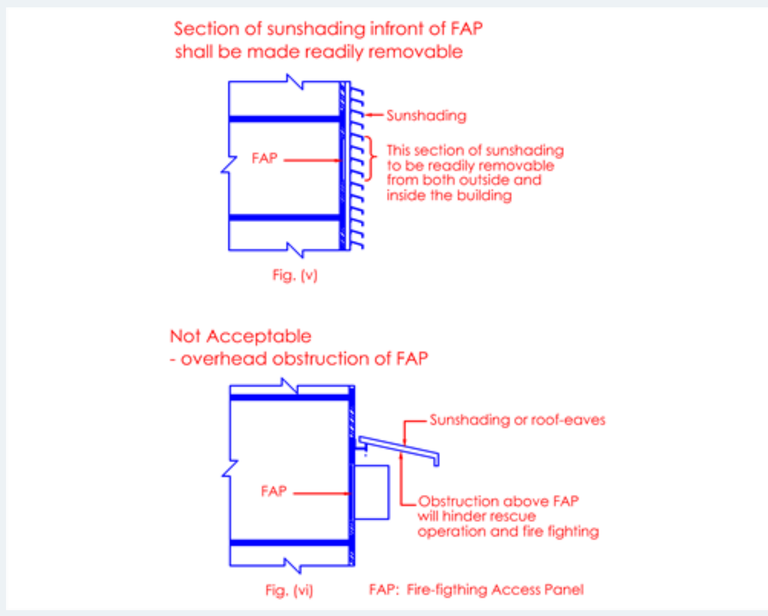
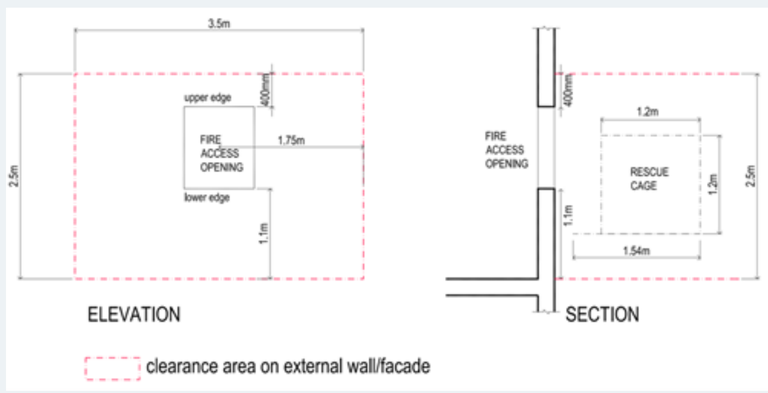


Figure 4.2.3a. - 2

The purpose of the access opening is to enable firefighters to gain access from external to rescue any occupant who is trapped in the building and to allow firefighting from the outside of building. Access panels shall be placed at habitable spaces. In situation where the upper storey of a building is windowless, the FAPs could also be used for smoke and heat venting.

Access opening shall not be located at protected staircases or lobbies. As these spaces are being protected, there is no need for firefighters to gain access into them from the outside.

Sun shading to window shall be designed to have openable section in front of the designated FAP. QP should consult the SCDF for FAPs that are obstructed by the sun shading and seek acceptance on the method of opening or removal of that section of sun shading in front of the FAP before building plan submission.



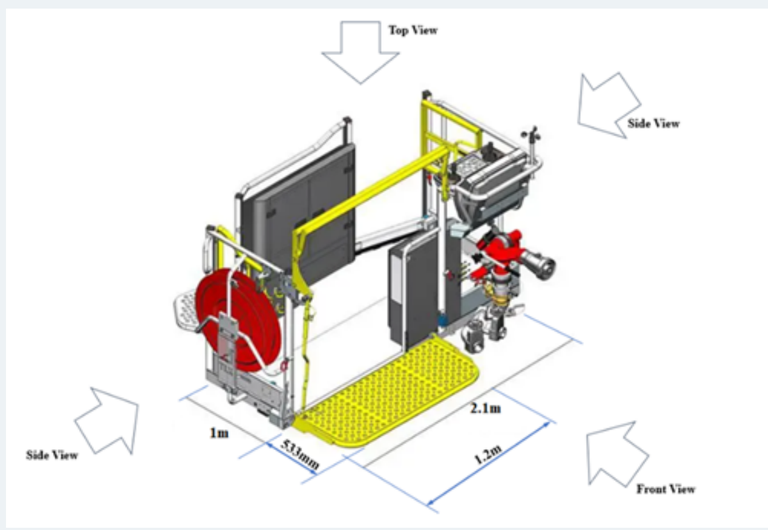


Figure 4.2.3a. - 3

b. Location

The fire access opening shall be placed against an occupied space. It shall not be placed at a plant/store room, common corridor, exit staircase, smoke-free approach to exit staircase or space that leads only to a dead end.

c. Signage

Panels to fire access openings shall be indicated with either a red or orange triangle of equal sides (minimum 150mm on each side), which can be upright or inverted, on the external side of the wall and with the wordings 'Firefighting Access - Do Not Obstruct' of at least 25mm height on the internal side.

Rationale

The red/orange triangular signage provided on the external side of the fire access panels helps firefighters on the ground to locate the designated fire access openings readily during an emergency.

Explanation and Illustrations

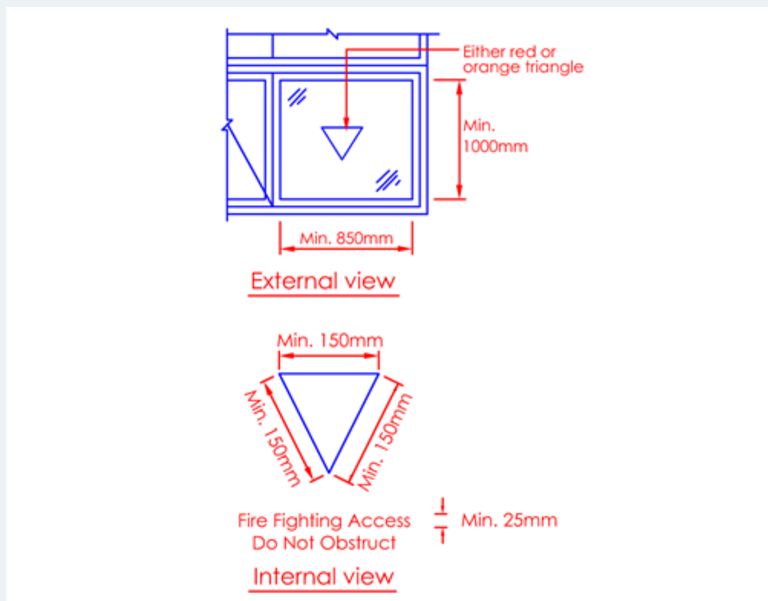


Figure 4.2.3c. : Signage for fire access opening

The signage, either in red or orange triangle would help firefighters on the ground to locate the designated access openings. The triangle can be upright or inverted.

d. Size

Fire access openings shall be not less than 850mm wide by 1m high with sill height of not more than 1.1m, and head height not less than 1.8m above the inside finished floor level.

Exception:

(1) The sill height can be extended to at most 1.25m for those fire access openings that are located at roof garden/ terrace.

Rationale

The sill height of not more than 1.1m is to facilitate the free movement of firefighters into or out of the building. Higher sill heights may impede their access and increases their risk of falling.

Explanation and Illustrations

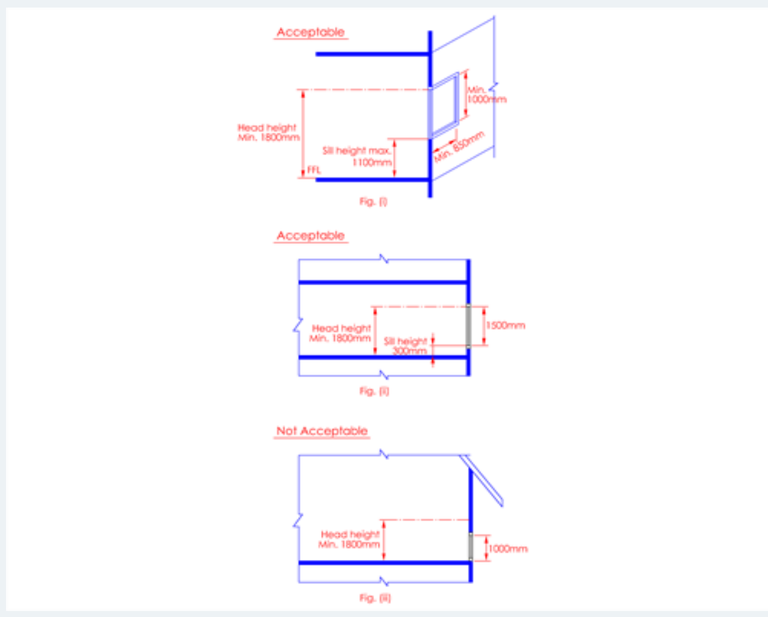


Figure 4.2.3d. - 1

In Fig. (iii), although the height of access opening complies with the Clause (1000mm), the head height is less than 1800mm.

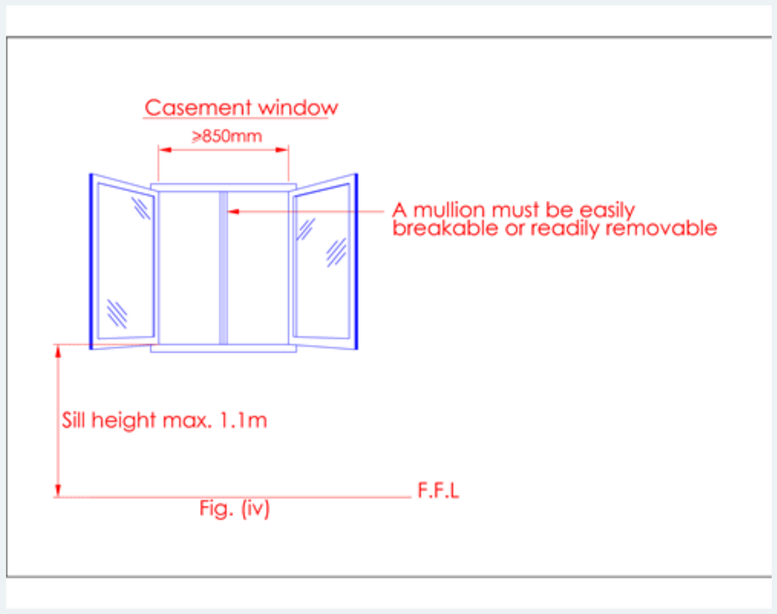


Figure 4.2.3d. - 2

Signage shall be provided to indicate the access openings, both inside and outside habitable rooms to prevent any obstruction at all times. High level access openings are not acceptable as firefighters could incur physical injuries if they fall down from the opening when trying to gain access into the building. The sill height of not more than 1100mm is to facilitate the free movement in/out of the building. Higher sill height would pose problems as firefighter could incur a fall when entering the building and restrict movement.

The minimum width of 850mm shall not include a mullion usually found in casement windows. The provision of mullion would reduce the access opening. This would cause difficulties to firefighters when trying to get into or out of the building, carrying with them equipment or injured occupant.

e. Number and position of fire access openings for buildings other than residential

(1) Number of fire access opening

For PG III to VIII, the number of fire access opening shall be based on the length of the fire engine accessway. Every 20m of fire engine accessway or part thereof shall be provided with an access panel.

(2) Position

Fire access openings shall be remote from each other and located along the side of the building. Such fire access openings shall be spaced at most 20m apart measured along the external wall from centre to centre of the fire access openings. The fire access opening shall be distributed such that there is at least one opening at every 20m of the fire engine accessway, except for parts of the non-PG VI or non-PG VIII building that are single-storey.

Explanation and Illustrations

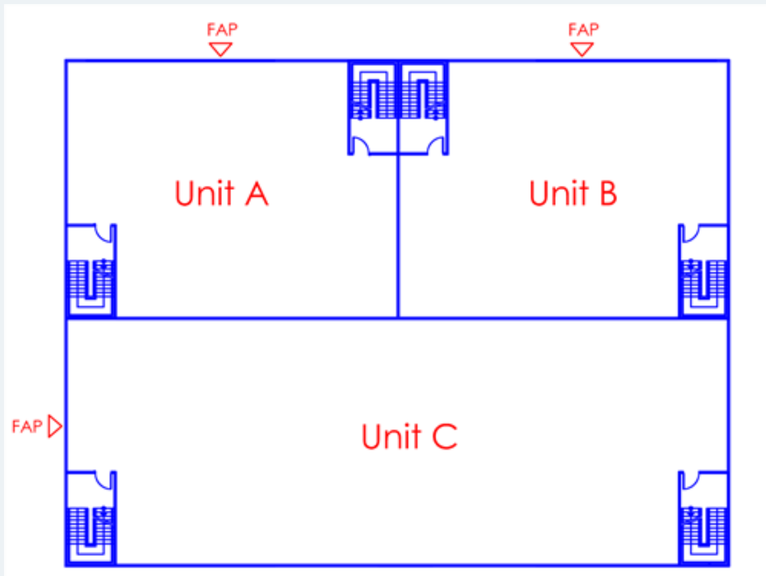
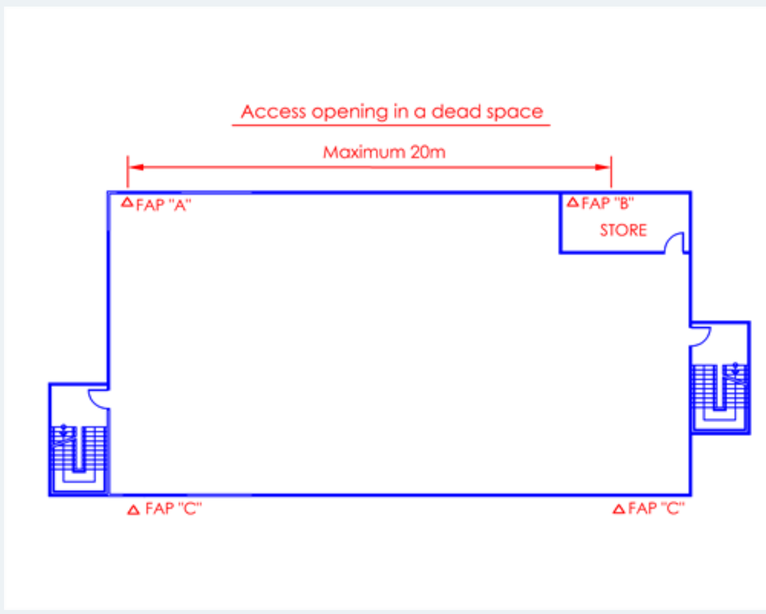


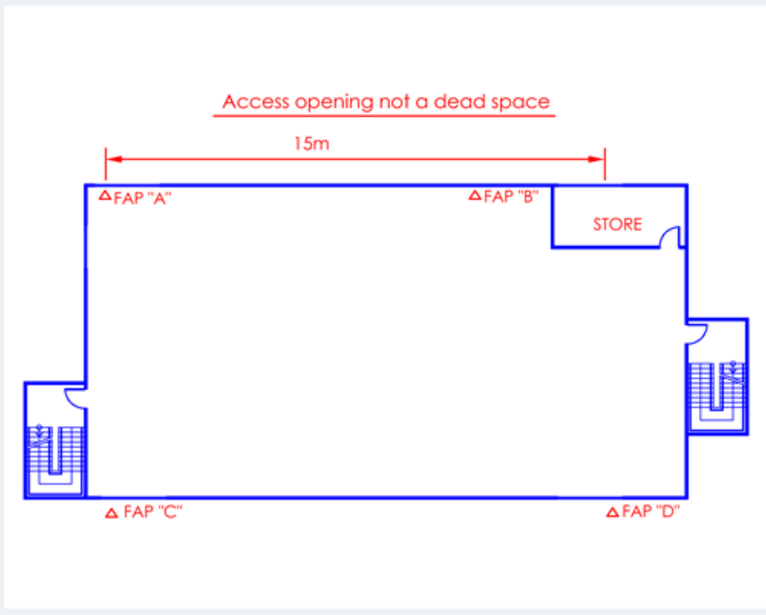
Figure 4.2.3e.(2) - 1

As the compartments are not accessible from one another, each compartment shall be provided with at least one access opening. FAPs are provided along the external wall overlooking the fire engine accessway.



Not acceptable

Figure 4.2.3e.(2) - 2



Acceptable

Figure 4.2.3e.(2) - 3

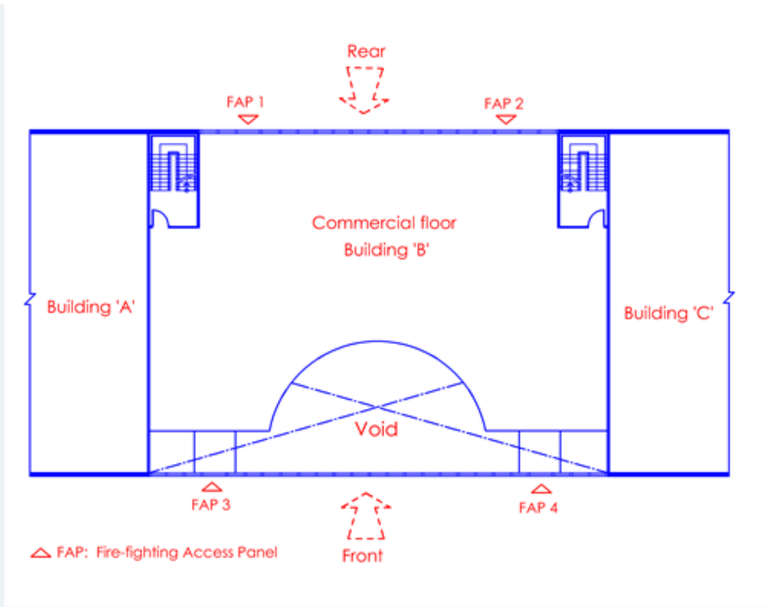
Location of access openings should not be rigidly governed by the 20m-apart rule, as access panels should open into “habitable space” Thus, providing access openings at a “dead space” or “store room” is not allowed. However, access openings at the following areas should be avoided:

a. Staircases

b. Smoke stop lobbies

The distance between access openings may vary as deemed fit. It is not necessary to be 20m all the time. In some circumstances, it may be less than 20m, depending on the shape of the building, the floor layout and the usage of the various rooms at which access panels are being provided.

Access openings are meant for conducting rescue operation and fighting fires from the outside, while the firefighter rides on an aerial ladder. Providing an access opening in the staircase will not serve much purpose. It is unlikely that the fire is in the staircase; and gaining access into the staircase directly should be possible without having to do it from the firefighting appliances.



Acceptable

Figure 4.2.3e.(2) - 4

In situation where void or atrium interferes with the siting of FAPs, for example, FAPs 3 and 4 as shown in the above figure, QPs should consult the SCDF to determine the alternative suitable location for the affected FAPs and the adequacy of the overall provision per storey of the building up to 90m habitable height.

FAP 3 and FAP 4 shall have direct access to the commercial floor.

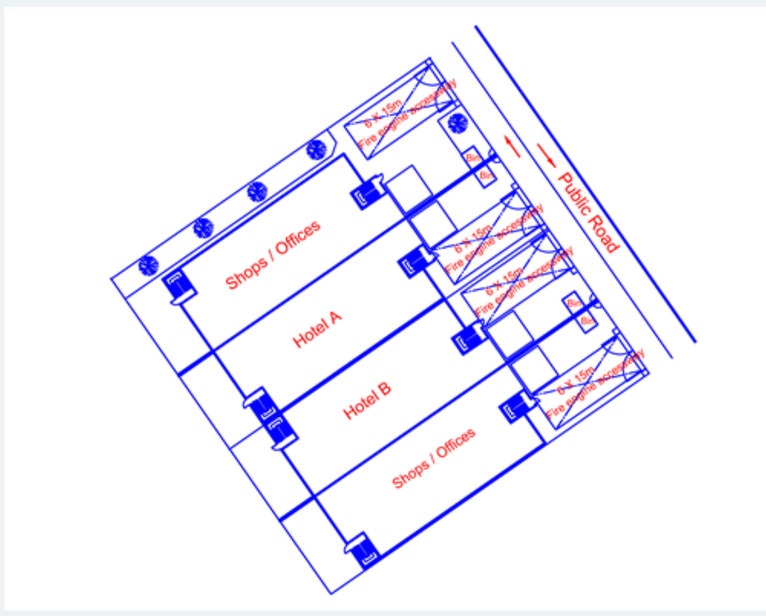


Figure 4.2.3e.(2) - 5

In long narrow sites, the provision of fire engine accessway would affect the layout of the building. To compensate for the lack of fire engine accessway, it would be necessary to provide internal firefighting facilities such as sprinkler system, fire lift, wet or dry rising main. QPs shall obtain waiver approvals prior to making building plan submission.

(3) Fire access opening to compartment or spaces

(a) For buildings under PG III, IV, V and VII exceeding the habitable height of 10m, and up to 90m, fire access openings are required at every storey level, other than the 1st storey, and shall face the fire engine accessway directly.

(b) For building under PG VI and VIII, fire engine access openings located over a fire engine accessway shall be provided along the external walls, up to a habitable height of 90m.

(4) Additional openings for ventilation

For buildings under PG III to VIII where an area or space has a ceiling height greater than 10m, additional high level ventilation openings for smoke venting and firefighting purposes shall be provided and located in the external walls opening into the area or space, except for an area or space that is provided with engineered smoke control system and/ or smoke purging system. The ventilation opening shall meet the following criteria:

(a) the number and location of the openings shall comply with *Cl.4.2.3e.(1)* and *Cl.4.2.3e.(2)*.

(b) the dimensions of the openings shall comply with *Cl.4.2.3d.*;

(c) the openings can be in the form of openable panels/louvres, breakable glazing, or permanent openings; and

(d) the openings shall not be indicated with the triangular signage as mentioned under *Cl.4.2.3c.*, but instead be labelled with red wording, "DO NOT ENTER – FOR SMOKE VENTING ONLY", of height not less than 50mm and visible from the building exterior.

Rationale

The additional high level ventilation openings are meant for use by firefighters to vent out the smoke so as to facilitate firefighting and rescue operations.

Note

Refer to *Table 9.8B* for smoke control requirements for general warehouse.

Explanation and Illustrations

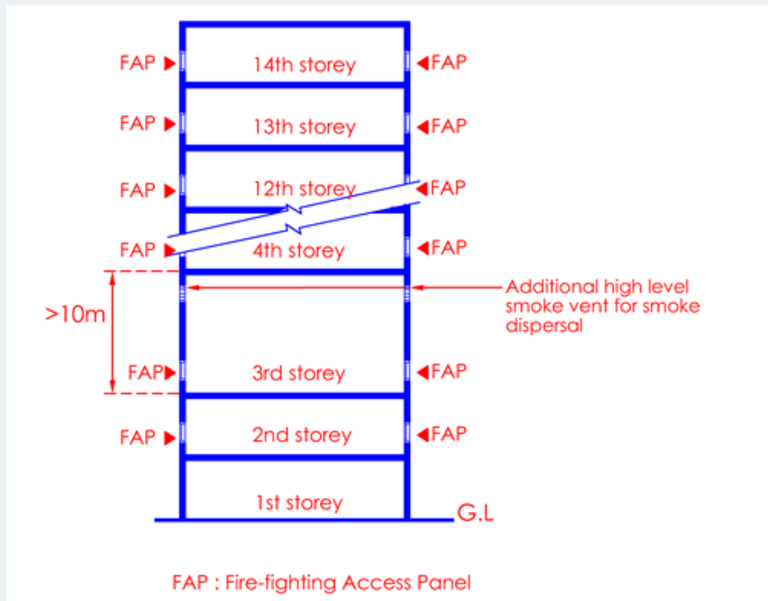


Figure 4.2.3e.(4) : High level access opening

The additional openings are meant for smoke venting. They shall be labelled as 'Smoke Vent' of size not less than 50mm in height.

f. Exemption

The provision of fire access openings shall not be applicable:

(1) buildings under PG I and II, including buildings of non-residential ancillary usage (such as a gym, club rooms open-to-sky roof garden, intermediate floor sky terrace, etc.) within the residential occupancy.

(2) aboveground multi-storey car park where parapet walls are provided to comply with ventilation requirements stipulated in Cl.3.2.8.

CLAUSE 4.3 ACCESS TO BUILDINGS WITH RISING MAINS

Buildings fitted with rising mains and automatic sprinkler system shall have fire engine accessway/ fire engine access road for firefighting appliances within 18m of breeching inlets. The breeching inlets shall be visible from the fire engine accessways or fire engine access road.

Rationale

The requirement for breeching inlets to be sited within 18m of the fire engine accessway/fire engine access road is for expediency of conducting firefighting operation. With this distance, only one length of hose would be needed for firefighters to provide water supply to the dry risers and/or fire water storage tanks.

Breeching inlets shall be visible from the fire engine accessway/access road to avoid delay in locating them upon arrival of the firefighting crew.

Explanation and Illustrations

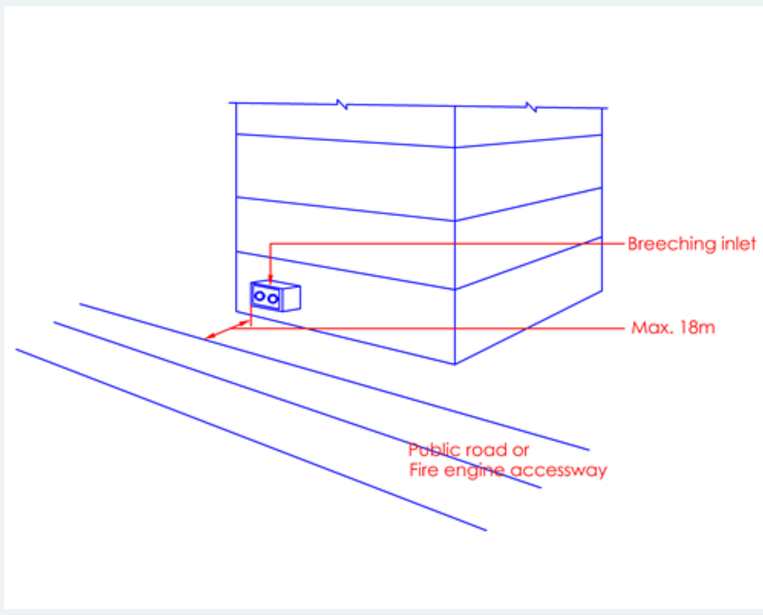


Figure 4.3

Breeching inlets should be visible from fire engine accessway to avoid delay in locating them upon arrival of fire crew. For better control and limit to one hose length being used, the breeching inlets shall not be sited more than 18m away from the fire engine accessway.

CLAUSE 4.4 PRIVATE FIRE HYDRANT

4.4.1 Provision of private fire hydrant

a. General

Every part of a fire engine accessway and/ or fire engine access road shall be within an unobstructed distance of 50m from a fire hydrant. Where a public fire hydrant conforming to this requirement is not available, private fire hydrant(s) shall be provided. See *Diagram 4.4.1a.*.

Explanation and Illustrations

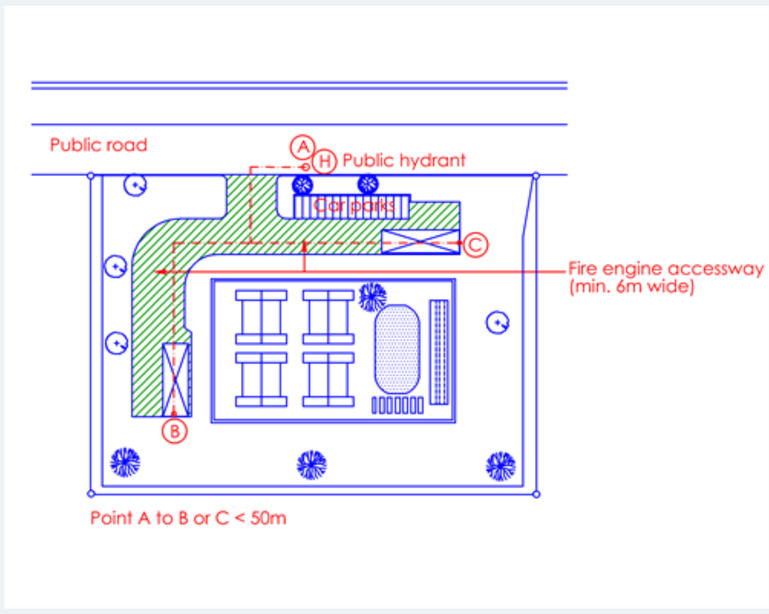


Figure 4.4.1a.

The distance of 50m is measured horizontally along the fire engine accessway.

b. Use of public fire hydrant

Existing public fire hydrants along one side of a public road shall not be designated to serve developments sited on the other side of the public road, except for a road having at most two lanes, regardless of traffic direction.

c. Locations of fire hydrants

In situations where more than one private fire hydrants is required, the fire hydrants shall be located along the fire engine accessway/ fire engine access road such that every part of the fire engine accessway/ fire engine access road is within an unobstructed distance of 50m from any fire hydrant. See *Diagram 4.4.1c.*.

Rationale

Public roads with multiple lanes will likely have high volume of traffic. In the event where only one fire hydrant exists on the opposite side of the road, the traffic would be affected when firefighters utilise the hydrant. This will create congestion or result in road closure, thus disrupting the traffic flow.

Explanation and Illustrations

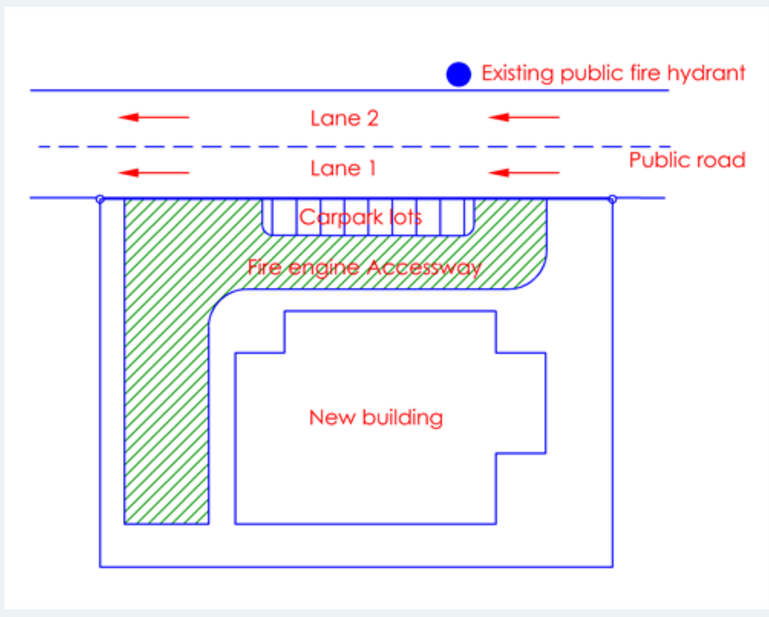


Figure 4.4.1b.

All developments shall be provided with its own private hydrant. In the case of a new development where the existing public hydrant is within the stipulated coverage, such hydrant can be considered. To qualify for the relaxation, the existing public hydrant shall be within an unobstructed distance of 50m to every part of a fire engine access road and/or fire engine accessway.

If the existing public hydrant is sited across the other side of the public road, the said public hydrant is not allowed to serve the development if the public road is more than 2 lanes, regardless of direction of traffic flow.

d. Siting and types of fire hydrants

Siting and types of fire hydrants shall comply with the requirements stated in *SS 575*.

Explanation and Illustrations

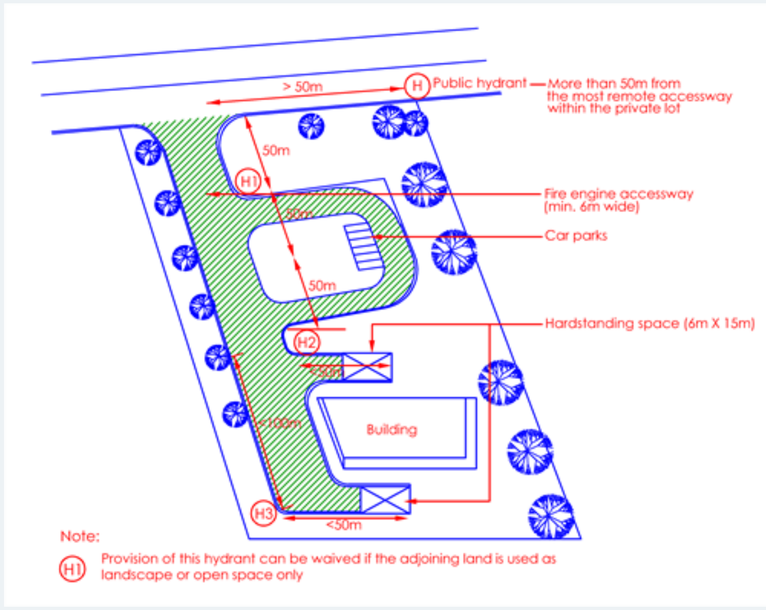
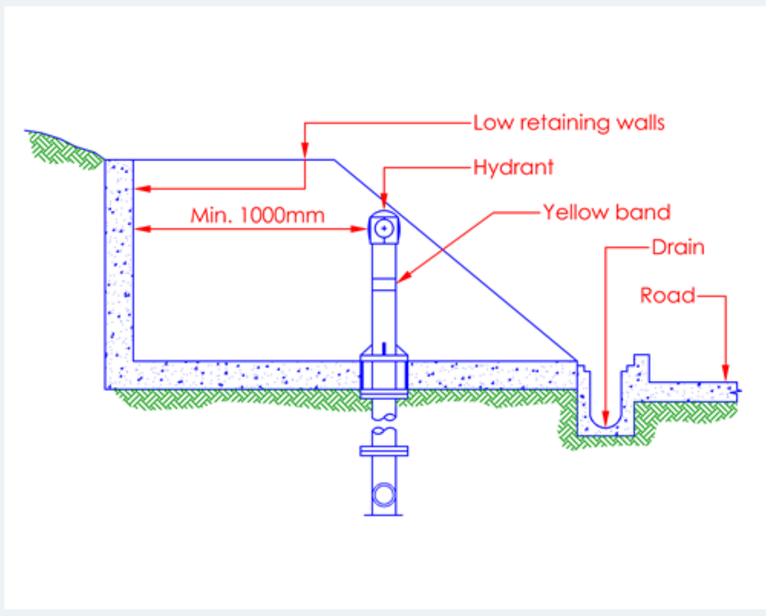


Figure 4.4.1d. – 1

Hydrant H1 is not required if the adjoining land is maintained as open space. However, if the land is later developed for new buildings or usages, provision of hydrant would be required.



Section

Figure 4.4.1d. – 2

The minimum 1000mm clearance between the building or retaining wall/boundary wall and fire hydrant is to allow the minimum working space for hose connection.

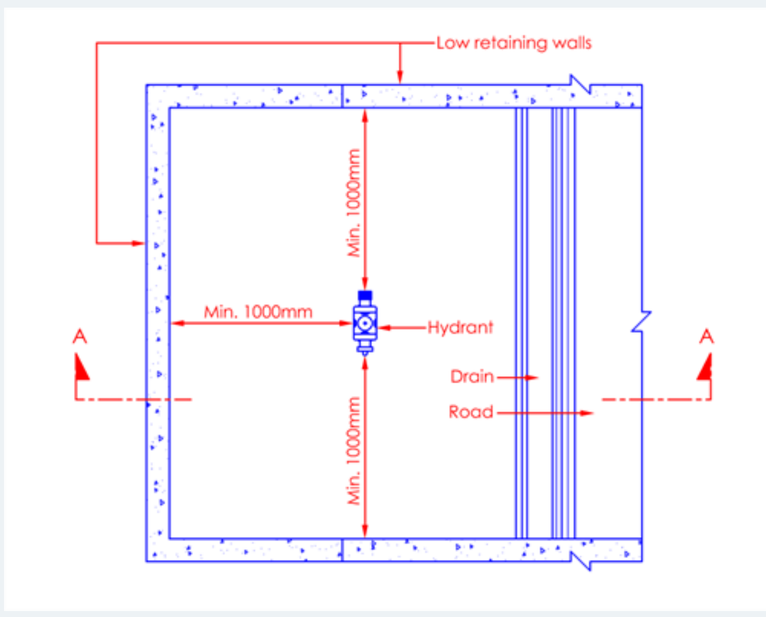
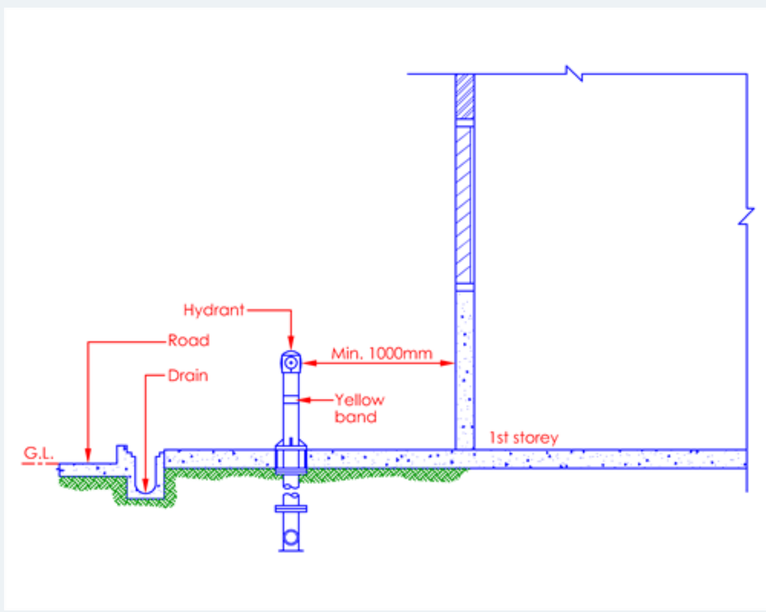


Figure 4.4.1d. – 3



Section

Figure 4.4.1d. – 4

e. Ringed fire hydrant pipes

For a building that is required to have an island site fire engine accessway the fire hydrant pipe shall be a ring system. Isolation valves shall be provided on the fire hydrant ring such that on any section of ring, not more than one fire hydrant can be isolated when required for maintenance without affecting the water supply (both designed pressure and flow) to the other fire hydrants on the ring.

Explanation and Illustrations

(No illustration)

Where the building is provided with island site fire engine accessway, the hydrant pipe serving hydrants within development shall be a ringed water supply system. This system to hydrant will ensure uninterrupted water supply to facilitate firefighting operation during a fire emergency. Isolation valves shall be provided at strategic locations such that any section of the ring (only one fire hydrant) scheduled for maintenance or repair shall not affect the water supply (pressure and flow) to other connected private hydrants. The hydrant ring pipe should be run above-ground or laid beneath earth. Where it is not practical (e.g. at road crossing), the section of underground hydrant pipe shall be appropriately supported to prevent any pipe leakage due to movements of vehicles above. Additional isolation valves should be provided at pipe sections just before and after the road crossing.

f. Valve locking device

A locking device shall be provided to lock the valves in open position during normal operation. Underground valves shall be kept in an open position at all times.

4.4.2 Water supply for private fire hydrant

The provision of water supply for a private fire hydrant system, where required by this Code, shall comply with the following requirements

a. Private fire hydrant at or below reduced level 125m

(1) Private fire hydrants installed at reduced level 125m and below can receive direct supply from public water mains provided the flow and pressure from the public water mains meet the fire hydrant requirements as shown in *Table 4.4A*, or the following requirements are complied with:

(a) the AFA of the largest compartment shall not exceed 1000m^2 for PG III, IV, V & VII and not exceed 500m^2 for PG VI & VIII buildings. No AFA limit for covered car park in PG II, III, IV, V & VII buildings;

(b) the nominal bore of the fire hydrant pipe and the bulk water meter shall not be less than 150mm in diameter; and

(c) the running pressure/flow at the hydraulically most unfavourable fire hydrant of the private fire hydrant system shall comply with the following:

(i) running pressure >= 0.9 x (running pressure of the nearest public fire hydrant – pressure drop across the bulk water metre); and

(ii) flow rate >= 0.9 x water flow of the nearest public fire hydrant or >= total flow demand (as required in *Table 4.4A*) of the private fire hydrant system, provided the running pressure at the most remote private fire hydrant is greater than 2 bars.

Note:
In calculating the frictional loss for the private fire hydrant system, the design flow rates shown in *Table 4.4A* shall be used. The pressure drop across bulk water metre shall not be more than 1 bar.

(2) If the requirements stipulated in *Cl.4.4.2a.(1)* cannot be met, a storage tank of sufficient capacity meeting the flow rate and duration as specified in *Table 4.4A* with the requisite pumping facilities shall be provided.

Explanation and Illustrations

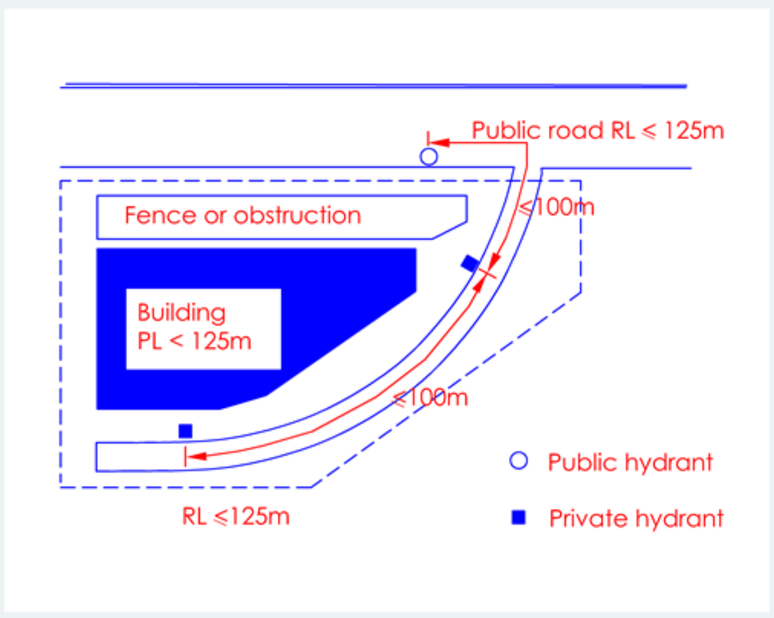


Figure 4.4.2a.

There is a need to differentiate at RL 125m as public mains located at above RL 125m would not be able to provide the required water pressure. It is important that hydrants annotated in building plan should be given their respective reduced levels.

a. Private hydrants that are sited at RL<125m are allowed to take the water supply from public water mains, which likewise should not be located above RL 125m.

b. There is a need to observe the RL<125m as the public water mains located at above RL 125m would not be able to provide the required pressure and flow rate for firefighting purposes.

It is therefore important that private hydrants and the supply public water mains annotated in building plans should be given their respective reduced levels.

Allowable losses in hydrant pipe

(Using Hazen-William's formula)

$P = [6.05 \times Q^{1.85} \times 10^7] / [C^{1.85} \times d^{4.87}]$

Example :

Q = 27 L/s = 1620 L/min

d = 150mm = 0.15m

C = 140

P = 0.14173 kPa/m

Pressure after bulk meter (P1) = 300 kPa

Length of hydrant pipe = 180m

Number of bends = 4 nos.

Equivalent length of bends = 30m

Total equivalent length = 210m

Pressure loss in pipe = 29.76296 kPa

Pressure available at remote hydrant (P2) = 270.237 kPa

% loss in pressure = 0.90079 (Not < 90%)

b. Private fire hydrant above reduced level 125m

(1) Where more than one private fire hydrant is located above reduced level 125m within the same plot, storage and pumping arrangements of water supply to these specified fire hydrants shall comply with the requirements stipulated in *Cl.4.4.2c.*.

Explanation and Illustrations

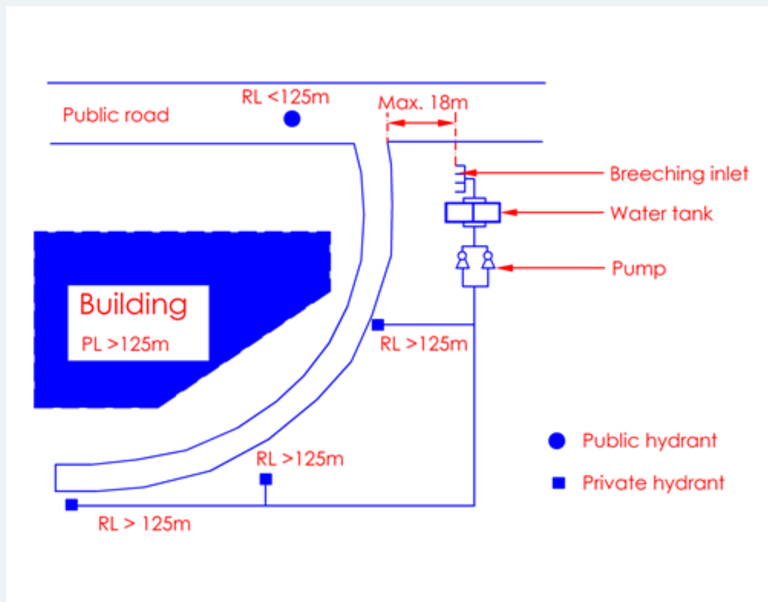


Figure 4.4.2b.(1)

The hydrants are required to be charged with water all the times so that firefighters could use them for feeding the breeching inlets and for firefighting purposes.

(2) The private fire hydrant can be in the form of a dry fire hydrant, if it is not the sole fire hydrant within 50m from any breeching inlet(s) feeding firefighting systems for the building(s) within the plot of land, which include:

(a) automatic fire sprinkler systems, or

(b) dry riser systems, or

(c) wet riser systems.

(3) A dry fire hydrant shall comply with all of the following requirements:

(a) A dry private fire hydrant shall be connected to a 150mm diameter dry pipe, which shall be connected at the other end to a four-way breeching inlet.

(b) This breeching inlet shall be within 18m from any fire engine accessway/fire engine access road having minimum 4m width and within 50m from any wet fire hydrant, private or public.

(c) The private dry pillar shall be painted in "yellow" and labelled "dry" on the fire hydrant pillar.

(d) A signage indicating the location of breeching inlet shall be positioned next to the dry private fire hydrant.

Explanation and Illustrations

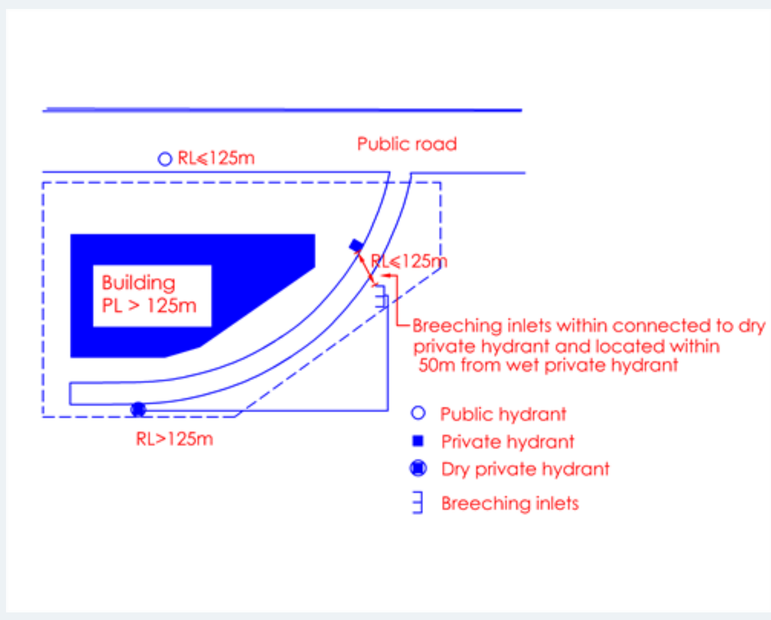


Figure 4.4.2b.(2)

"Dry" hydrant is equivalent to the provision of dry rising main. Care should be taken to prevent accidental damage by vehicle etc. to the horizontal run of the pipe aboveground.

The dry pipe should be differently identified on site. The provision of dry hydrant is a relaxation as all hydrants are required to be fed with water at all times. This is allowed as the firefighters could use other hydrants located below RL 125 which are within 50m from the breeching inlets.

c. Water supply and storage requirement

(1) Where more than one private fire hydrant is located above reduced level 125m within the same plot, storage and pumping arrangements of water supply to these specified fire hydrants shall comply with those for wet rising mains stipulated in *SS 575* and *Table 4.4A* Water Supply & Storage Requirements for Private Fire Hydrant.

(2) For development with fire hydrant storage and pumping arrangements, breeching inlet to fire hydrant tank is required. This breeching inlet shall be within 18m from any fire engine accessway/ fire engine access road and within 50m from any wet fire hydrant, private or public.

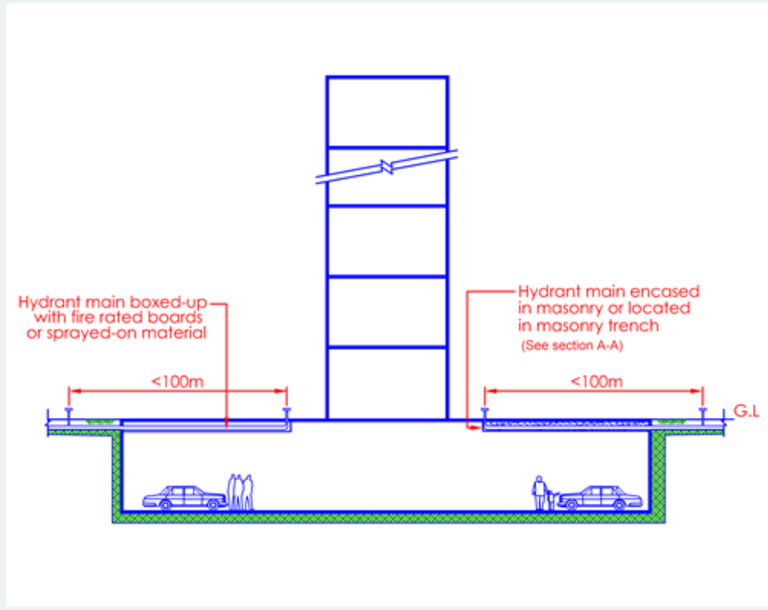
(3) The requirements and provisions for breeching inlet for the pumped fire hydrant system shall be in accordance with the *SS 575*.

4.4.3 Protection of fire hydrant mains in buildings

Rationale

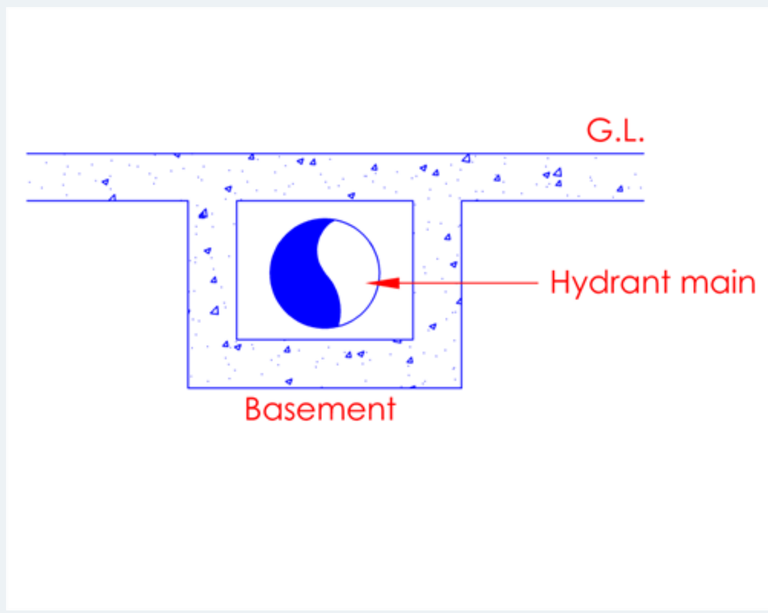
Hydrant mains running passing through a building shall be appropriately protected to prevent any damage to the hydrant pipework by fire or any activities/works carried out in the building. The hydrant mains, if damaged, would affect the water supply to the hydrant(s) which in turn would affect the firefighting operation.

Explanation and Illustrations



Section

Figure 4.4.3 - 1



Section A - A

Figure 4.4.3 - 2

Hydrant mains supplying water to hydrant shall be appropriately protected to prevent any damage arising from fire or mechanical impact from moving objects or the carrying out of addition/alteration works within the building. Water mains, which is damaged, would affect the water supply to the hydrant. This would in turn affect the firefighting operation in an emergency. Hydrant mains protected with dry protection e.g. boxed-up with fire-rated boards or sprayed on materials shall only be allowed to be routed or located in basement or floor protected by sprinkler system.

All fire hydrant mains which pass through a building shall have its full length within the building protected with fire resistance construction complying with *Cl.3.8.7b.* of at least the same fire resistance as the element of structure, provided all of the following requirements are complied with:

a. The fire hydrant mains shall be located in common circulation areas, such as car parking spaces (except spaces used for mechanical car parking) and driveways, i.e. they shall not pass through private or confined spaces.

b. No services other than sprinkler pipe(s) shall be located above or crossing over the fire hydrant mains. Where services need to cross-over the hydrant mains, the following conditions shall be complied with:

(1) the services shall only cross over the fire hydrants mains perpendicularly;

(2) the tensile stress of the supports for the services shall not exceed 10N/mm^2; and

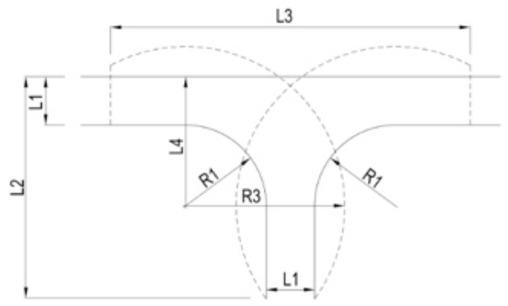
(3) the services shall be adequately protected by the building's sprinkler system.

c. The fire hydrant mains shall be located away from explosion risk areas.

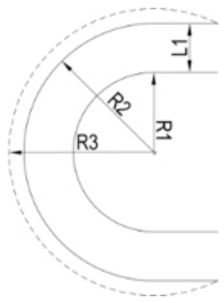
d. The protective enclosure to the fire hydrant mains shall be labelled with the words "FIRE HYDRANT MAIN" of minimum 50mm height at suitable intervals.

RELATED TABLES AND DIAGRAMS OF CHAPTER 4

Diagram 4.2.2e.: Turning Facilities for Firefighting Appliances



Cul-de-sac turning facility



U-turn radii

Dimensions of Turning Facilities for Firefighting Appliances			
Parameters	Building Habitable Height		
	≤ 10m*	> 10 & ≤ 50m#	> 50m#
R1	4.0m	6.5m	7.5m
R2	8.0m	10.5m	12.0m
R3	8.5m	12.0m	14.8m
L1	4.0m	4.0m	4.5m
L2	11.0m	16.0m	21.0m
L3	15.0m	28.1m	33.5m
L4	8.0m	10.5m	12.0m
Note: * - These dimensions are applicable to all PG except PG VI and VIII buildings, unless otherwise stated in Cl.4.2.2a.(1). For PG VI and VIII buildings ≤ 10m, it shall refer to (> 10 & ≤ 50) requirements, as indicated in Table 4.2C # - Not applicable to PG I buildings. For PG I buildings, it shall refer to (≤ 10m) requirements			

Diagram 4.2.2e.: Turning facilities for firefighting appliances

Diagram 4.2.2f.: Building Structure over Fire Engine Accessway/ Fire Engine Access Road

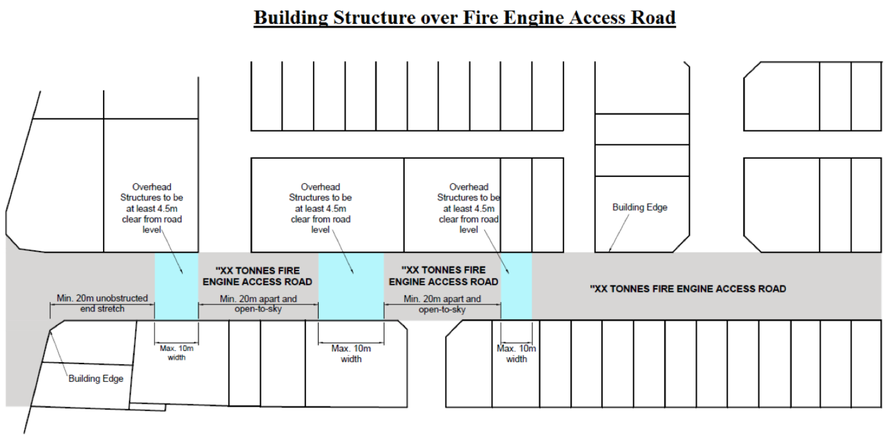


Diagram 4.2.2i.(2): Marking of fire engine accessway/ fire engine access road

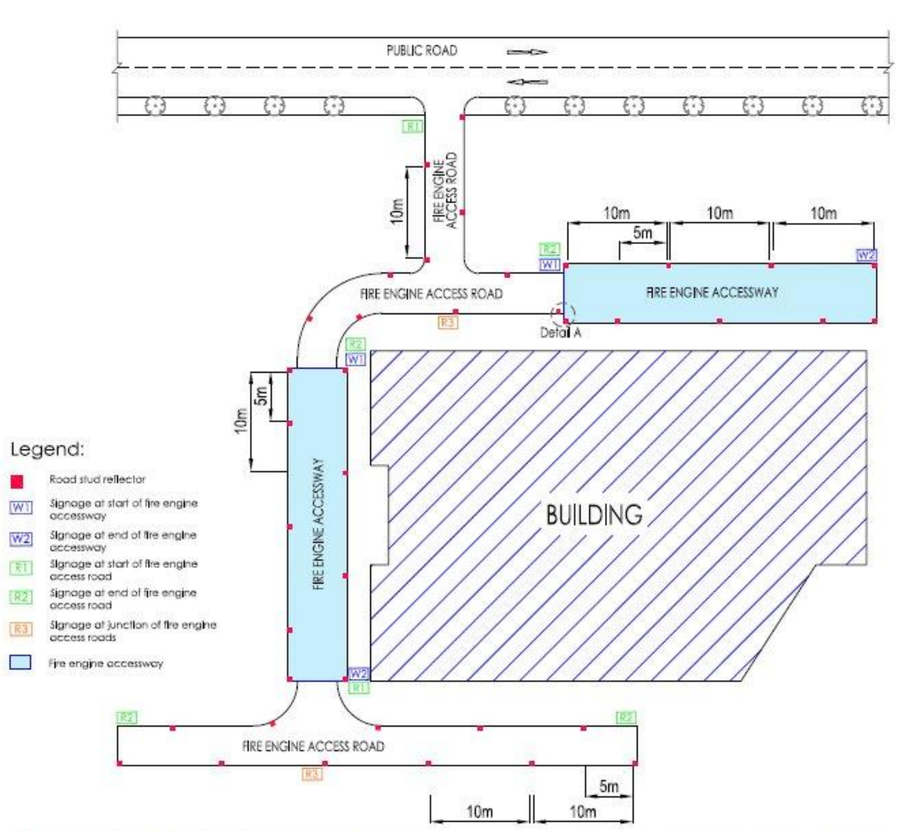
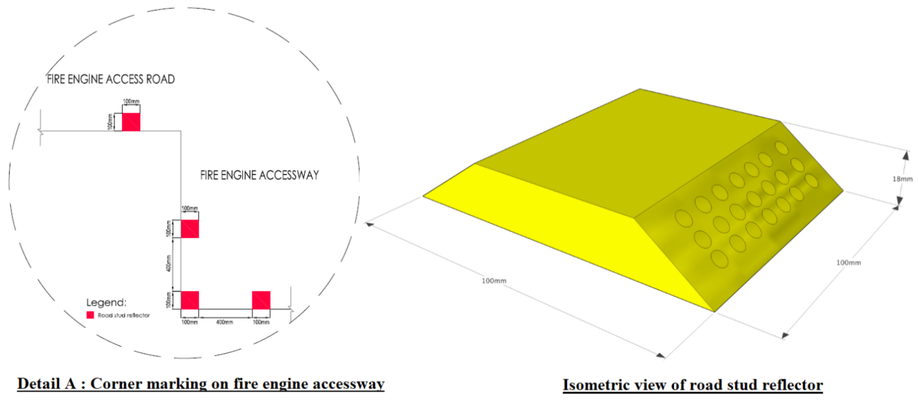


Diagram 4.2.2i.(2) : Marking of fire engine accessway/fire engine access road



Detail A : Corner marking on fire engine accessway **Isometric view of road stud reflector**

Diagram 4.2.2i.(2): Marking of fire engine accessway/ fire engine access road

Diagram 4.2.2i.(3): Pictogram signage for fire engine accessway/ fire engine access road

Diagram 4.2.2i.(3): Pictogram signage for fire engine accessway/ fire engine access road

Diagram 4.2.2j.(1) - 1 & 2

Diagram 4.2.2j.(1) - 1: CPL 34 firefighting appliance – Wheels & jacks layout

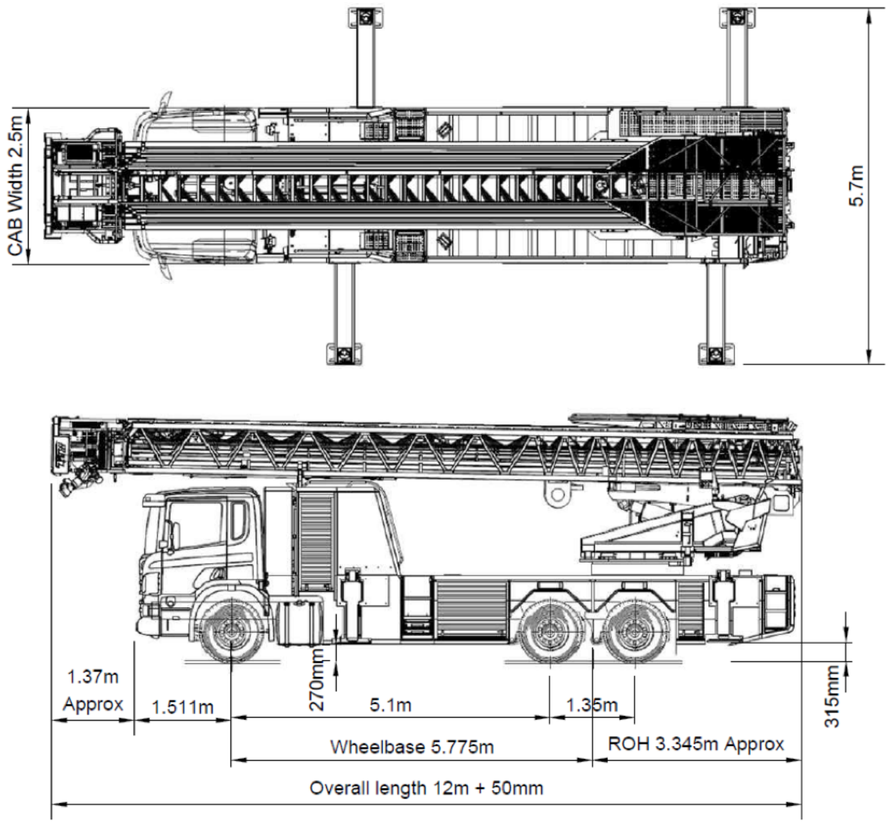


Diagram 4.2.2j.(1) – 2: AL 56 & CPL 60 firefighting appliances – Wheels & jacks layout

Diagram 4.2.2j.(3) - 3: HLA 90 firefighting appliance - Wheels & jacks layout

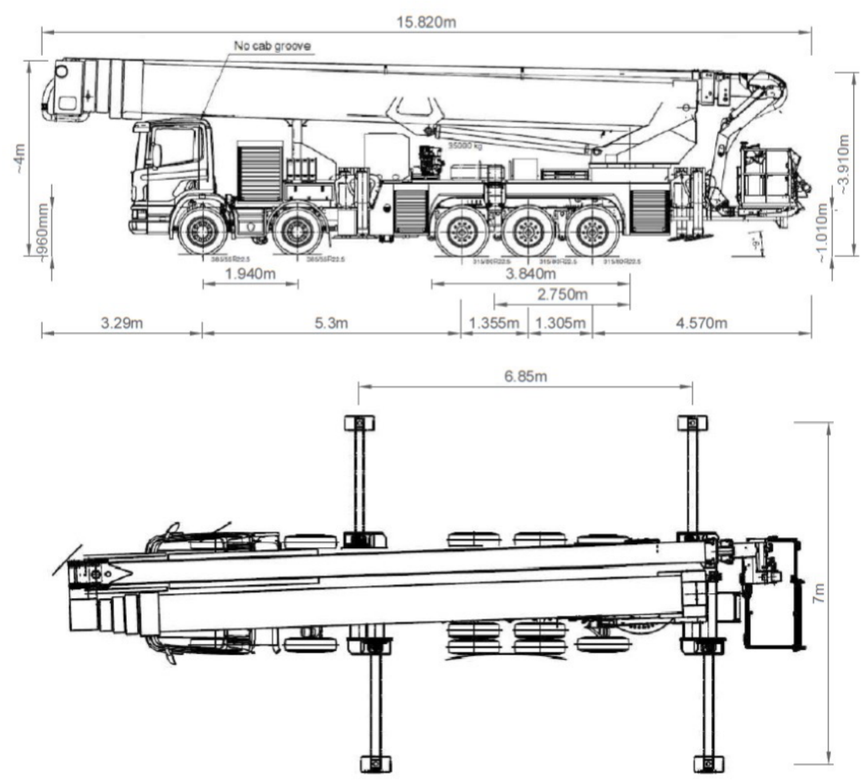


Diagram 4.2.2j.(3) – 3: HLA 90 firefighting appliance – Wheels & jacks layout

Diagram 4.2.2l. Bi-directional fire engine accessway/fire engine access road

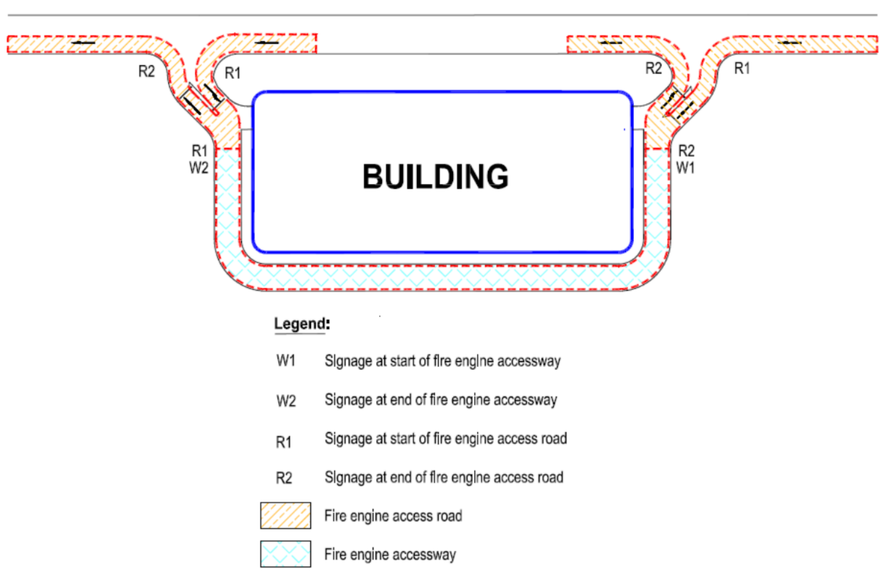
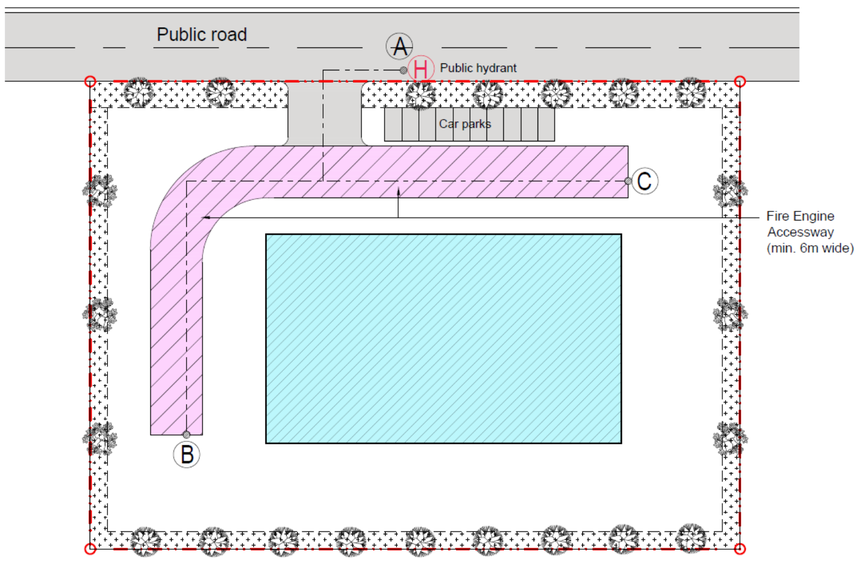


Diagram 4.2.2l. Bi-directional fire engine accessway/fire engine access road

Diagram 4.4.1a.: Provision of private fire hydrant

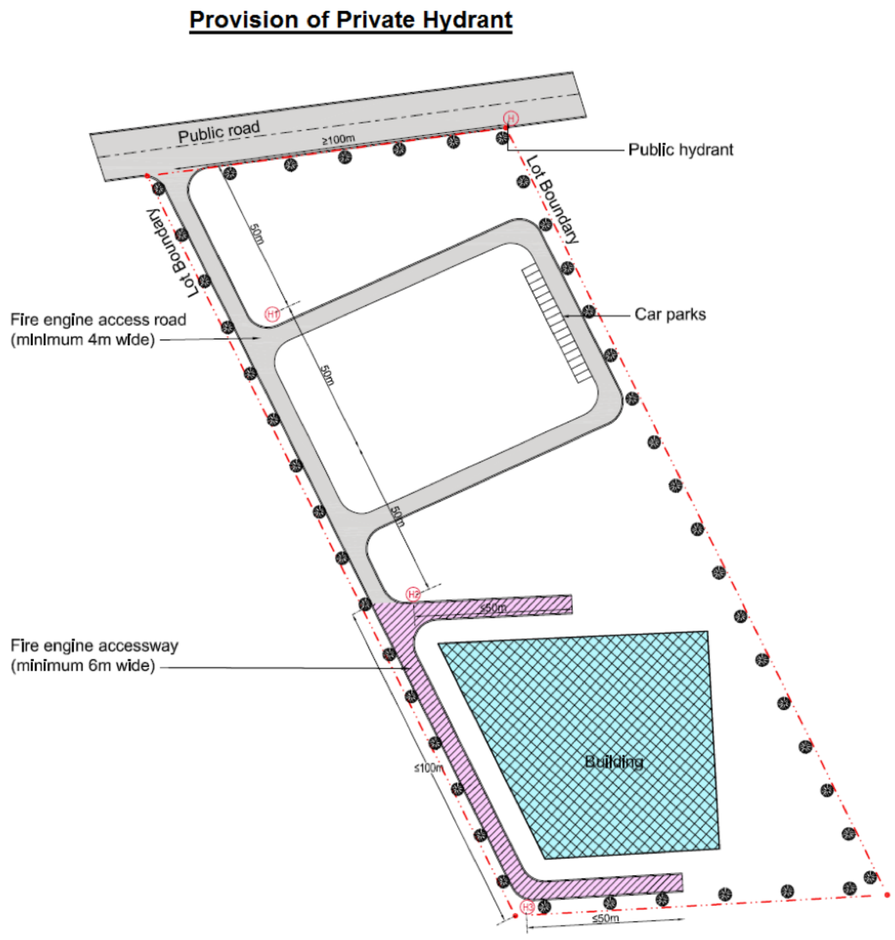


Point A to B or C ≤ 50m

Every part of a fire engine accessway/fire engine access road in a private lot shall be within an unobstructed distance of 50m from a hydrant. Where a private hydrant conforming to such requirement is not available, private hydrant(s) shall be provided.

Diagram 4.4.1a.: Provision of private fire hydrant

Provision of Private Hydrant



Note:

H1 H2 H3 Private hydrant

In a situation where more than one private hydrant is required, the hydrants shall be located along the fire engine accessway/ fire engine access road such that every part of the fire engine accessway/ fire engine access road is within an unobstructed distance of 50m from any hydrant.

Diagram 4.4.1c.: Siting of private fire hydrant

TABLE 4.2A: FIRE ENGINE ACCESSWAY/FIRE ENGINE ACCESS ROAD FOR PG II BUILDINGS

TABLE 4.2A: FIRE ENGINE ACCESSWAY/FIRE ENGINE ACCESS ROAD FOR PG II BUILDINGS			
Details	**Habitable Height (m)**		
	≤ 10	**> 10 & ≤ 50**	**> 50**
Width of fire engine access road	> 4m		
Width of fire engine accessway*	Not required	> 6m	> 7m
Length of fire engine accessway*	-	> 15m	> 15m
Type of firefighting appliance	Pump ladder	CPL 34 & AL 56	AL 56, CPL 60 & HLA 90
Loading capacity of fire engine road#	> 24 tonnes	> 30 tonnes	> 50 tonnes
Loading capacity of fire engine accessway#	-	> 30 tonnes	> 50 tonnes
Axle/ Jack loading	-	See Table 4.2D & Table 4.2E	
Turning facility	See Diagram 4.2.2e.		
U-turn radii			
Note: # - The appended figures for loading capacity of fire engine accessway/ fire engine access road are characteristic values * - A fire engine accessway of at least ¼ length of perimeter (minimum 15m), whichever is greater, shall be provided to access at least one facade of each block			

TABLE 4.2B: FIRE ENGINE ACCESSWAY/FIRE ENGINE ACCESS ROAD FOR PG III, IV, V & VII BUILDINGS

TABLE 4.2B: FIRE ENGINE ACCESSWAY/FIRE ENGINE ACCESS ROAD FOR PG III, IV, V & VII BUILDINGS			
Details	**Habitable Height (m)**		
	≤ 10	**> 10 & ≤ 50**	**> 50**

Width of fire engine access road	> 4m		
Width of fire engine accessway	Not required	> 6m	> 7m
Length of fire engine accessway	-	See Table 4.2.2a.(6)	
Type of firefighting appliance	Pump ladder	CPL 34 & AL 56	AL 56, CPL 60 & HLA 90
Loading capacity of fire engine access road#	> 24 tonnes	> 30 tonnes	> 50 tonnes
Loading capacity of fire engine accessway#	-	> 30 tonnes	> 50 tonnes
Axle/ Jack loading	-	See Table 4.2D & Table 4.2E	
Turning facility	See Diagram 4.2.2e.		
U-turn radii			
Note: # = The appended figures for loading capacity of fire engine accessway/ fire engine access road are characteristic values			

TABLE 4.2C: FIRE ENGINE ACCESSWAY/FIRE ENGINE ACCESS ROAD FOR PG VI & VIII BUILDINGS

TABLE 4.2C: FIRE ENGINE ACCESSWAY/FIRE ENGINE ACCESS ROAD FOR PG VI & VIII BUILDINGS			
Details	**Habitable Height (m)**		
	≤ 10	**> 10 & ≤ 50**	**> 50**
Width of fire engine access road	> 4m		
Width of fire engine accessway	> 6m	> 6m	> 7m
Length of fire engine accessway	See Table 4.2.2a.(7)		
Type of firefighting appliance	CPL 34 & AL 56	CPL 34 & AL 56	AL 56, CPL 60 & HLA 90
Loading capacity of fire engine access road#	> 30 tonnes	> 30 tonnes	> 50 tonnes
Loading capacity of fire engine accessway#	> 30 tonnes	> 30 tonnes	> 50 tonnes
Axle/ Jack loading	See Table 4.2D & Table 4.2E		
Turning facility	See Diagram 4.2.2e. under (>10 & ≤50)	See Diagram 4.2.2e.	
U-turn radii			
Note: # = The appended figures for loading capacity of fire engine accessway/ fire engine access road are characteristic values			

TABLE 4.2D: AXLE LOADING OF FIREFIGHTING APPLIANCES

TABLE 4.2D: AXLE LOADING OF FIREFIGHTING APPLIANCES										
Axle No. (from font)	**Type of firefighting appliances**									
	Pump Ladder		**CPL 34**		**AL 56**		**CPL 60**		**HLA 90**	
	Loading Wt. (kg)	**No of wheels**	**Loading Wt. (kg)**	**No of wheels**	**Loading Wt. (kg)**	**No of wheels**	**Loading Wt. (kg)**	**No of wheels**	**Loading Wt. (kg)**	**No of wheels**
Axle 1	10000	2	7500	2	9000	2	9000	2	9000	2
Axle 2	14000	2	10500	2	10500	4	9900	4	9000	2
Axle 3	-	-	10500	4	10500	4	9900	4	10500	4
Axle 4	-	-	-	-	-	-	8200	2	10500	4
Axle 5	-	-	-	-	-	-	-	-	10000	2
Axle 6	-	-	-	-	-	-	-	-	-	-
Note: The appended figures for axle loading are characteristic values										

TABLE 4.2E: JACK LOADING OF FIREFIGHTING APPLIANCES

TABLE 4.2E: JACK LOADING OF FIREFIGHTING APPLIANCES				
Type of Fire Appliance	**CPL 34**	**AL 56**	**CPL 60**	**HLA 90**
Jack load contact area	5625 cm²	5625 cm²	7125 cm²	7125 cm²
Maximum pressure per Jack (4 jacks per vehicle)	37 N/cm²	37 N/cm²	37 N/cm²	50 N/cm²
Note: The appended figures for jack loading are characteristic values				

TABLE 4.4A: WATER SUPPLY & STORAGE REQUIREMENTS FOR PRIVATE FIRE HYDRANT

TABLE 4.4A: WATER SUPPLY & STORAGE REQUIREMENTS FOR PRIVATE FIRE HYDRANT				
Purpose Group	**Accessible Floor Area***	**Minimum Flow Rate**	**Minimum Running Pressure**	**Minimum Water supply and Storage Duration**
	(m²)	**(L/s)**	**(bar)**	**(mins)**
PG I & II	-	27	2	45
Covered car park not within PG VI & VIII buildings +	NL	38	2	45

PG III, IV, V & VII	≤ 1000	38	2	45
	> 1000 & ≤ 5000	57		
	> 5000 & ≤ 10000	76		
	> 10000	95		
PG VI & VIII	≤ 500	38	2	90
	> 500 & ≤ 5000	57		
	> 5000 & ≤ 10000	76		
	> 10000 & ≤ 15000	95		
	> 15000 & ≤ 20000	114		
	> 20000	133		

Note:

NL – No limit

* – Based on the Accessible Floor Area (AFA) of the largest compartment in the building

+ – This requirement is only applicable to car parking facilities within PG II, III, IV, V & VII buildings, either as a standalone multi-storey car park or within a building (above ground or below ground). The hydrant requirements for the remaining parts of the buildings shall comply with Cl.4.4.4.2a., Cl.4.4.4.2b. and Cl.4.4.4.2c.

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
4.2.2	15 Sep 2020	15 Sep 2020	Clarification	Fire engine accessway and fire engine access road a. (1) A fire engine accessway is not required for the following buildings, however, a fire engine access road for access by firefighting appliances shall be provided to within a travel distance of 60m of every point on the projected plan area of the following buildings: (a) (b) (c)	15 Sep 2020
4.2.2a(3)(b)	10 May 2019	Immediate	Clarification		10 May 2019
4.2.2a.(3)(a) and (b)	1 Sep 2021	1 Mar 2022	Revised/ Clarification	Fire engine accessway and fire engine access road (3) For a building under PG II that exceeds the habitable height of 10m, all of the following shall be complied with: (a) travel distance of 18m to the entrance of all exit staircases where the landing valves (dry or wet riser) are provided. (b) of each block and shall be located at a distance of at least 2m and at most 10m away from the façade of the building. (c) stipulated in Table 4.2A, Table 4.2D and Table 4.2E.	1 Sep 2021
4.2.2a.(3)(b)	1 Mar 2023	1 Mar 2023	Relaxation	A fire engine accessway of at least ¼ length of perimeter (minimum 15m), whichever is greater, shall be provided to access at least one entire façade of each block and shall be located at a distance of at least 2m and at most 10m away from the façade of the building. This is to facilitate rescue with direct access to unit windows (excluding exit staircase, smoke-free approach to exit staircase).	1 Sep 2022
4.2.2a.(3)(b) (dated 1 Sep 2024)	1 Sep 2024	1 Sep 2024	Relaxation	4.2.2a.(3) PG II buildings exceeding 10m habitable height (b) A fire engine accessway of at least ¼ length of perimeter (minimum 15m), whichever is greater, shall be provided to access at least one façade of each block and shall be located at a distance of at least 2m and at most 10m away from the façade of the building. This is to facilitate rescue with direct access to unit windows (excluding exit staircase, smoke-free approach to exit staircase). For the purpose of computing the extent of perimeter for fire engine accessway, only the external facade perimeters of residential units are required to be included. Common areas such as corridors/ lobbies, lift/ service shafts, exit staircase, landscape areas, etc. can be omitted from the computation.	1 Mar 2024
4.2.2a.(3)(b) and (c)		01 Mar 2019	New		---
4.2.2a.(5)	1 Sep 2021	1 Mar 2022	Revised/ Clarification	Basement In the case of a basement, the fire engine accessway/fire engine access road shall be provided to within a travel distance of 18m to the entrance of all exit staircases that are provided with landing valves (dry or wet riser) in accordance with Cl.6.2.2b.. The measurement of 18m shall be between the fire engine accessway/fire engine access road and the entrance of exit staircase.	1 Sep 2021
4.2.2a.(6)		01 Mar 2019	Revised, formerly Cl.4.2.2(b)(i)		---
4.2.2a.(6) (dated 2 Dec 2019)	2 Dec 2019	2 Dec 2019	Clarification	PG III, IV, V & VII buildings exceeding 10m habitable height For buildings under PG III, IV, V and VII exceeding the habitable height of 10m, a fire engine accessway shall be located directly below the fire access openings to provide direct reach to the designated fire access panels. The required length of fire engine accessway shall be computed based on the largest Accessible Floor Area (AFA) of any aboveground floors as follows: (a) for interconnected floors, including basements connected to aboveground floors, the AFA shall be the aggregate areas of all the interconnected floors, or (b) for buildings with more than one group of interconnected floors, the AFA shall be taken as the largest of the aggregate floor areas among the groups of interconnected floors.	2 Dec 2019
4.2.2a.(8)		01 Mar 2019	New		---
4.2.2b		01 Mar 2019	Revised, formerly Cl.4.2.2(d)(ii)		---
4.2.2c	1 Sep 2024	1 Sep 2024	Relaxation	4.2.2c. Location The fire engine accessway shall be positioned so that the nearer edge shall be at least 2m or at most 10m from the centre position of the fire access opening, measured horizontally.	1 Mar 2024
4.2.2e.(2)		01 Mar 2019	Revised, formerly Cl.4.2.2(d)(vi)		---
4.2.2f.(2) to (5)		01 Mar 2019	New		---
4.2.2h.	1 Mar 2021	1 Sep 2021	Revised/Clarification	h. Obstruction Fire engine accessways/fire engine access roads shall be kept clear of obstructions at all times. Plants, trees or other fixtures shall not obstruct the path between the fire engine accessway and fire access openings.	1 Mar 2021
4.2.2i(3)	10 May 2019	10 May 2019	Change in requirements	A sign post with white background and red wording of not less than 50mm in height shall be provided at the start and end of a fire engine accessway/fire engine access road. The height measured from the ground to the lowest point of the sign shall be between 1m and 1.5m. The sign post shall be visible at night and shall not be positioned more than 3m from the fire engine accessway/fire engine access road. Every part of the fire engine accessway/fire engine access road shall not be more than 15m from the nearest sign post. See Diagram 4.2.2i.(3).	10 May 2019

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
4.2.2i.	15 Mar 2021	15 Mar 2021	Revised	Marking of fire engine accessway and fire engine access road (1) except where public roads are designated as fire engine access road. (2) accessways/fire engine access roads shall be marked with reflective white or yellow strips of size not less than 100mm (W) x 400mm (L). The markings shall be visible at night and shall be provided on both sides of the fire engine accessways/fire engine access roads at an interval of not more than 5m. (3) height shall be provided at the start and end of a fire engine accessway/fire engine access road. The height measured from the ground to the lowest point of the sign shall be between 2m and 2.2m. The sign post shall be visible at night and shall not be positioned more than 3m from the fire engine accessway/fire engine access road. Every part of the fire engine accessway/fire engine access road shall not be more than 15m from the nearest sign post. See Diagram 4.2.2i.(3).	15 Sep 2020
4.2.2j.		1 Mar 2019	Revised, formerly Cl.4.2.2(d)(i)		---
4.2.2l.	1 Mar 2021	1 Sep 2021	Revised/Clarification	Nil	1 Mar 2021
4.2.3a. (1 March 2023)	1 Mar 2023	1 Sep 2023	Revised	Fire access opening to building for firefighting a. Provision Fire access openings shall be provided on the external wall for external firefighting and rescue operations. This can include unobstructed external wall openings, windows, balcony doors, glazed wall panels and access panels. Windows, doors, wall panels or access panels shall be readily openable from the inside and outside. The inside and outside of fire access openings shall be unobstructed at all times during the occupancy of the building. There shall be no furniture or any other obstruction within 1m from the fire access openings at the landing inside the building.	1 Mar 2023
4.2.3b.	1 Sep 2021	1 Sep 2021	Clarification	b. Location The fire access opening shall be placed against an occupied space. It shall not be placed at plant/store room, exit staircase, smoke-stop/fire lift lobby or space that leads only to a dead end.	1 Sep 2021
4.2.3b.(dated 25 Aug 2023)	25 Aug 2023	25 Aug 2023	Revised/ Clarification	4.2.3b. Location The fire access opening shall be placed against an occupied space. It shall not be placed at plant/ store room, exit staircase, smoke -free approach to exit staircase or space that leads only to a dead end.	25 Aug 2023
4.2.3e.(3)		01 Mar 2019	Revised, formerly Cl.4.2.3(f)		---
4.2.3e.(4)		01 Mar 2019	Revised, formerly Cl.4.2.3(f)(iv)		---
4.2.3e.(4) (dated 25 Aug 2023)	1 Mar 2024	1 Mar 2024	Revised/Clarifications	4.2.3e.(4) Additional openings for ventilation For buildings under PG III to VIII where an area or space has a ceiling height greater than 10m, additional high level ventilation openings for smoke venting and firefighting purposes shall be provided and located in the external walls opening into the area or space. The ventilation opening shall meet the following criteria: (a)	25 Aug 2023
4.4.1e	15 Sep 2020	15 Sep 2020	Clarification	Ringed fire hydrant pipes For a building that is required to have an island site fire engine accessway under Cl.4.4.2b., the fire hydrant pipe shall be a ring system. Isolation valves shall be provided on the fire hydrant ring such that individual fire hydrant can be isolated when required for maintenance without affecting the water supply (both designed pressure and flow) to the other fire hydrants on the ring.	15 Sep 2020
4.4.1f.		01 Mar 2019	New		---
4.4.2	1 Dec 2020	1 Dec 2020	Clarification /Relaxation	Water supply for private fire hydrant a. Private fire hydrant at or below reduced level 125m Private fire hydrants installed at reduced level 125m and below can receive direct supply from public water mains. If the flow and pressure from the public water mains cannot meet the fire hydrant requirements as shown in Table 4.4A, a storage tank of sufficient capacity with the requisite pumping facilities shall be provided. For premises with private fire hydrants receiving direct supply from public water mains and not able to comply with the flow requirements stipulated in Table 4.4A, the following requirements shall be complied with: (1) the compartment size shall not exceed 1000m2; (2) the nominal bore of the fire hydrant pipe and the bulk water meter shall not be less than 150mm in diameter; and (3) the running pressure/flow at the hydraulically most unfavourable fire hydrant of the private fire hydrant system shall comply with the following: (a) running pressure >= 0.9 x (running pressure of the nearest public fire hydrant – pressure drop across the bulk water metre); and (b) flow rate >= 0.9 x water flow of the nearest public fire hydrant or >= total flow demand (as required in Table 4.4A) of the private fire hydrant system, provided the running pressure at the most remote private fire hydrant is greater than 2 bars. Note: In calculating the frictional loss for the private fire hydrant system, the design flow rates shown in Table 4.4A shall be used. The pressure drop across bulk water metre shall not be more than 1 bar. b.	1 Dec 2020
4.4.2a.(1)(a)	1 Sep 2021	1 Sep 2021	Clarification/Relaxation	Water supply for private fire hydrant a. Private fire hydrant at or below reduced level 125m (1) Private fire hydrants installed at reduced level 125m and below can receive direct supply from public water mains provided the flow and pressure from the public water mains meet the fire hydrant requirements as shown in Table 4.4A, or the following requirements are complied with: (a) the AFA of the largest compartment shall not exceed 1000m2 for PG III, IV, V & VII and not exceed 500m2 for PG VI & VIII; (b)	1 Sep 2021

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
4.4.3	15 Mar 2021	15 Mar 2021	Revised	Protection of fire hydrant mains in buildings All fire hydrant mains which pass through a building shall have its full length within the building protected with fire resistance construction complying with Cl.3.8.7b. of at least the same fire resistance as the element of structure, provided all of the following requirements are complied with: a. The fire hydrant mains shall be located in common circulation areas, such as car parking spaces and driveways, i.e. they shall not pass through private or confined spaces. b. No services (except sprinkler pipes) shall be located above or crossing over the fire hydrant mains. c. The fire hydrant mains shall be located away from explosion risk areas. d. The protective enclosure to the fire hydrant mains shall be labelled with the words “FIRE HYDRANT MAIN” of minimum 50mm height at suitable intervals.	15 Sep 2020
Diagram 4.2.2e	1 Sep 2021	1 Mar 2022	Revised/ Clarification	Existing Diagram 4.2.2e.	1 Sep 2021
Diagram 4.2.2i.(3)	1 Sep 2024	1 Sep 2024	Clarification	Existing Diagram 4.2.2i.(3)	1 Mar 2024
Table 4.2A	1 Sep 2021	1 Mar 2022	Revised/ Clarification	Existing Table 4.2A	1 Sep 2021
Table 4.2A (dated 1 Sep 2024)	1 Sep 2024	1 Sep 2024	Relaxation	Existing Table 4.2A	1 Mar 2024
Table 4.2C	1 Sep 2021	1 Mar 2022	Revised/ Clarification	Existing Table 4.2C	1 Sep 2021
Table 4.4A	1 Dec 2020	1 Dec 2020	Clarification /Relaxation	Existing Table 4.4A	1 Dec 2020

CLAUSE 5.1 GENERAL

The installation, control and distribution of wiring of electrical equipment in buildings shall be in accordance with *SS 638* and *SS 551*.

Explanation and Illustrations

(No illustration)

Buildings under PG I are not required to provide primary and secondary source of power supplies, except in the case of electrical passenger lift installed within the dwelling building.

CLAUSE 5.2 PRIMARY AND SECONDARY POWER SUPPLIES

5.2.1 Installations requiring primary and secondary power supplies

Where any of the following installations is required by this Code or other Codes/ Regulations, its primary and secondary source of power supply shall comply with the corresponding Code of Practice stated therein.

a. Electrical lifts

Where an electrical passenger or goods lift is required, its electrical installations, including batteries and other forms of secondary power supply, shall comply with SS 550. Where the provision of fire lift is required by this Code, installation of the primary and secondary supplies shall also comply with the above- mentioned Code of Practice.

Explanation and Illustrations

(No illustration)

Electrical installations, inclusive of battery and other forms of secondary power supply shall comply with SS 550. However, for building under PG I,emergency supply is not required. The power supply to the lift shall be from a sub-main circuit so that whenever there is power failure to the house, the electrical supply to the lift is still available.

For lifts which are not powered by emergency generator, an Automatic Rescue Device (ARD) should be incorporated in the lift system to bring the lifts to the nearest lift landing and open its door upon power failure from the sub-main circuit. Installation of hydraulic lifts is acceptable, provided there is safety feature to bring the lift to the lowest floor, except basement upon power failure.

SS 550 does not specifically require the installation of generator set to provide secondary power supply to the above lifts. If emergency generator is not available, power supply to passenger lift and fire lift shall be provided via a sub-main circuit to enhance reliability.

For buildings exceeding the 60m habitable height and mixed developments under *Cl.6.6.3b.* and the provision of private lifts under *Cl.3.8.8h.*, emergency power supply from a generating plant shall be provided to home the lift to the designated floor when there is a power failure in the building.

Where electrical fire alarm system is required, its primary power supply as well as type and capacity of battery shall comply with SS CP 10.

Atrium smoke control system is required if any building under PG VI and VIII is designed to incorporate an atrium under *Cl.7.5.* Large basement occupancy other than car park usage shall be provided with engineered smoke control system, if the accessible floor area exceeds 2000m² under Cl.7.4. All smoke control systems shall be connected to secondary power supply.

Lifts that are commonly found in buildings under PG VI and VIII are electrical passenger lifts, fire lifts and goods lifts.

Although the current SS 550 does not specifically require the installation of generator set to provide secondary power supply to the above lifts, however in the case of multi-storey industrial buildings under *Cl.6.6.3b.*, generator set is required to be provided to operate the lifts during an emergency.

Where an emergency generator is provided, the lifts would be designed to home to the designated floor under generator power upon loss of normal power supply.

b. Electrical fire alarm system

Where electrical fire alarm system is required, its primary power supply as well as its type and capacity of battery shall comply with *SS 645*.

Explanation and Illustrations

(No illustration)

1. Fire alarm panel - For buildings which are provided with automatic fire alarm system, the fire alarm panel should be located near the main entrance of the building.

2. Alarm Sounding - The fire alarm sounder shall have a sound that is readily distinguishable from any other alarm system. However, permission may be obtained for having a common sounding for fire alarm and burglar alarm in residential houses only.

3. Connection to monitoring station - It is not a requirement to connect the automatic fire alarm system to monitoring station for residential houses.

Provision of electrical fire alarm system is not required in buildings under PG II, except those located over commercial development or car park. The electrical fire alarm system shall be provided with emergency battery supply to the requirement of SS CP 10.

c. Exit light and emergency lighting systems

Where exit or emergency lighting system is required, its electrical wiring, type and capacity of battery or other form of secondary power supply shall comply with *SS 563*.

Explanation and Illustrations

(No illustration)

The provision of exit or emergency lighting system would be required for non-residential areas, such as basement car park in cluster housing development.

Emergency lighting in exit staircases and escape routes outside the residential units would need to be provided with either self-contained battery or connected to secondary power supply.

d. Emergency voice communication system

Where an emergency voice communication system is required, its electrical wiring shall be fire-rated or otherwise fire-protected in accordance with *SS 546*. The appropriate type and capacity of secondary source of supply shall also be provided accordingly

Explanation and Illustrations

(No illustration)

The current Fire Code requires emergency voice communication system to be provided in buildings under *Cl.8.2.1a.* PG III to VIII.

The type and extent of the emergency voice communication shall be in accordance with Cl.8.2 of the Fire Code. Technical requirements such as fire-rated cables, routing and emergency power supply shall comply with SS CP 546.

e. Wet rising main system

Where a wet rising main system is required, the relevant electrical supply shall be installed in accordance with *SS 575*. A secondary source of power supply with capacity stipulated in *SS 575* shall be provided for the wet rising main pump

Explanation and Illustrations

(No illustration)

Where a building under PG II exceeds 60m in habitable height, wet rising main system shall be provided. The wet riser pumps including any transfer pumps shall require connection to secondary power supply. If emergency generator is available, the electrical pumps shall be connected to emergency generator supply. In the absence of emergency generator set, the duplicate wet riser pump or transfer pump shall be diesel engine driven and shall start automatically upon demand of water supply. This is to ensure that the wet riser main system would remain operational during failure of normal power supply.

f. Fire sprinkler system

Installation of electrical supply for sprinkler systems shall comply with *SS CP 52*. The capacity of the secondary source of supply, where required, shall satisfy operational requirements under the respective hazard category.

Explanation and Illustrations

Buildings under PG II are usually not provided with sprinkler system, except those with basement car parking facilities. See *Cl.6.4.1d.*.

Buildings under PG III to VIII exceeding 24m in habitable height, larger than the permitted compartmentation size and containing the respective hazard category (high risk) shall be provided with automatic fire sprinkler system complying with SS CP 52.

The sprinkler pump including any transfer pumps shall be connected to secondary power supply. If electrical generator set is available, the electrical pumps shall be connected to this source of supply. In the absence of electrical generator set, the duplicate sprinkler pump or transfer pump shall be diesel engine-driven and shall start automatically when there is demand on the sprinkler system to supply water. This is to ensure that the sprinkler system would remain operational during failure of normal power supply.

g. <u>Mechanical ventilation/ pressurisation systems</u>

The following systems shall be provided with secondary source of power supply:

Explanation and Illustrations

(No illustration)

Standby source of power supply may be in the form of emergency generator. This is to ensure that the mechanical ventilation system provided to these rooms or spaces would not be affected during power failure.

(1) mechanical ventilation system for the following rooms or spaces:

(a) exit staircases;

(b) exit passageways;

(c) smoke-free/ fire lift lobbies;

(d) area of refuge within the same building;

(e) basement car parks;

(f) fire command centres;

(g) emergency power generator rooms;

(h) engine driven fire pump rooms;

(i) rooms involving the use and/ or storage of flammable liquid/ gas and explosive substances;

(j) any other areas where such systems are installed for fire precautionary measures; and

(2) pressurisation systems for the following areas:

(a) smoke-free/ fire lift lobbies;

(b) internal exit staircases;

(c) hotel corridors;

(d) hostel corridors;

(e) healthcare corridors; and

(f) any other areas where such systems are installed.

(3) all smoke control/ purging systems, including associated equipment forming part of the systems.

h. <u>Air supply system for generator and fire pump</u>

A secondary source of power supply shall be provided for the mechanical ventilation system which is installed to provide air for the operation of the following equipment:

(1) emergency generator; and

(2) engine driven fire pump.

Explanation and Illustrations

(No illustration)

If the emergency generator or engine driven fire pump rooms are provided with mechanical ventilation, the mechanical ventilation system should continue to function under secondary source of power supply.

5.2.2 Cable installation

Power supply cables for equipment that are required to operate during a fire emergency shall be of fire resistant type. The fire resistant cables shall comply with *SS 299*.

5.2.3 Electric motors and control equipment

All motors and their control equipment, as well as the associated wiring and accessories, shall be suitable for their particular application and for the environment they are exposed to. In addition, they shall comply with all of the following requirements:

a. High Rupturing Capacity Fuses (HRC) or Moulded Case Circuit Breakers (MCCB) with magnetic release shall be installed and be capable of protecting the cable connections to the motor, and of carrying the stalled current of the motor for a period not less than 75% of the period for which such a current would cause the motor windings to fail;

b. any no-volt release mechanism shall be of the automatic resetting type, such that on restoration of supply the motor can start automatically;

c. thermal overload trips shall not be permitted; and

d. magnetic (short circuit) trips are permitted for use in motor circuits of mechanical ventilation systems serving essential services.

5.2.4 Emergency generator

Explanation and Illustrations

(No illustration)

Emergency generator shall start automatically upon power supply failure and shall be sufficiently sized to supply power to fire safety systems such as essential fans, fire pumps & lift system for a required period of time.

a. Where emergency generators are provided as a secondary source of supply, they shall comply with *SS 535*.

b. For outdoor emergency generator, all of the following requirements shall be complied with:

(1) Day tank incorporated within the body of the emergency generator shall be constructed of steel. The day tank shall be of double skin construction. The emergency generator enclosure shall be able to contain any leakage of diesel.

(2) Alternatively, an internal bund wall shall be built within the outdoor emergency generator's day tank large enough to contain 100% of the diesel content within the day tank.

(3) The maximum quantity of diesel permitted in the day tank is 1000 litres.

Amendment History - Chapter 5 - Electrical Power Supplies

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
5.2.1g.(1)		01 Mar 2019	Revised, formerly Cl.5.2.1(g)(i) to (x)		---
5.2.1g.(2) and (3)		01 Mar 2019	New		---
5.2.4b		01 Mar 2019	New		---

CLAUSE 6.1 PORTABLE EXTINGUISHERS

6.1.1 General

a. Portable fire extinguishers, where required, shall be constructed in accordance with *SS EN 3*.

b. All portable fire extinguishers, where required to be provided, shall be charged, tested, maintained and properly tagged in accordance with *SS 578*.

6.1.2 Provision

a. Fire extinguishers shall be provided in all buildings except the following:

(1) PG I buildings;

(2) residential floors of PG II buildings;

Explanation and Illustrations

(No illustration)

Cl.6.1.2a.(2) specifically precludes residential floors under PG II from the need to provide portable fire extinguishers. However, in a block of residential apartments, one would expect to find rooms or spaces designed for such use as electrical switch rooms, transformer rooms, generator rooms, lift motor rooms, general store rooms, etc.. For such spaces or rooms, fire extinguishers of suitable type and capacity should be provided to take care of any outbreak of incipient fire.

(3) roof of single storey buildings with roof height not more than 12m or roof of any buildings with inaccessible pitched roof up to 24m from grade level used solely for roof-mounted PV installations in accordance with *Cl.10.2.1b.(1)*; and

(4) roof of an external/ open-sided overhead bridge/ shed/ linkway/ walkway with clear width less than 6m, roof height not more than 12m and used solely for roof-mounted PV installations in accordance with *Cl.10.2.1b.(1)*; and

(5) green roofs which are accessible for maintenance purposes only and which comply with *Cl.10.2.1b.(1)(a)*.

b. Where the roof level is a non-habitable floor, fire extinguishers shall be provided to cover the M&E plants/ equipment.

6.1.3 Type, size and siting

Explanation and Illustrations

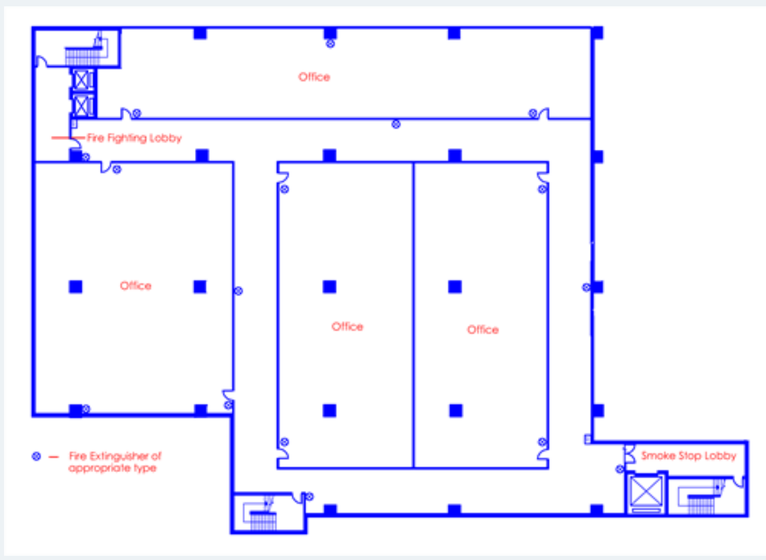


Figure 6.1.3

The type, size, quantity and siting of the portable fire extinguishers shall comply with the requirements in SS 578.

Portable fire extinguishers provided in building are meant to be used by occupants as a first line defence, in handling fires of limited size. Fire extinguishers shall be conspicuously located in positions where they will be readily accessible and immediately available in the event of fire. They shall be located along the normal paths of egress from a space to an exit. Fire extinguishers provided to deal with special risks shall be sited near the risk concerned, but not too near as to be inaccessible in case of fire.

The selection of the most appropriate fire extinguisher depends on the fire hazards anticipated pertaining to occupancies of a building, the effectiveness of the fire extinguisher used on that class of hazard, and the weight of the extinguisher can be handled by occupants. Fire extinguishers shall be located so that no person needs to travel more than 15m to reach an extinguisher.

The classification of portable fire extinguishers provided shall be selected in accordance with *SS 578* such that the nature of processes and contents within the building concerned can be effectively protected. The size, quantity and siting of these portable fire extinguishers shall comply with the requirements in *SS 578* under the respective class of occupancy hazard.

6.1.4 Installation and marking

Explanation and Illustrations

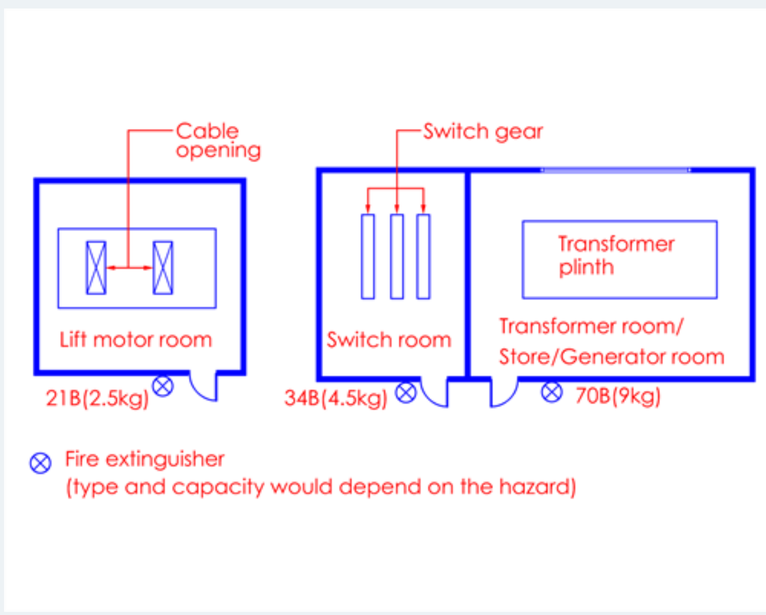


Figure 6.1.4 : Common areas which require fire extinguishers

Installation requirements

a. Portable extinguishers shall be installed in every building except dwelling units.

b. The operating instructions of portable extinguishers shall face outward when the extinguishers are located in cabinets, in wall recesses or on shelves.

Portable fire extinguishers provided shall be installed and conspicuously marked in accordance with requirements by *SS 578*.

CLAUSE 6.2 RISING MAIN AND HOSE REEL SYSTEMS

6.2.1 Type of rising mains

a. The type of rising main system provided shall be appropriate to the building as follows:

(1) dry rising mains shall be installed in PG II to VIII buildings of habitable height more than 10m, but not more than 60m;

(2) wet rising mains shall be installed in buildings with habitable height exceeding 60m; and

Explanation and Illustrations

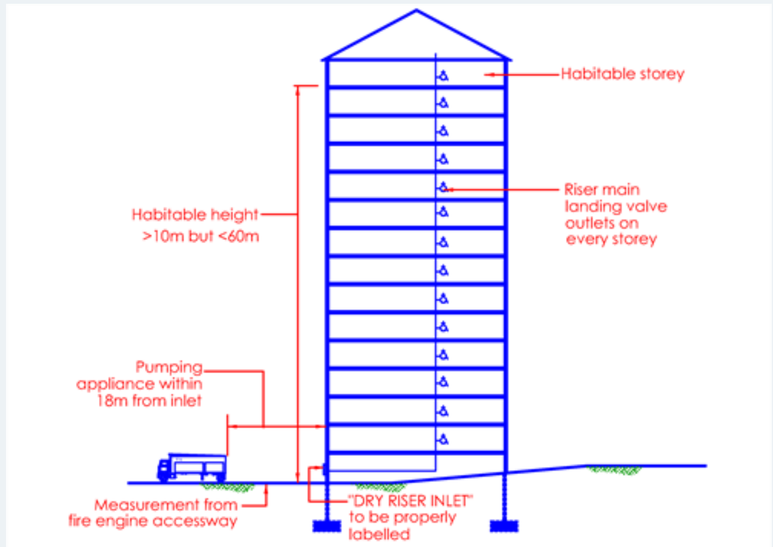


Figure 6.2.1a.(1) : Provision of dry rising mains

Dry rising main (dry riser).- A vertical pipe installed in a building for firefighting purposes, fitted with inlet connections at fire engine access level and landing valves on various floors, which is normally dry but is capable of being charged with water usually by pumping from fire engine pumps.

Dry rising mains are basically dry water pipes. The empty mains need to be charged with water through the breeching inlets by fire fighting appliance. The dry rising mains should not exceed 60m to avoid excessive pumping pressure.

Generally, building with a small foot print and the riser stack is located at the perimeter wall of the building, there is no need to provide landing valve at 1st storey level. However, if the riser stack is located deep inside the building as shown in *Figure 6.2.1a.(1)*, then landing valve is required to be provided at 1st storey level.

(3) separate dry and wet rising main systems in a building are permitted.

Explanation and Illustrations

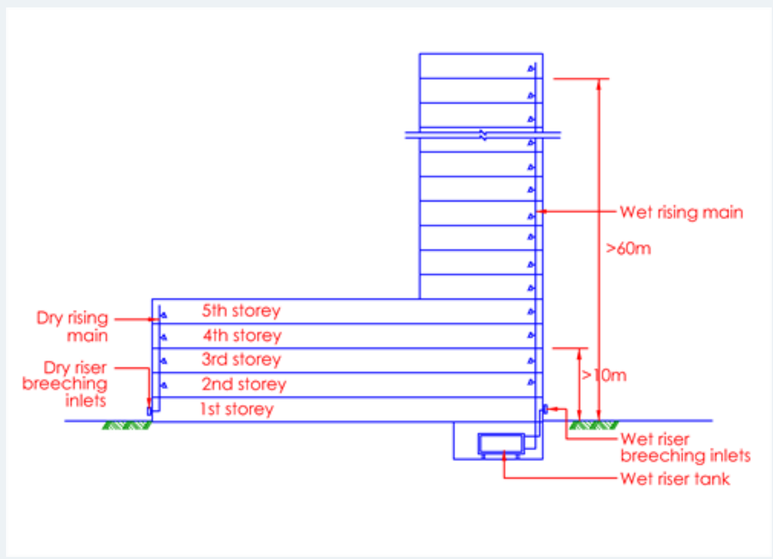


Figure 6.2.1a.(3)

Where a block of residential building has podium and tower blocks integrated:

(1) Tower block exceeding 60m in habitable height shall be provided with wet rising main.

(2) Podium block needs to be provided with dry rising main only.

b. Notwithstanding the requirements in *Cl.6.2.1a.*, dry rising mains conforming to *SS 575* shall be provided to supply any part of a single or multiple level basement.

Explanation and Illustrations

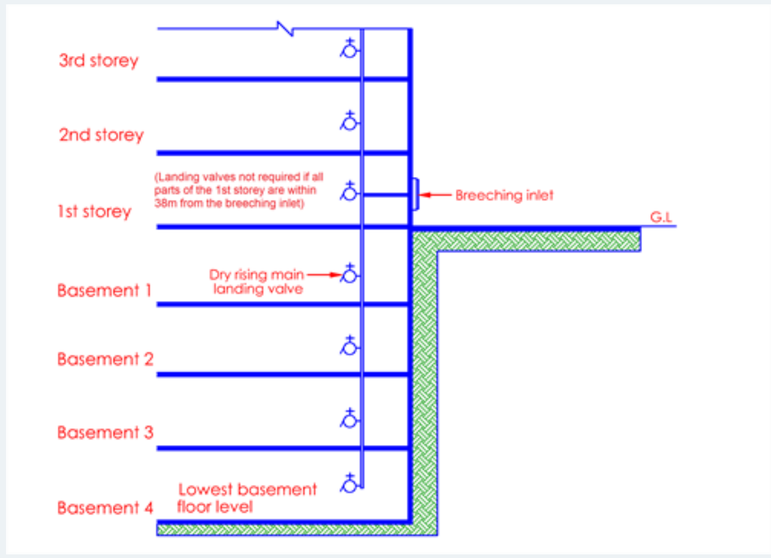


Figure 6.2.1b. – 1 : Rising mains in building of habitable ht. greater than 10m

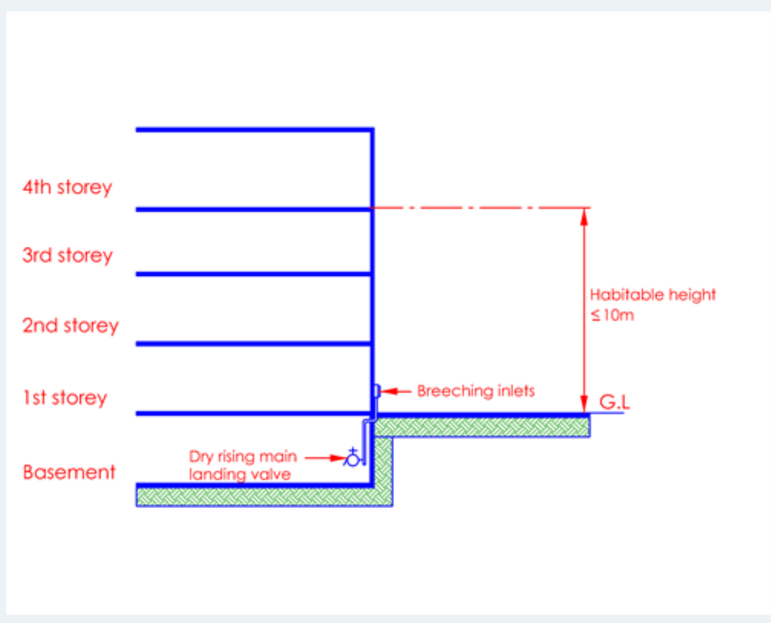


Figure 6.2.1b. – 2 : Rising mains in building of habitable ht. 10m and less

All basements except those under PG I are required to be covered by dry rising main, irrespective of the depth and number of basements below ground level. Rising main would help to provide steady supply of water required by firefighters during emergency. The provision would eliminate the tedious process of laying fire hoses from ground level into the basement floors to tackle any outbreak of fire.

Where breeching inlets are provided at the foot of the riser stack, landing valve for PG II is not required to be provided at the 1st storey level.

c. Where the building has access from more than one ground level or road level, the height measurements for the purpose of this Code shall be taken from the level of the fire engine accessway. Where there is no fire engine accessway, the height measurements shall be based on fire engine access road.

Explanation and Illustrations

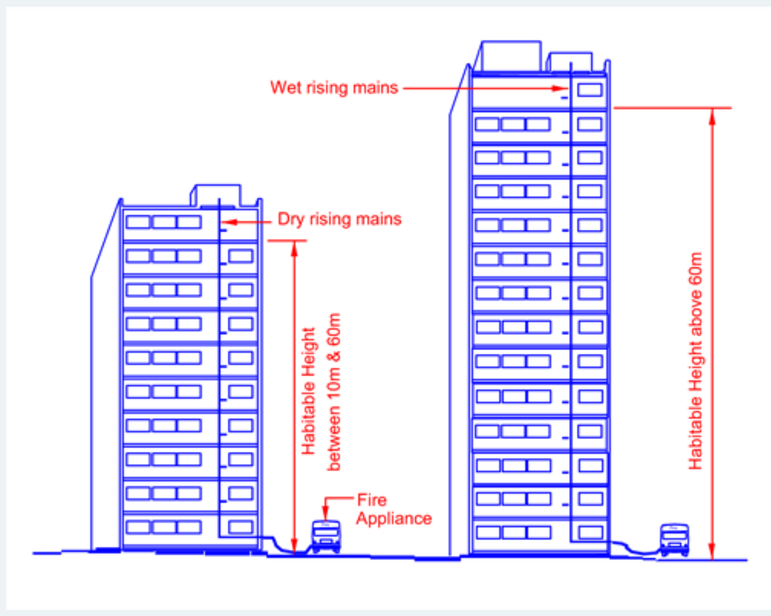


Figure 6.2.1c. : Type of rising mains to be installed in high-rise buildings

1. For the purpose of determining the provision of rising main to an apartment or maisonette building, the habitable height shall be taken from the level of the lowest fire engine accessway or fire engine access road where breeching inlets are provided.

2. Dry rising mains are basically dry water pipes. The empty mains need to be charged with water through the breeching inlets by fire engines. The dry rising mains should not exceed 60m in height to avoid excessive pumping pressure.

3. Wet rising mains are constantly charged with water that provide the required flow rate and pressure for firefighting and equipped with water storage capacity for a given duration of 60 mins. The breeching inlets, usually provided at ground level, are meant for replenishing the water tank.

6.2.2 Number, location and size of rising mains

Note

Under normal circumstances, a building below 10m in habitable height would not require rising mains. However, if such buildings have very large floor area or footprint, whereby its internal areas are outside the coverage of a fire hose length of 38m from the fire-fighting access panels, it is recommended that the internal rising mains to be incorporated to cover these areas. Otherwise, consultation with the SCDF ought to be sought.

a. Standard

The number, distribution, size and installation of rising mains shall comply with the requirements stipulated in *SS 575*.

b. Locations of landing valves

(1) Rising mains and the associated landing valves shall be kept free of physical and visual obstruction, and be located in the following order of priority:

(a) Fire lift lobby.

(b) Smoke-free lobby, or external corridor with landing valves not more than 5m from the exit staircase.

(c) Exit staircase, or common area and within a protected shaft not more than 5m from the exit staircase.

(2) Exception

In the case of a PG II residential floor where the fire lift lobby is connected to the smoke-free lobby or external corridor, the rising mains and landing valves can be located inside the smoke-free lobby or external corridor. The line-of-sight distance between the landing valves and the fire lift lobby shall not exceed 5m.

Explanation and Illustrations

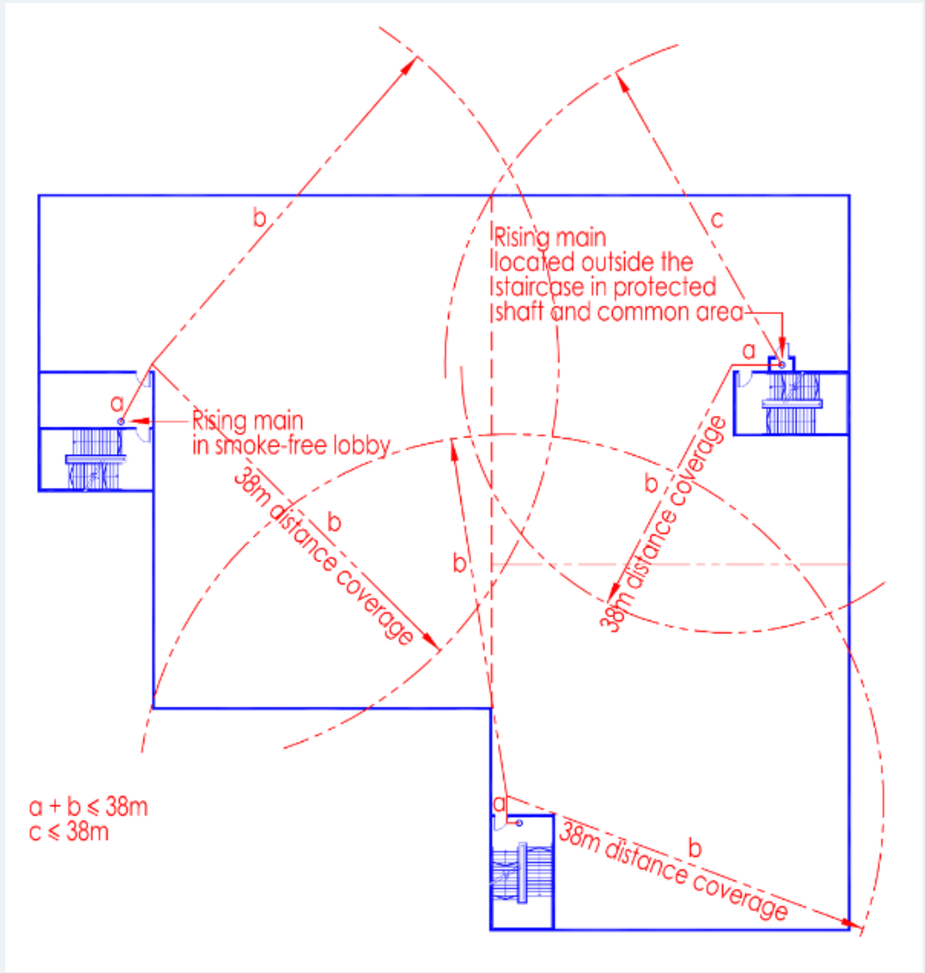


Figure 6.2.2a. - 1

All buildings with habitable height exceeding 10m would require one or more rising mains. All parts of the floor shall be within 38m from a landing valve.

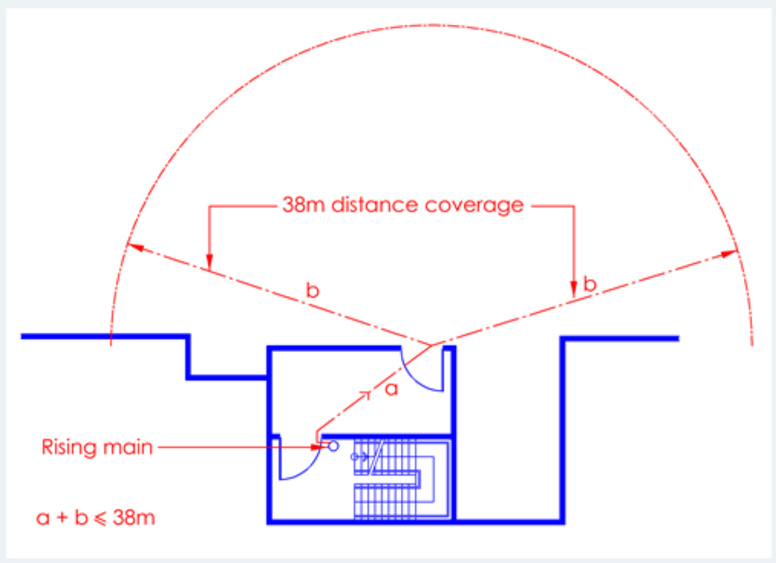


Figure 6.2.2a. - 2

The provision of rising main shall be such that all parts of any floor are within 38m from a landing valve, measured along a route suitable for hose lines including any distance up or down a staircase.

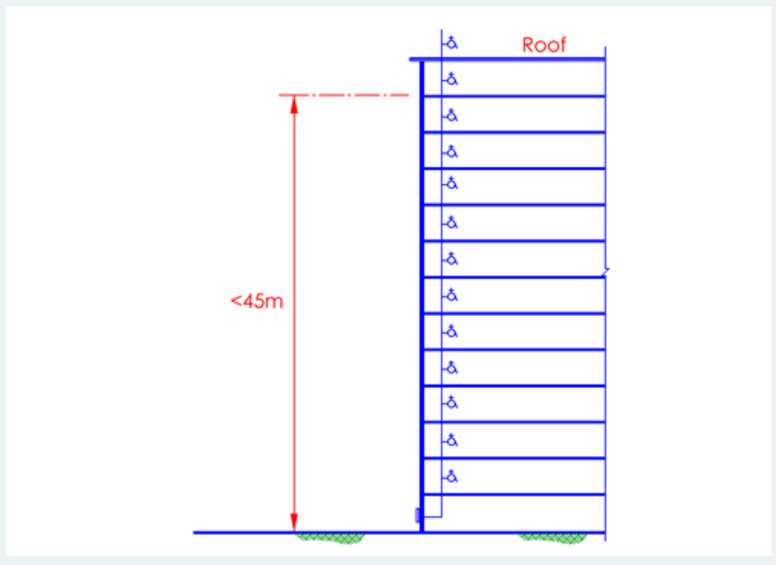


Figure 6.2.2a. - 3 : 100mm minimum nominal bore rising main

The minimum nominal bore of a rising main shall be 100mm where the rising main does not exceed 45m in height and only one landing valve is provided at each floor.

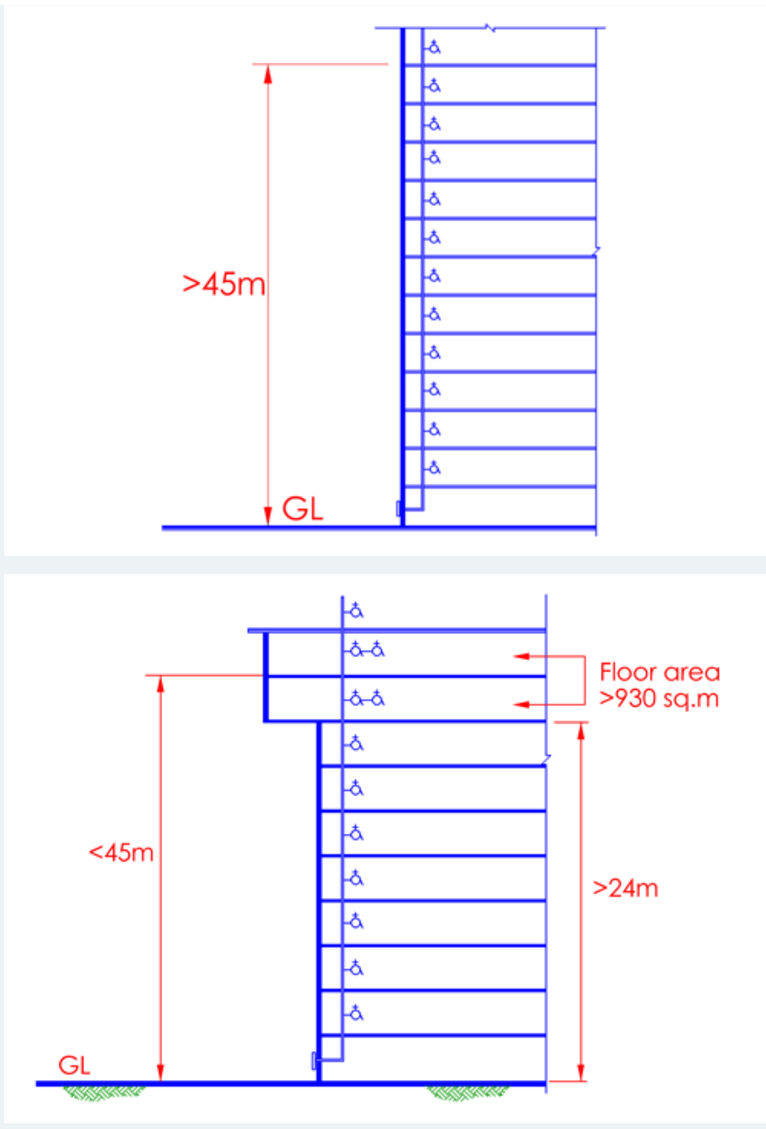


Figure 6.2.2a. - 4 : 150mm minimum nominal bore rising main

The minimum nominal bore of a rising main shall be 150mm where the rising main either (i) exceeds 45m in height or (ii) is permitted to have two landing valves on any floor.

The height of rising main is the habitable height measured from the fire engine access level to the finished floor level of the topmost floor served by the rising main, irrespective whether or not the main is extended above roof level. The above figure shows two landing valves being installed in the top 2 floors though the height of rising main does not exceed 45m, the minimum nominal bore of the rising main shall not be less than 150mm.

c. Provision for landing valves and standby fire hoses

(1) The provision for landing valves shall comply with *SS 575*. Where any part of the 1st storey of a building, except for PG II buildings, is more than 38m (30m hose line length and a jet throw of 8m) from the breeching inlet, a landing valve at the 1st storey shall be provided.

(2) Where all the exit staircases in a building under PG III to VIII are installed with rising mains and standby fire hoses, and yet part of a floor space is beyond the 38m (30m hose line length and a jet throw of 8m) coverage of any landing valve, an additional standby fire hose shall be provided at the landing valve nearest to this floor space.

(3) Exemption

Landing valve is not required under the following situation:

(a) Mezzanine floor of factory or warehouse unit, subject to compliance with *Cl.9.6.1a(2)* or *Cl.9.8.1a.(2)*, respectively. The coverage distance of the nearest landing valve at the main floor to the most remote point of the mezzanine floor shall not exceed 38m (30m hose line length and a jet throw of 8m). Otherwise, *Cl.6.2.2c.(2)* shall be complied with.

Explanation and Illustrations

1. Location of rising mains

The entire pipework and landing valves comprising each rising main system inside the building shall be confined:

a. within a ventilated lobby of a protected lobby approach stairway, where this is provided, or

b. in such other protected areas as may be agreed with the SCDF.

2. Rising mains shall be so located that they are protected against mechanical and fire damage.

3. No part of a rising main shall be placed in any shaft containing a gas, steam or fuel pipelines or electrical cables and wirings.

4. Where passing through other than protected area e.g. protected lobby shaft, pipe need to be encased or protected by and fire rating material with 2-hr fire resistance rating.

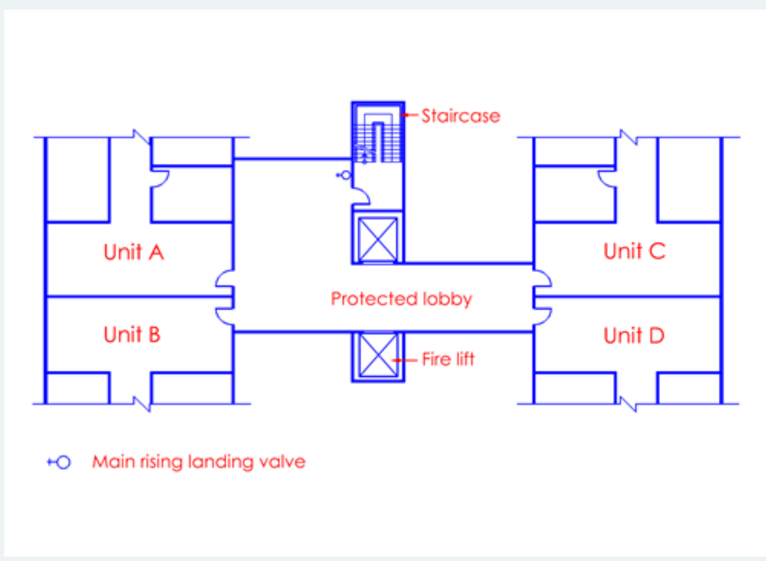


Figure 6.2.2c. - 1 : Example A - Block of flats/maisonettes

A single rising main is provided in example A as the distance from the remotest point in any residential unit to the rising main landing valve, measured along the route of travel, does not exceed 38m.

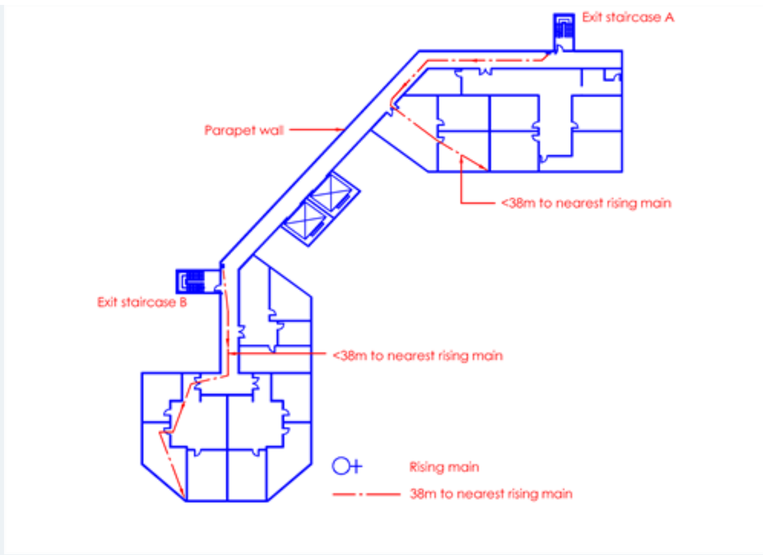


Figure 6.2.2c. - 2 : Example B

Two stacks of rising mains are required in example B if the coverage or travel distance to the remotest point of the floor exceeds 38m.

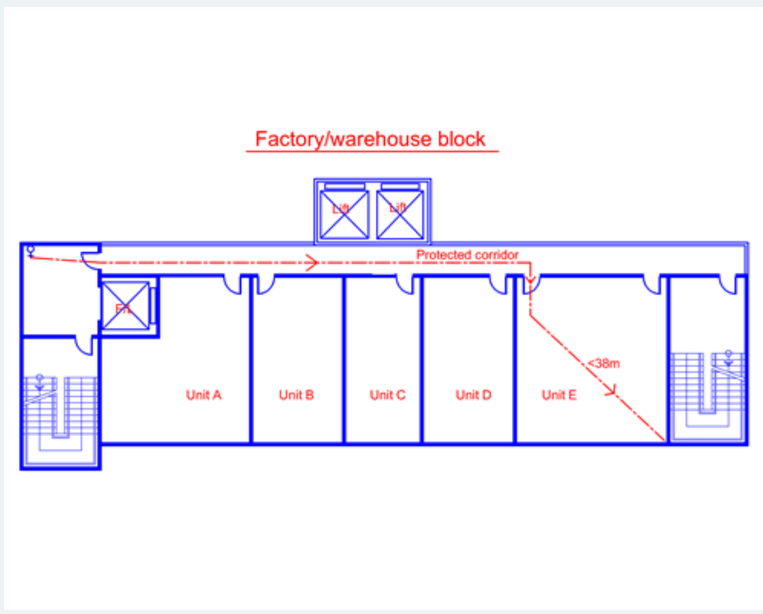
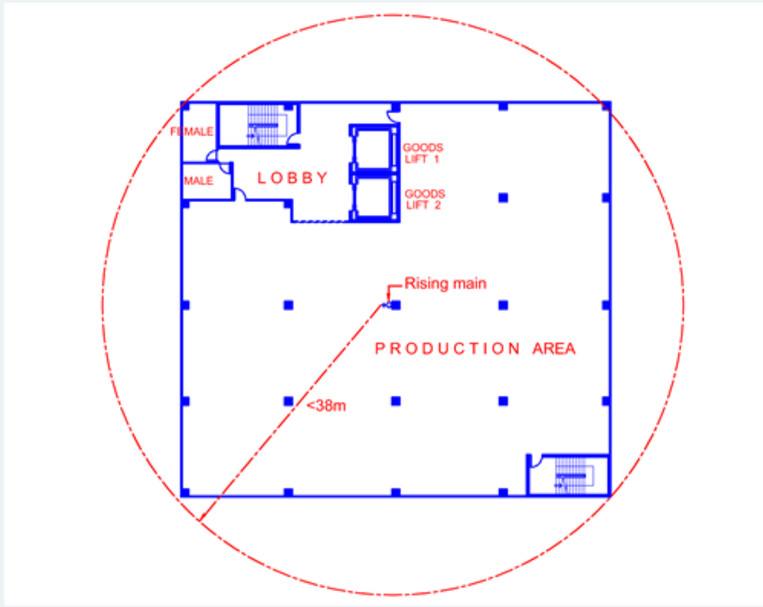


Figure 6.2.2c. - 3 : Example C : Office/factory/warehouse block

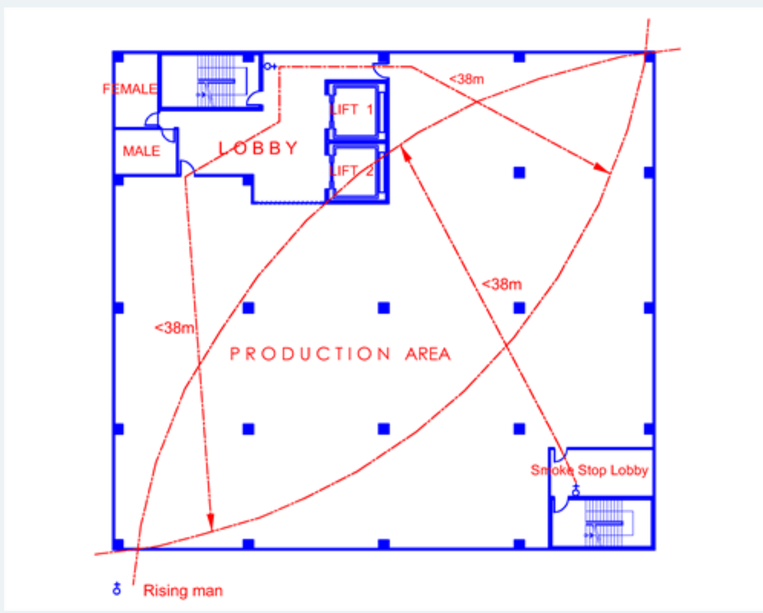
A single rising main is provided in example C as the distance from the remotest point in any unit to the rising main landing valve, measured along the route of travel, does not exceed 38m.



Not Acceptable

Figure 6.2.2c. - 4

The above figure shows rising main installed in the core of a building, meeting the requirements of distance coverage (38m). Such arrangement is deem not acceptable to the SCDF. The position of rising mains shall be located in the following areas (see *Cl.6.2.2b.*) in the order of priority.



Acceptable

Figure 6.2.2c. - 5

The above figure is an acceptable arrangement of positioning rising mains in the order of priority. Two stacks of rising main are required if the distance exceeds 38m, measured from the landing valve to the remotest point.

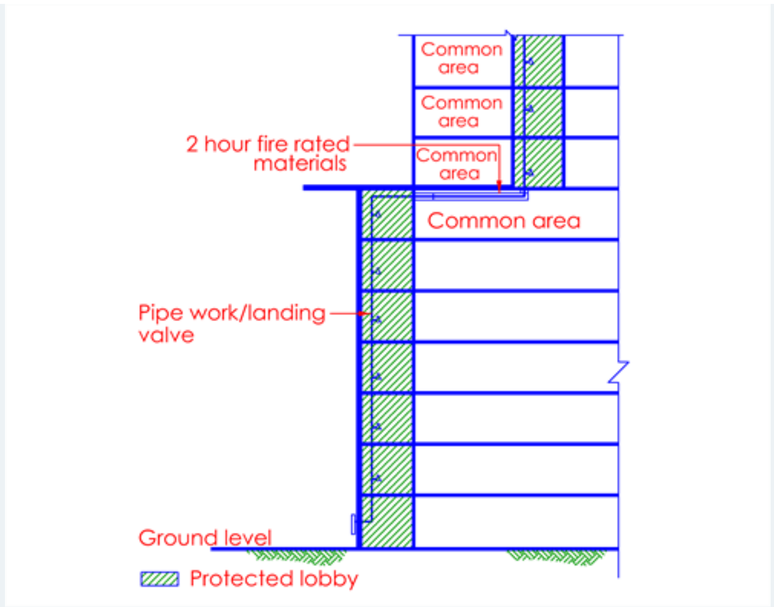


Figure 6.2.2c. - 6

Where the pipe work and landing valve are located outside protected lobby or area allowed by the SCDF, they shall be protected by approved 2-hr fire-rated enclosures.

Provision of landing valve to any rising main for PG II at 1st storey is not required even if any part of that storey is more than 38m from the external wall of the building.

A landing valve with an instantaneous female coupling for connecting to SCDF's 63.5mm diameter standard hose shall be provided for each rising main on every floor above the ground, including the 1st storey, every basement floor and on the roof for testing purposes. External walls refer to the external walls of the building that are facing or adjoining the boundaries. Where any part of the floor space in the building is less than 38m from the external wall, firefighters could connect multiple hose lengths to the fire pumper for the supply of water. As it is time consuming and laborious to connect additional multiple hose lengths, landing valve shall be provided to the rising mains at 1st storey if any part of the floor space in the building exceeds 38m from the external wall of the building.

6.2.3 Breeching inlets and fire engine accessways/ fire engine access roads

a. All buildings fitted with rising mains shall have a fire engine accessway/ fire engine access road for firefighting appliances within 18m of the breeching inlet. The breeching inlets shall be visible from the fire engine accessway/ fire engine access road.

Explanation and Illustrations

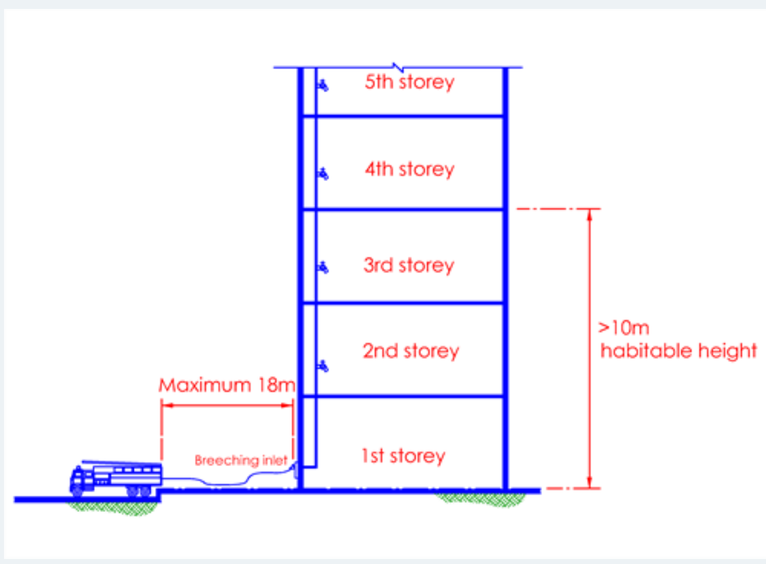


Figure 6.2.3a.

(a) The breeching inlets would be located on the external wall of the building and to be within 18m of the fire engine accessway or fire engine access road. The breeching inlets shall be visible from the adjacent accessway.

(b) Thus, a fire engine accessway can serve more than one rising main to one or more buildings, provided (a) above is complied with.

b. The requirements and provisions for breeching inlets for the rising main system shall be in accordance with the *SS 575*. Connecting pipes between the inlets and the vertical run of the rising mains, where applicable, shall be kept as short as possible.

Explanation and Illustrations

(No illustration)

The inlets and the vertical run of the rising main shall be kept as short as possible. The total pressure loss of the dry rising main shall not exceed 6 bar based on the design water flow rate. This is to correspond with the maximum habitable height of 60m.

6.2.4 Wet rising mains

a. Water supply

The capacity of the water supply from the public mains and the storage capacity for a wet rising main system shall comply with the requirements in *SS 575*.

Explanation and Illustrations

(No illustration)

1. For wet rising mains it is essential that pressures and flows be adequate at all times to serve the required number of jets likely to be used.

2. The water supply to the rising mains should be kept entirely independent of water supplies feeding other installations including those for other firefighting systems.

3. Means of supply for wet rising mains

a. Each wet rising main shall be fed from a suction or storage tank having a minimum effective storage capacity capable of supplying water at the rate of 27 L/s for a period of at least 30 minutes.

b. The storage tank(s) shall be automatically supplied either directly or indirectly via other tanks from a public main(s). The pipe drawing water from public mains to the tank shall be at least 150mm in diameter.

c. Break tanks not serving as storage tanks shall have an effective holding capacity of not less than 11.5m³ for each wet rising main.

4. Water tanks for wet rising mains

Tanks supplying water for domestic purposes shall not be used as suction tanks for wet rising mains.

b. Flow

The flow requirements for wet rising main system shall comply with those stipulated in *SS 575*.

Explanation and Illustrations

1. The minimum water supply flow rate shall be maintained in the wet rising system when 3 landing valves within the system are in the fully open position:

   a. 27 L/s for a residential building.

   b. 38 L/s for a non-residential and mixed occupancy building.

2. When more than one wet rising main is required in any zone in a building, the minimum common water supply shall be as stated below. Where the total maximum supply rate exceeds those stated in (a) and (b), another common water supply system shall be used.

   a. For a residential building, 27 L/s for each rising main.

   b. For a non-residential or any mixed occupancy building 38 L/s for the first rising main and 19 L/s for each additional rising main, subject to a total maximum supply rate of 95 L/s for PG III, IV, V & VII buildings and 133 L/s for PG VI and VIII buildings.

c. Running pressure

Running pressure at each discharging landing valve on the wet rising main system shall be maintained between the minimum and maximum values as stipulated in *SS 575*.

Explanation and Illustrations

(No illustration)

A minimum running pressure of 3.5 bar and a maximum of 5.5 bar shall be maintained at each landing valve when any number, up to three, are fully opened.

d. Static pressure

Static pressure in any line of hose connected to a landing valve in a wet rising main system shall not exceed the specified value in *SS 575*.

Explanation and Illustrations

(No illustration)

1. To reduce the risk of hose bursting, arrangements shall be made in accordance with BS 5041: Pt 1 so that when the water is shut off at the nozzle the static pressure in any line of hose connected to a landing valve does not exceed 8 bar.

2. To dispose of excess flows and pressures over and above those required (i.e. when only one jet is in use) a pressure control valve shall be incorporated in the body of the landing valve which is then permanently connected into the relief pipe. This relief pipe should run throughout the length of the wet rising main installation and should terminate either back into the suction tank or to drain.

e. Storage tanks

The location of storage tank and capacity of break tank where required shall comply with the requirements in *SS 575*.

Explanation and Illustrations

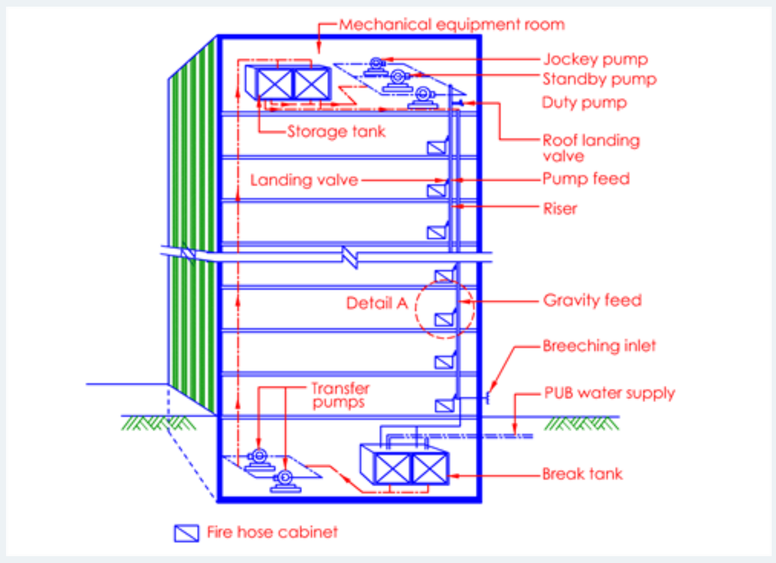


Figure 6.2.4e. – 1 : Wet rising mains system for building height exceeding 60m

1. The location and number of storage tank would be determined by the design of the wet rising main system and the height of the building. SS 575 should be fully complied with.

2. It is important that at early design stage of the building, the type of design of the wet rising main system should be drawn up to allow allocation of space for pumps and water tanks.

3. Usually, storage tanks and pumps are located in mechanical service floor in upper storey and basement, and on the roof of the building.

4. The capacity of break tank shall have an effective holding capacity of not less than 11.5m³ for each wet rising main.

Footnote:

(a) Storage tank is water tank having a minimum effective wet rising main storage capacity capable of supplying water at a given rate for a period of at least 30 minutes.

(b) Break tank is either (a) a tank into which the incoming supply connection from the PUB water mains discharge, or (b) an intermediate tank for limiting the system pressure.

(c) Suction tank is a tank from which a pump can draw water.

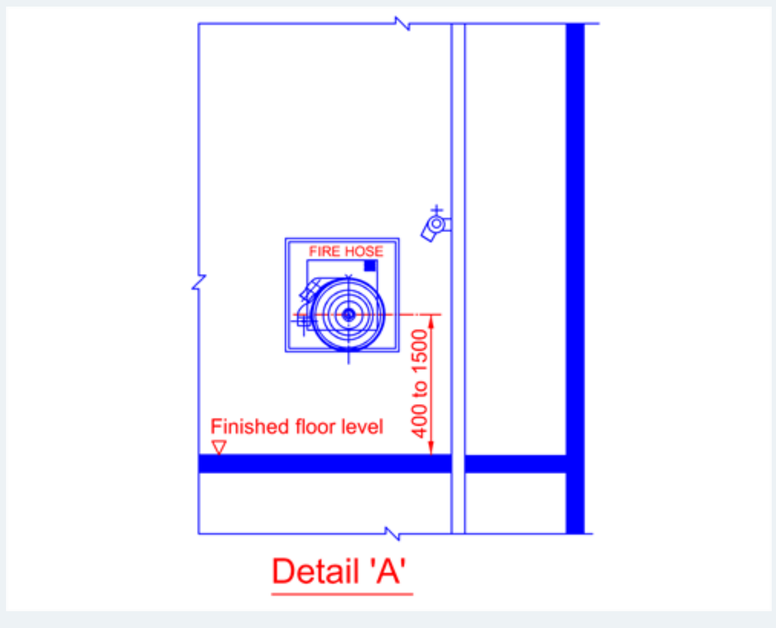


Figure 6.2.4e. – 2 : Fire hose cabinet detail

Wet rising mains system

1. “Wet rising mains” function similarly to dry rising mains. However, the pipes are permanently charged with water from a pressurised supply, and fitted with landing valves on various floors.
2. The breeching inlet act as an alternative means of supplying water to the rising mains system should the incoming public water supply pipes be damaged or the water supply is inadequate.

f. Fire pumps

Installation of fire pumps for wet rising main system shall comply with the requirements of *SS 575*. Wet riser pumps shall be installed within a fire compartmented fire pump room, whose fire rating shall be in accordance with *Table 6.4A*. The fire pump room floor level shall not be lower than the main floor level.

g. Water supply system

(1) The water supply requirements for wet riser system shall be as follows:

TABLE 6.2.4g: WATER RISER SYSTEM		
No: of stacks	**Water flow rate (L/s)**	
	Non-residential buildings	**Residential buildings**
1	38	27
2	57	40.5
3	76	54
4 & above	95	67.5

(2) The minimum water storage capacity shall be capable of supplying water at the above flow rate for the period as specified in *SS 575*.

Explanation and Illustrations

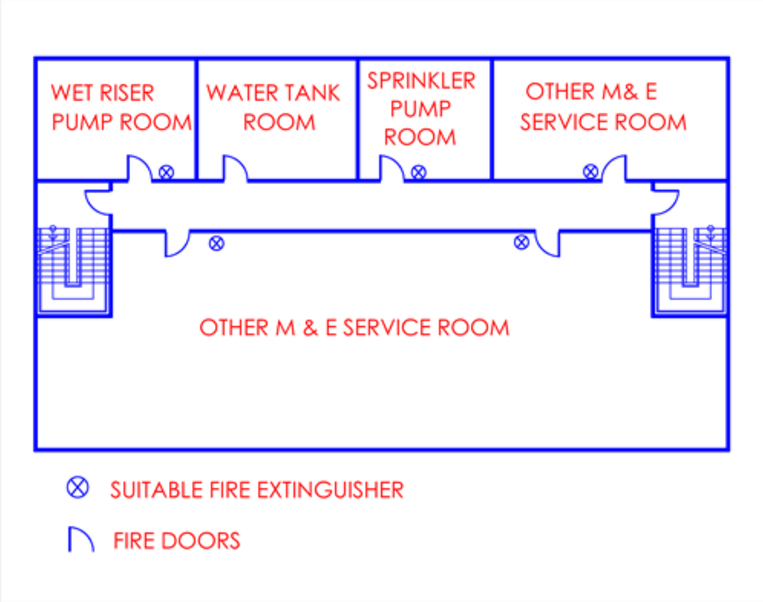


Figure 6.2.4f. : Example of pump room in basement

Pump room in basement

1. Pumps, which are part of the wet rising main system, must be properly protected from the effect of heat and fire. As pumps are the vital nerves of the system, they should be installed in room having the necessary fire-rated enclosures and door (min 2-hr fire resistance rating).
2. Pumps shall be selected to meet the design requirements of the rising main system and be listed by recognised institution such as UL or FM.
3. There should be a voice communication system to provide intercommunication amongst all pump rooms.
4. Mechanical ventilation and electrical lighting in the pump room shall be equipped with standby emergency power supply.

6.2.5 Standby fire hose for rising mains

Standby fire hoses shall be provided for every rising main except for those in buildings under PG II. The following requirements shall be complied with:

a. Type and folding method

(1) The standby fire hose shall be of 63.5mm nominal internal diameter in order to ensure that the hose coupling will fit the existing coupling tail pieces. The hose shall be rugged and capable of carrying water under substantive pressure in accordance with *BS 6391*. The fire hose shall be of Type 3 as stipulated in *BS 6391*.

(2) The fire hose couplings shall be manufactured to BS specifications or equivalent and of be light alloy or gunmetal. The coupling shall be of 63.5mm diameter and be of the instantaneous type with standard (double-pull) release mechanism. The couplings shall be secured to the hoses with galvanised mild steel wire and applied over a hose guard of synthetic fibre. It shall be able to withstand a minimum working pressure of 15 bars.

(3) Each hose shall have a standard length of 30m and shall be kept stowed in a Dutch Roll and housed in a glass fronted cabinet. The Dutch Roll shall be rolled in the manner shown in *Diagram 6.2.5a.(3)*.

Explanation and Illustrations

Standby hose provides the firefighter greater hose length connection in situation where the floor space is extensive. The hose from other floors could be transferred to fire floor quickly when required by firefighters. Standby hose shall be kept locked in a cabinet, when placed along escape corridor, in common area and circulation space. The hose is allowed to be left mounted on hook or cradle inside the riser main shaft.

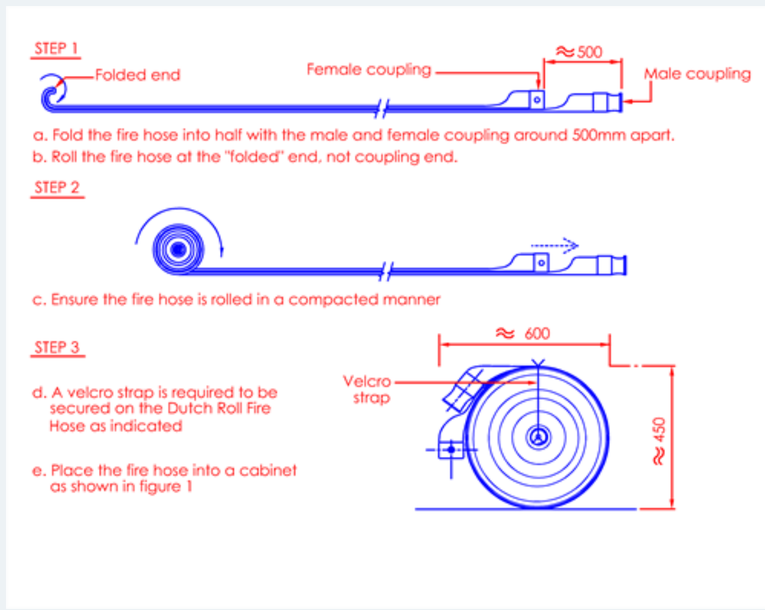


Figure 6.2.5a. : Dutch roll folding method

b. Position

(1) The fire hose shall be installed just next to, but not more than 2m from the landing valve as shown in *Diagram 6.2.5b.(1).*

(2) The entire fire hose and cabinet shall be installed away from direct sunlight.

c. Mounting

The wall mounted fire hose and cabinet shall be as follows:

(1) The cabinet shall be firmly mounted on the wall and able to withstand the weight of the hose(s) it houses.

(2) The cabinet shall be constructed of non-combustible material and be maintenance free.

(3) The cabinet lock, if provided, shall be one that can be operated manually from the inside without the use of a key when the front tempered glass (minimum 300mm x 300mm) is broken by firefighters.

(4) The cabinet swing door shall be made openable such that it will not obstruct the retrieving of the fire hose by firefighters.

(5) The depth of the cabinet shall not exceed 250mm for one fire hose or 350mm for two fire hoses.

(6) The cabinet shall be painted in a contrasting colour such that it is conspicuous and easily identified.

(7) The wording, “FIRE HOSE”, with letter height of at least 50mm and shown in contrasting colour, shall be painted directly on the front panel as shown in *Diagram 6.2.5b.(1).*

(8) In lieu of the cabinet, a simple wall mounted cradle for the fire hose can be provided, but only in the riser main shaft. The cradle shall be constructed and positioned to facilitate the retrieving of fire hose by firefighters.

(9) The cradle (in lieu of the cabinet) shall be maintenance-free. The fire hose installation height shall be limited as indicated in *Diagram 6.2.5b.(1).*

Explanation and Illustrations

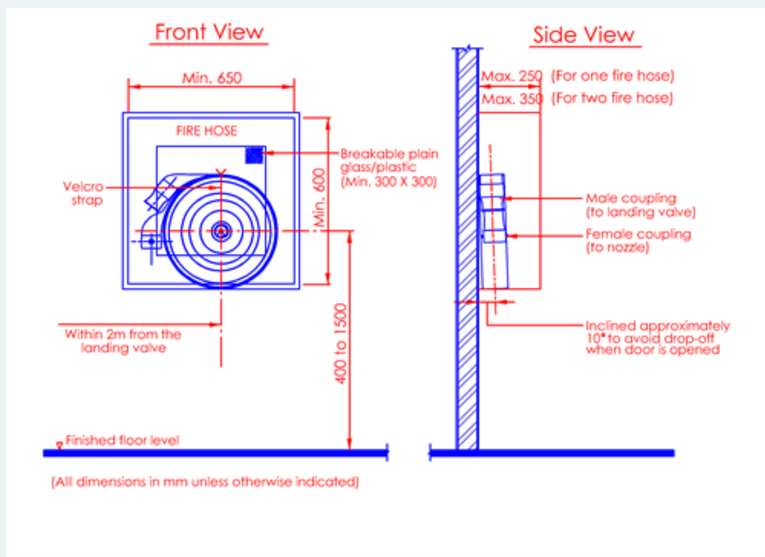


Figure 6.2.5b. : Dutch rolled fire hose with cabinet (surface-mounted or recessed)

d. General

(1) Only clean, dry and compactly rolled (Dutch Roll with the Velcro strap secured as shown in the *Diagram 6.2.5a.(3)* and *b.(1)*) hose(s) shall be placed in the cabinet.

(2) *BS 6391* stipulates the technical requirements for quality acceptance standards of the fire hose. In addition, the above mentioned requirements shall be applicable for acceptance of the standby fire hose.

Note

QPs are reminded to ensure that premise owners are aware of the manufacturer's recommendation for maintenance of the standby hoses provided on site.

6.2.6 Building under construction

Explanation and Illustrations

Provision of wet rising main is required when building exceeds a habitable height of 60m.

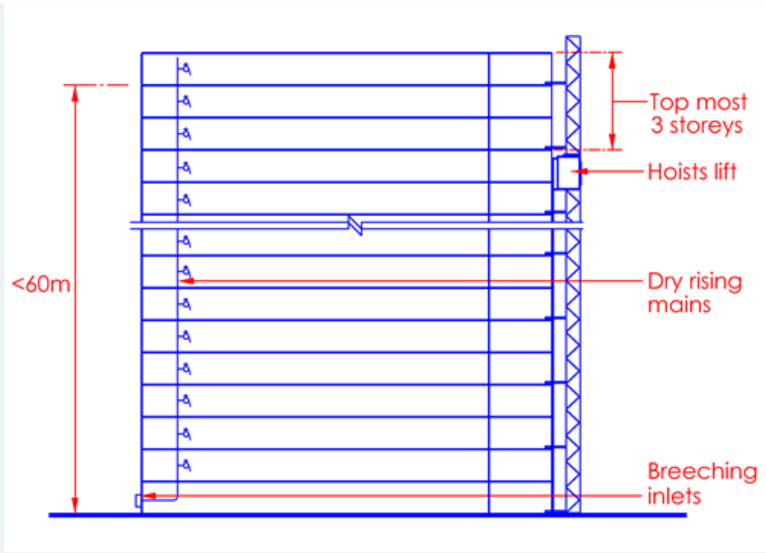


Figure 6.2.6 - 1 : Under-construction building of habitable ht not exceeding 60m

Rising main is dry type before the habitable height of 60m is reached.

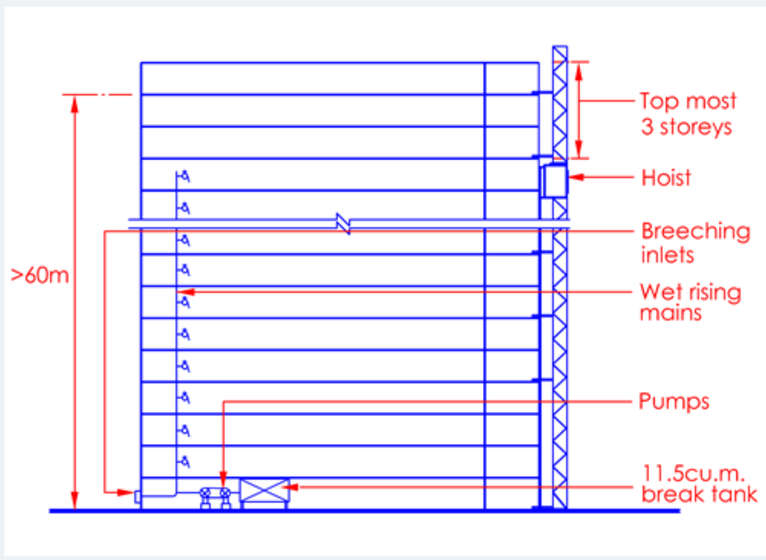


Figure 6.2.6 - 2 : Under-construction building of habitable ht exceeding 60m

Rising main is converted to wet type with the installation of pump and water tank

a. Breeching inlets

Breeching inlets (2-way or 4-way) should be provided as per approved building plan.

b. Fire lift

As it is not feasible to provide fire lift for use by firefighters, a passenger hoist, which is usually installed at site could be used. The hoist need not serve the topmost 3 floors, until the roof is being completed.

c. Electrical power supply

Supply from power grid or generator set could be acceptable.

d. Fire engine access road

During construction stage, there could be other works involving laying of services, excavation work etc that would prevent provision of access road and the space available would not permit the maneuverability of fire engine.

However, every opportunity should be taken to put in the access road in place. This is necessary for the purpose of conducting effective fire fighting operations should a fire occur at any time. In view of the above, additional portable fire extinguishers should be provided at each floor level instead.

e. Rising main landing valve

Rising main and landing valve shall be provided to every floor, except the topmost 3 floors as the building gains height, and made operational.

f. Rising main pressure & flow

As it is not feasible to provide a full-sized water tank and pump to meet the flow and pressure required for 45 mins of firefighting, a break tank of minimum 11.5m³ should be provided, instead for firefighting of 5 mins duration. Upon the arrival of fire engine the tank could be replenished via the public hydrant. The break tank must be constructed before the building reaches the 60m height.

g. Responsibility/Accountability

The main contractor for the project shall be responsible and accountable for the provision and maintenance of the rising main in the building under construction.

h. Checklist

Inspection and testing checklists of rising mains are attached for ease of reference.

S/No	Description	Yes	If no, remedy action/comments
PART B : CHECKLIST FOR THE TESTING OF RISING MAINS			
BREECHING INLET		In - Order	Not In – Order	Remarks
1	Inlet housed in protective enclosure			
2	Rigidly support			
3	Labeled " dry/wet Raser Inlet " and numbered accordingly			
4	Clear of obstruction			
RISER				
5	Air relief valve provided			
6	Labeled & numbered accordingly			
7	Earthing provided			
LANDING VALVE				
8	Blank cap provided			
9	Strapped and padlock in closed position			
10	Clear of obstruction			
TESTING OF PRESSURE/FLOW				
11	Dry rising mains a. Pressure constant at 300 psi (20.7 bar) for 30 mins. b. Regularly tested			
12	Wet rising mains a. Static pressure shall not be less than 8 bar b. Topmost landing valve Fully opened (under pump/gravity feed) with flow rate at 27 L/S c. Provide break tank with Minimum water capacity of 11.5m			

Date inspected : By : Signature :

* Delete as appropriate

INSPECTION CHECKLIST FOR BULIDING UNDER CONSTRUCTION

S/No	Description	Yes	If no, remedy action/comments
PART A			
1	Dry rising mains shall be installed progressively during the course of construction as per approved plan and made operational for all storeys except the uppermost 3 storeys, for building exceeding 8 storeys or habitable height of 24m.		
2	Wet rising mains shall be installed progressively during the course of construction as per approved plan and made operational for all storeys except the uppermost 3 storeys, for building exceeding 18 storeys or habitable height of 60m. The following shall be provided: a. Break tank with minimum water capacity of 11.5 cubic metre; and b. Fire pumps which are operational and supplied with emergency power supply.		
3	Provision of breeching inlets (2-way / 4-way)* provided as per approved plan. The following shall be complied with: a. Breeching inlets made operational and housed in protectrve enclosure; and b. Labelled and numbered accordingly.		
4.	Riser stacks labelled and numbered accordingly: a. Earthing to be provided; and b. Air relief valve provided.		
5.	Landing valves provided with blank caps and are strapped and padlocked in closed position.		
6.	Dry rising mains are hydrostatically tested to constant gressure of 13.8 bars for at least 2 hours.		

Date inspected : By : Signature :

* Delete as appropriate

When a building in pursuance of Cl.6.2.1, is required to be equipped with rising mains, such rising mains shall be installed progressively as required under Cl.9.9.3 during the course of construction. All outlets, landing valves and inlets, water tanks and pumps, and hydrants shall be properly installed so as to be readily operational in case of fire.

6.2.7 Foam inlets

Explanation and Illustrations

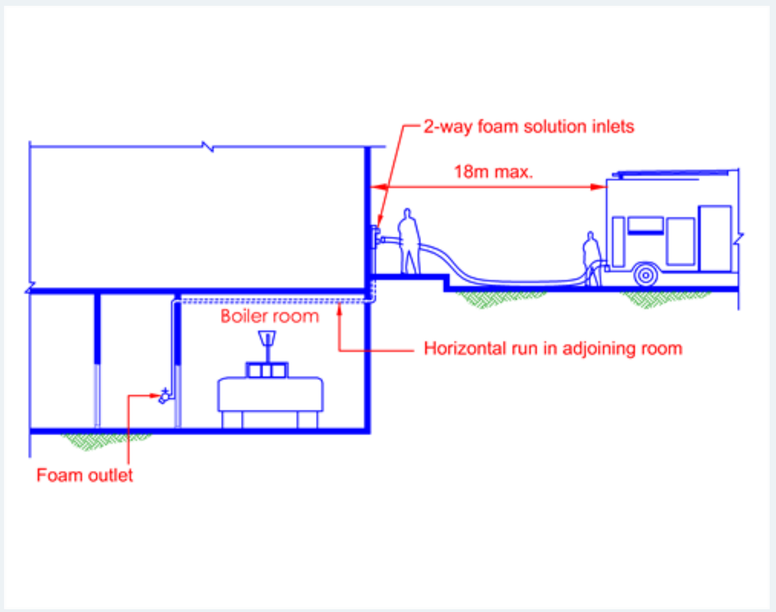


Figure 6.2.7

The above figure shows the foam supply pipe being run through a room adjoining the boiler room. The other alternative of routing the pipe works through the boiler room is acceptable if the pipes are enclosed with fire-rated materials having the necessary fire resistance rating.

Foam inlets pipe works are provided for the purpose of delivering foam solution to the lobby or circulation area close to the room(s) containing highly combustible materials. This arrangement is similar to a rising main system, except that it is meant to deliver foam solution instead of water. Under this arrangement, ready mixed foam solution would be pumped into the 2-way breeching inlets at ground level. Firefighter would carry the necessary hoses with foam making branch to tap the foam solution from the landing valve and to jet in the foam at the seat of the fire in the room.

a. Provision

(1) Where boiler room or storage room containing highly combustible materials are located in a basement, or is not easily accessible for firefighting, foam inlets and pipe works shall be provided for the purpose of delivering foam solution to an area close to the room concerned.

(2) In situations where such rooms have access openings along a fire engine accessway, provision of foam solution inlets and outlets is not required.

b. Breeching inlet

A two-way breeching inlet shall be provided at ground level with pipe run of minimum 100mm bore, terminating with a landing valve just outside the high fire risk room. The provision of the breeching inlet shall comply with the relevant clauses of *SS 575*.

6.2.8 Hose reels

a. Provision

(1) Hydraulic hose reel(s) conforming to the requirements in *SS 575* shall be provided for every storey of every building regardless of building height.

(2) Where a roof level is a non-habitable floor, fire hose reels shall be provided to cover the M&E plants/ equipment.

(3) Exemption

(a) PG I buildings.

(b) Non-residential occupancy at the 1st storey of a mixed commercial-cum-residential building or single storey standalone building, which fulfils all of the following conditions:

(i) AFA of the non-residential unit does not exceed 150m².

(ii) Individually compartmented except for the parts of the unit fronting and within 3m from the external space.

(iii) Not used as an eating establishment, or for storage of flammable materials.

(iv) Not used as a public entertainment outlet.

(v) Not belonging to PG VI or VIII buildings.

Explanation and Illustrations

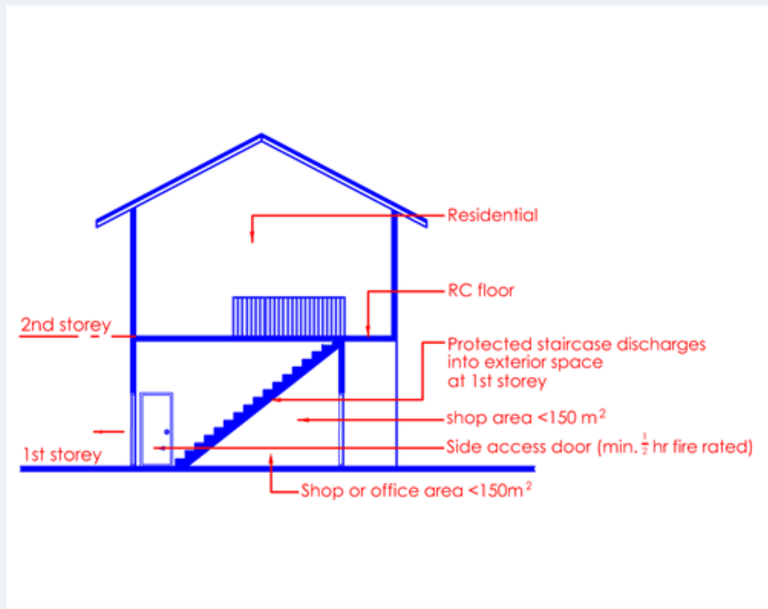


Figure 6.2.8a.(3)(b)

The staircase serving the upper storey living quarters shall be compartmented from the shop area by minimum 1-hr fire-rated enclosures. The communicating side access door between the staircase and shop area at 1st storey level shall be minimum ½-hr fire-rated and fitted with self-closer. This door shall always be kept in the closed position to prevent smoke and fire from spreading to the living quarters if there is a fire in the shop area.

(vi) Not used as a dormitory, hostel, etc. where sleeping risk is involved.

(c) Other standalone buildings as follows:

(i) Single-storey guard houses.

(ii) Bin centres.

(iii) 22kV (and lower) electrical substations.

(iv) Open-sided sheds (excluding those for PG VI and VIII usages) with AFA not exceeding 200m^2 and openings that constitute not less than 80% of the perimeter wall area (measured along the roof eaves).

(v) Domestic water supply, rainwater, wastewater, sewage pumping stations with AFA not exceeding 300m^2.

(vi) Roof of single storey buildings with roof height not more than 12m or roof of any buildings with inaccessible pitched roof up to 24m from grade level used solely for roof-mounted PV installations in accordance with *Cl.10.2.1b.(1)*.

(vii) Roof level of an external/ open-sided overhead bridge/ shed/ linkway/ walkway with clear width less than 6m, roof height not more than 12m and used solely for roof-mounted PV installations in accordance with *Cl.10.2.1b.(1)*.

(viii) Green roofs which are accessible for maintenance purposes only and which comply with *Cl.10.2.1b.(1)(a)*.

(ix) Open-sided sheds for M&E plants/ equipment with AFA not exceeding 20m^2 and openings that constitute not less than 80% of the perimeter wall area (measured along the roof eaves).

(x) Open-sided sheds for PG III field training usages without any storage, with AFA not exceeding 300m^2 and openings that constitute not less than 80% of the perimeter wall area (measured along the roof eaves).

(d) Mezzanine floor of factory or warehouse unit, subject to compliance with *Cl.9.6.1a.(2)* or *Cl.9.8.1a.(2)*, respectively. The coverage distance of the nearest hose reel at the main floor to the most remote point of the mezzanine floor shall not exceed 36m (30m hose path and 6m throw).

Explanation and Illustrations

Small buildings refer to detached and standalone buildings, such as guardhouse, pump house, bin centre, electrical substation. These would not be required to be provided with hydraulic hose reel. However, suitable type of fire extinguisher should be provided instead. For other types of small building, QPs should consult the SCDF before making building plan submission.

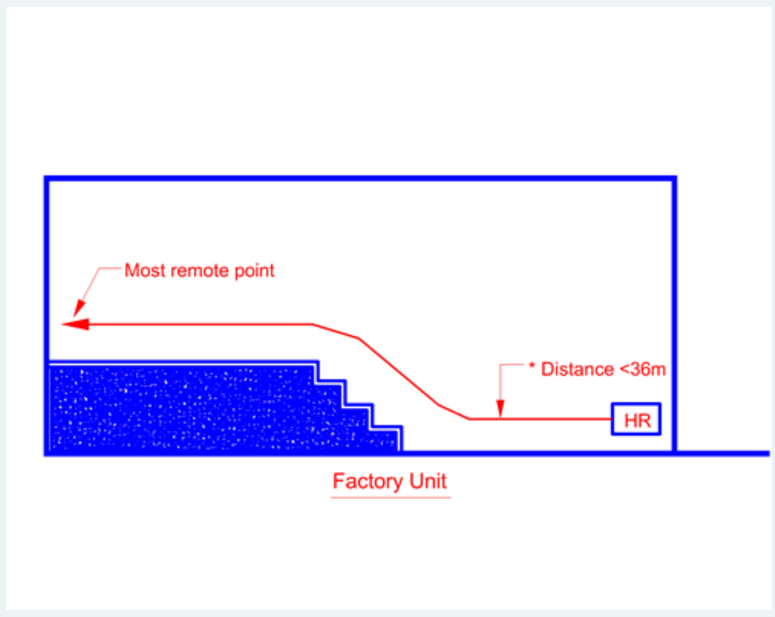


Figure 6.2.8a.(3)(d)

*Distance is to be measured along a route suitable for the hoseline having regard to any obstruction.

b. Size and type

The hose shall be of 20mm or 25mm nominal diameter and conform to *EN 694*, shall not exceed 30m in length and terminate in “shut-off” branches with 4mm or 6mm nozzles.

Explanation and Illustrations

(No illustration)

1. The reel or drum should be of adequate size to wind up the 30m length hose.

2. The length of the hose should not exceed 30m. The main reasons are:

   (a) an occupant using the hose reel to fight an incipient fire need not traverse more than 30m. Consideration must be given that the occupant needs to retrace his path to a safe exit if the incipient fire could not be put out. Thus, the aggregate travel distance to and from the incipient fire should not be excessive;

   (b) longer than 30m hose would require a bigger reel which would create some difficulties in running out the hose and that jamming of tubing could occur when in use.

3. An operating instruction notice plate should be provided next to the stop valve. The hose reel operating instructions shall be:

"Turn on the inlet valve before running out the hose"

4. All hose reels should be tested at least once a year. The test is to ensure that they are maintained in working order and able produce a jet of water with a minimum of 6m throw.

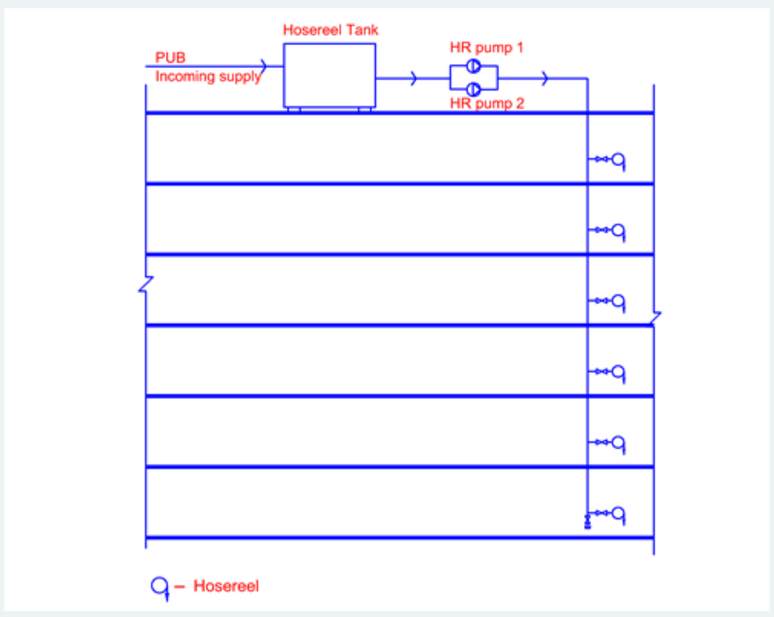
5. Hose reels located in recesses or cabinets shall bear the appropriate sign in accordance with SS 508

6. Hose reels are now required to be type tested by a recognised testing laboratory to meet the standard of EN 671 – 1 or equivalent and are subject to the Productivity & Standards Board Inspection Scheme.

c. <u>Water supply</u>

Water supply for hose reels in terms of flow rate and minimum running pressure shall comply with the requirements in *SS 575*.

Explanation and Illustrations



<u>Figure 6.2.8c.</u>

EXTRACTS FROM SS 575

1. Minimum requirements

(a) As a minimum, the water supply to hose reels shall be such that when the two topmost hose reels with the least hydraulic head in a building are operating simultaneously, each will provide a jet of at least 6m in length at a flow rate of at least 0.4 L/s. For example, when a 30m length of hose reel tubing (Type A of BS 3169) is in use with a 6.5mm nozzle, a minimum running pressure of 1.5 bar will be required at the entry to each reel. Similarly, for a 4.5mm nozzle, a minimum running pressure of 4 bars will be required.

(b) Pipework shall not be less than 50mm nominal bore and feeds to individual hose reels shall be at least 25mm nominal bore.

2. Hose reel pump

(a) Where the water pressure in hose reel main needs to be boosted, the provision of an electrically driven pump is usually a convenient method. A duplicate standby pump shall also be provided.

(b) Both motors and pumps shall be sited in positions where they are protected against tampering and physical and fire damage and the electrical supply to them shall be by an exclusive circuit with the cables following a route of negligible fire risk or be provided with adequate protection.

(c) The hose reel pumps system shall come into operation automatically with a drop in pressure or a flow of water. Both pumps shall be automatically primed at all times.

(d) All pumps shall also be capable of being started or stopped manually. The standby pump shall be so arranged that it will operate automatically on failure of the duty pump. Where more than one source of electrical supply is available, the duty and standby pump shall be connected to the different sources.

(e) Connection for boosted supplies - pumps shall be fed from a suction tank or inter-connected tanks having a minimum capacity of 1100 L. The tanks shall be automatically supplied from a town main or a reliable source, controlled by a ball valve of minimum diameter 50mm.

(f) Use of domestic water tank - tanks supplying water for domestic purposes shall not be used as suctions for hose reel installations unless arrangements have been made for domestic supplies to be drawn off in such a manner that the requisite reserve of water for the hose reel installation is always preserved.

3. Connection for boosted supplies

Pumps shall be fed from a suction tank or inter-connected tanks having a min. capacity of 1100 L. The tank(s) shall be automatically supplied from a town main or a reliable source, controlled by a ball valve of minimum diameter 50mm.

4. Use of Domestic Water Tanks

Tanks supplying water for domestic purposes shall not be used as suctions for hose reel installations unless arrangements have been made for domestic supplies to be drawn off in such a manner that the requisite reserve of water for the hose reel installation is always preserved. There shall not be any risk of contamination of water due to stagnation in the tank. The design of such arrangement is subject to PUB's approval.

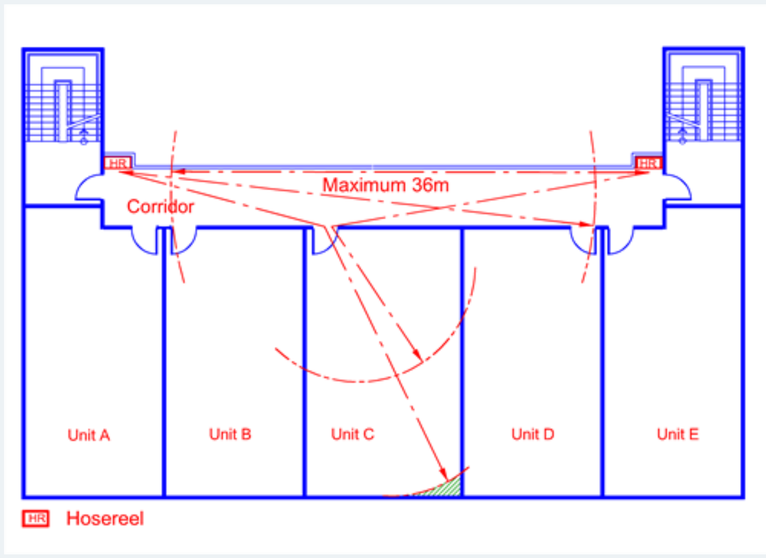
Footnote: Hose reel and sprinkler systems can share the same water tank under the conditions stipulated in SS CP 52.

d. Siting and installation

(1) Siting and details of installation for hose reels shall comply with the requirements in *SS 575*.

(2) Hose reels shall be sited in prominent and accessible locations within a distance of 5m from the exit door but not inside exit staircases. If there are parts of the floor space that are beyond the 36m coverage (30m hose path and 6m throw) of the hose reel, additional hose reels shall be provided at the common area or at a distance of not more than 5m from the exit access door of a room.

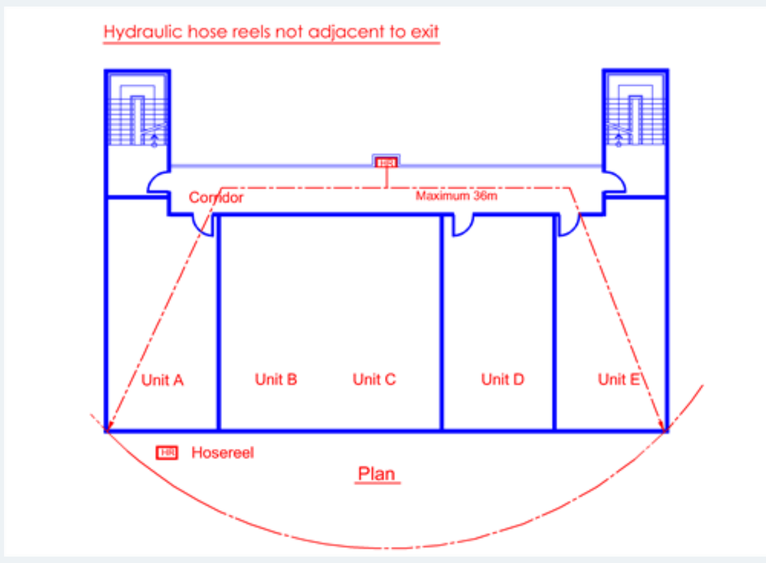
Explanation and Illustrations



Not Acceptable

Figure 6.2.8d.(1) - 1

The distribution of hydraulic hose reels as shown above is not acceptable as there is a pocket of area that is beyond the coverage of the hose reels.



Not Acceptable

Figure 6.2.8d.(1) - 2

EXTRACT FROM SS 575

Distribution of hydraulic hose reel

1. Siting

a. Hose reels shall be sited in prominent and accessible positions adjacent to exits, preferably just outside protected corridors, lobbies or staircases on exit routes, but not inside staircases.

b. In planning the location of hose reels, consideration should be given to the following points:

(1) Access to hose reels should not be obstructed by the parking, loading and unloading of vehicles or by the location of furniture, equipment or other material.

(2) Protection of hose reels from mechanical damage and unauthorised use.

(3) The location of internal walls, partitions, doorways, storage racking, stored heights of goods and other obstructions, which could restrict normal hose coverage through the building.

2. Installation of hose reels

References shall be made to SS 575 for details on installation of the hose reel.

(3) Hose reels located within a room shall not be used for covering the areas outside the room.

e. Piping

The use of copper or stainless steel piping is permissible for the connection of the hose reels to the PUB mains. Where only 1 number of hose reel is required, water supply pipe with nominal diameter of at least 25mm is permitted if the hose reel meets the required flow rate and pressure as stipulated in *SS 575*.

Explanation and Illustrations

(No illustration)

1. Pipework for hose reel system shall not be less than 50mm nominal bore and feeds to individual hose reels shall be at least 25mm nominal bore.

2. Copper or stainless steel pipes can be incorporated in the pipe works supplying water to the hose reels.

The above sub-clause allows the flexibility of using alternative material for the water supply pipe of the hose reel system.

6.2.9 Graphical symbols

Explanation and Illustrations

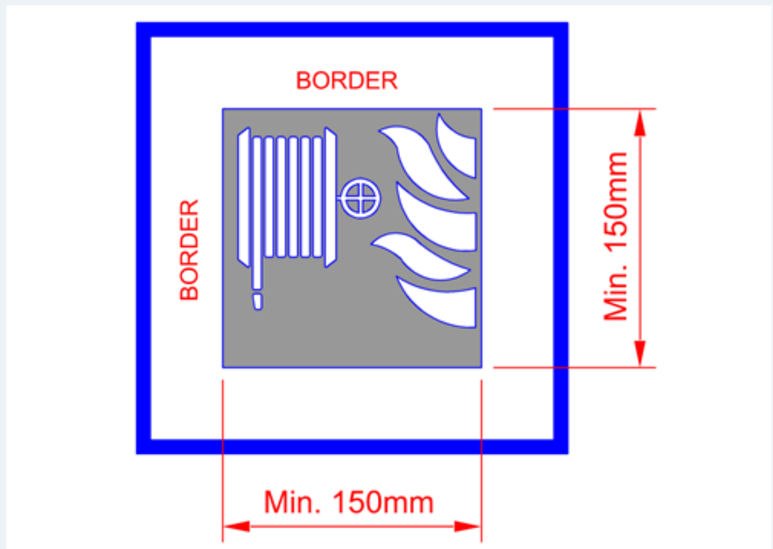


Figure 6.2.9

The minimum size of the symbol when viewed more than 12m away. The size of symbol is not inclusive of borders.

Graphical symbols to depict fire safety equipment are allowed for use in buildings provided the signs comply with *SS 508*. The *Table 6.2.9* shows the different sizes of the graphical symbol with respect to the viewing distance.

TABLE 6.2.9 SIZES OF GRAPHICAL SYMBOLS				
Viewing Distance	0 to 6m	> 6 to 9m	> 9 to 12m	12m or more
Minimum height of symbol (Z=100)	60mm	90mm	120mm	150mm
Note: The luminous factor (Z=100) from SS 563 is used to determine the size of the sign. It essentially dictates the size of the sign that varies with distance. The graphical symbol for firefighting equipment shall be sized such that the height and width are same. The size of symbol is not inclusive of borders.				

CLAUSE 6.3 ELECTRICAL FIRE ALARM SYSTEM

6.3.1 General

a. PG III to VIII occupancies

(1) Every building or part of a building, except that of PG I or II (residential floors), having a total floor area of more than that specified in column (3) of *Table 6.3A* having regard to the purpose group of the building or part of the building, shall be installed with a fire alarm system, either of the automatic or manual type as indicated in column (4), which shall be an electrically supervised system complying with the requirements of the *SS 645*. The fire alarm system shall be connected to the SCDF's Operations Centre through an approved alarm monitoring company if required under Cl.6.3.8.

Explanation and Illustrations

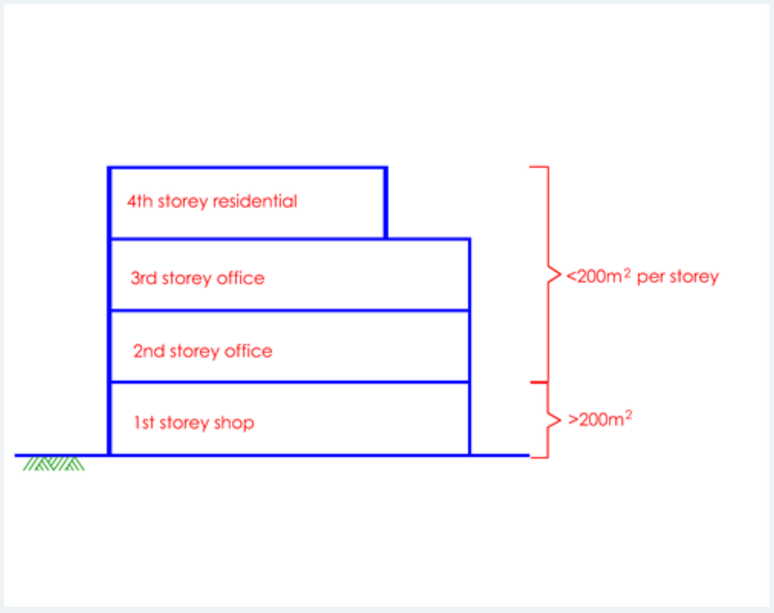


Figure 6.3.1a.(1) - 1

Based on the floor area of 1st storey, the above building is required to be provided with manual fire alarm system to 1st, 2nd and 3rd storey, which are for commercial usage. The bells of the alarm system shall be extended to the common areas (lobbies, corridors, staircases, etc.) of the residential floor at 4th storey.

Warehouse

Single storey warehouse not exceeding 2000m² is not required to be provided with fire alarm system unless otherwise specified by the SCDF. The main reason is that the building is small, hence escape to the exterior via exit doors would be straight forward.

Warehouse building of 2 to 4 storeys and having a total floor area (per storey) of greater than 1000m² is required to provide manual type of fire alarm system. This manual fire alarm system (break glass type) is not required to be connected to an approved alarm monitoring company.

Warehouse building which is more than 4 storeys is required to be provided with automatic fire alarm system such as smoke or heat detection types, irrespective of the floor area per storey.

Factory

Single storey factory building not exceeding 400m² is not required to be provided with fire alarm system unless otherwise specified by the SCDF. The main reason is that the building is small, hence escape to the exterior via exit doors would be straight forward.

Factory building of 2 to 4 storeys and having a total floor area (per storey) of greater than 200m² is required to be provided with manual type of fire alarm system. This manual fire alarm system (break glass type) is not required to be connected to an approved alarm monitoring company.

Factory building which is more than 4 storeys is required to be provided with automatic fire alarm system such as smoke or heat detection system, irrespective of the floor area per storey.

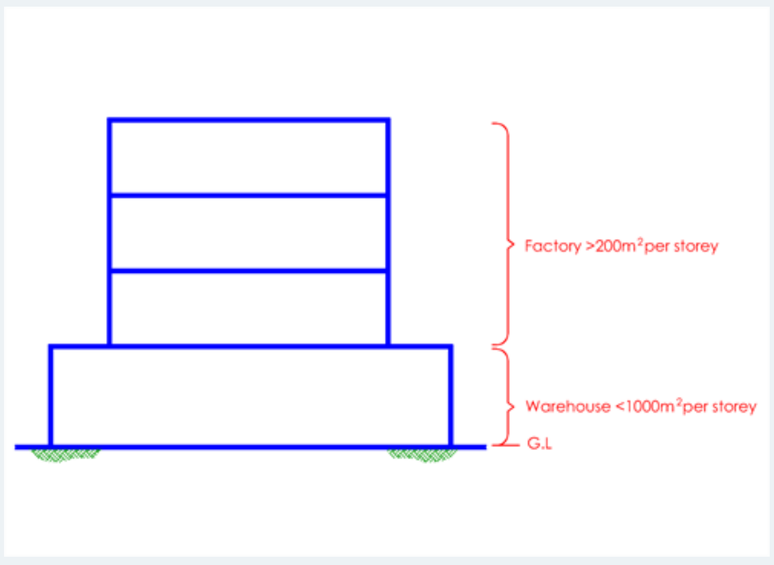


Figure 6.3.1a.(1) - 2

Even though the warehouse floor has less than 1000m², the whole building is required to be provided with manual fire alarm system as the factory floor (per storey) exceeds 200m².

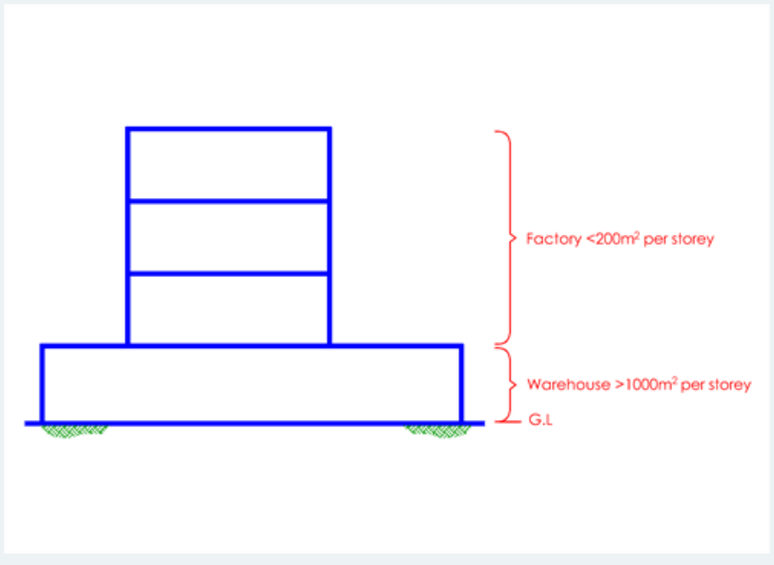


Figure 6.3.1a.(1) - 3

Although the floor area of each factory floor is less than 200m², the building is required to be provided with manual fire alarm system as the warehouse located at 1st storey exceeds 1000m².

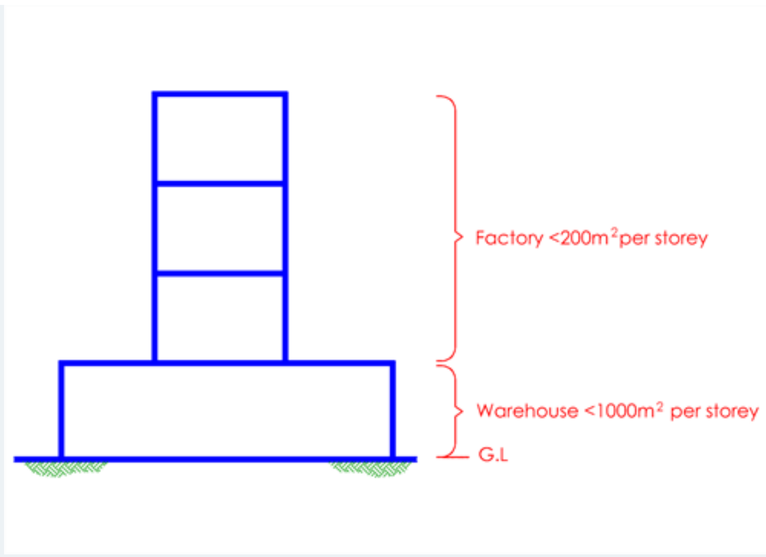


Figure 6.3.1a.(1) - 4

Factory or Warehouse

As the factory floor area per storey is less than 200m² and the warehouse floor area is less than 1000m² there is no need to provide fire alarm system unless requested by the SCDF. It should be noted that if in the event that warehouse floor is granted change of use to factory, a manual fire alarm system will be required to be provided to the whole building. The main reasons for the difference in floor area between factory and warehouse are:

a. occupants load of factory is higher than warehouse;

b. occupants would be working for long hours in factory as compared to warehouse where workers would only be involved when there is movement of goods in/out of the building.

Owners of factory or warehouse installed with manual fire system could opt for connection to the approved alarm monitoring station. Approved alarm monitoring stations are private monitoring companies. Owing to excessive false alarm signals being received by fire stations in the past, such monitoring was introduced to screen and verify the activation of automatic fire alarm signals.

Office/Shop

Single storey shop or office building not exceeding 400m^2 is not required to be provided with fire alarm system unless otherwise specified by the SCDF. The main reason is that the buildings are small, hence escape to the exterior via exit doors would be straight forward.

Building of 2 to 4 storeys and having a total floor area (per storey) of greater than 200m^2 is required to be provided with manual type of fire alarm system. This manual fire alarm system (break glass type) is not required to be connected to an approved alarm monitoring company.

Building which is more than 4 storeys is required to be provided with both automatic fire alarm system such as smoke or heat detection system and manual fire alarm system, regardless of the floor area per storey.

Place of Public Resort

1. With stay-in facilities:

Single storey building used as a place of public resort with stay-in facilities shall be provided with manual type of fire alarm system, regardless of the floor area.

Building of 2 or more storeys shall be provided with both automatic fire alarm system such as smoke or heat detector system and manual fire alarm system, regardless of the floor area per storey.

The main reason for having more stringent requirement in respect of the provision of fire alarm system is the presence of sleeping risk involving guests.

2. Without stay-in facilities:

Single storey building used as a place of public resort without stay-in facilities and having a floor area not greater than 400m2 is not required to be provided with fire alarm system unless otherwise specified by the SCDF. The main reason is that the building is small, hence escape to the exterior via exit doors would be straight-forward.

Building of 2 to 4 storeys and having a total floor area (per storey) of greater than 200m^2 shall be provided with manual fire alarm system. This alarm system is not required to be connected to an approved alarm monitoring station. Building which is more than 4 storeys is required to be provided with both automatic fire alarm system such as smoke or heat detection system and manual fire alarm system, regardless of the floor area per storey. This is in compliance with column (4) of *Table 6.3A*. The complementary manual fire alarm system would allow occupants to activate the system before the automatic smoke or heat detection system is set-off by the smoke or heat from the fire.

Mixed Occupancy

When there are two or more purpose groups in a building, the strictest requirement for any one of the purpose groups shall be applicable to the whole building.

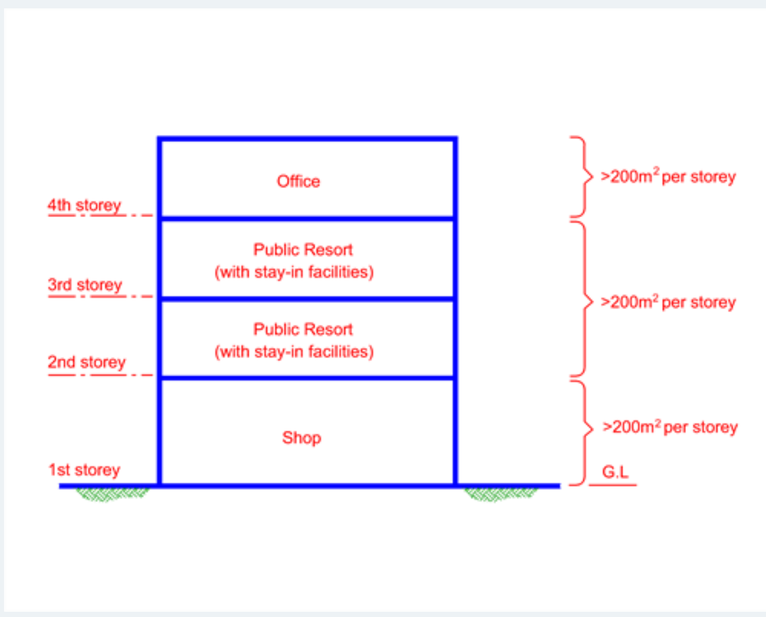


Figure 6.3.1a.(1) - 5 : Example of office/shop/public resort usage

Even though the whole building is not more than 4 storey, it is required to be provided with both automatic and manual fire alarm systems, owing to the sleeping risk in the 2nd & 3rd storeys.

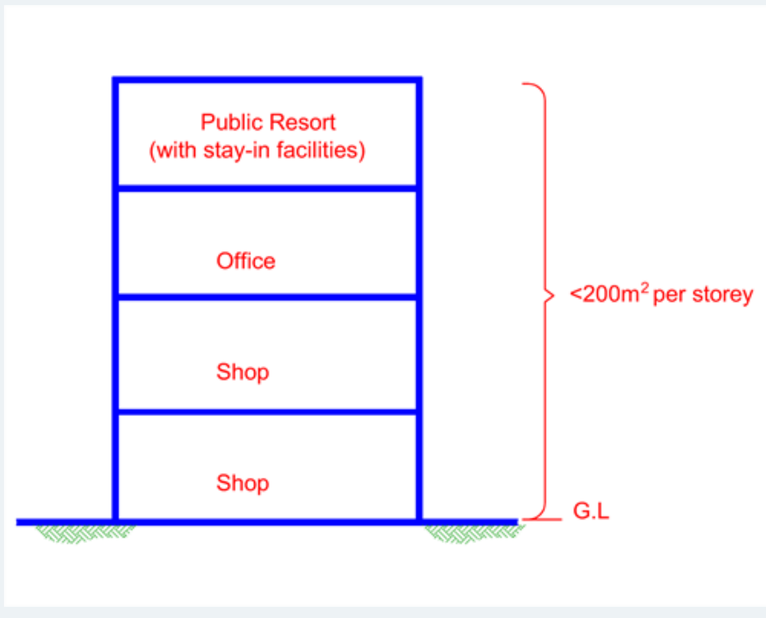


Figure 6.3.1a.(1) - 6

Although the floor area of each floor is less than 200m^2, the building is required to be provided with both automatic and manual fire alarm systems because of public resort with stay-in facilities.

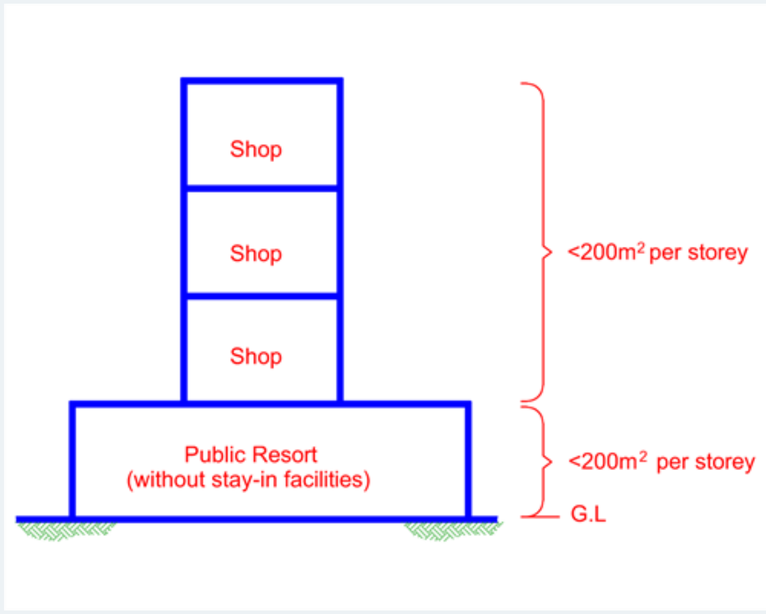


Figure 6.3.1a.(1) - 7

As the area per storey is less than 200m² and the public resort does not have stay-in facilities, there is no need to provide fire alarm system unless otherwise required by the SCDF.

School

1. Single storey school building is not required to be provided with fire alarm system unless otherwise specified by the SCDF. The main reason is that the building is single storey without sleeping accommodation, hence escape to the exterior via exit doors would be straight forward.

2. Building of 2 to 4 storeys without sleeping accommodation and having a total floor area (per storey) of greater than 400m2 is required to be provided with automatic type of fire alarm system. This automatic fire alarm system is not required to be connected to an approved alarm monitoring station. If the total floor area per storey exceeds 4000m², then both automatic and manual fire alarm system are required to be provided under *Cl.6.3.1a.(2)*.

3. Building of 2 to 4 storeys with sleeping accommodation shall be provided with both automatic and manual fire alarm system.

4. Building which is more than 4 storeys but less than 24m in habitable height without sleeping accommodation shall be provided with automatic type fire alarm system. If the total floor area per storey exceeds 4000m², then both automatic and manual fire alarm system shall be provided under *Cl.6.3.1a.(2)*.

5. Building which is more than 4 storeys but less than 24m in habitable height with sleeping accommodation shall be provided with both automatic and manual fire alarm system.

Healthcare occupancy

1. With stay-in facilities:

Single storey building used as healthcare occupancy e.g. hospital, old folk home etc., with stay-in facilities shall be provided with manual fire alarm system, regardless of the floor area.

Building of 2 or more storeys shall be provided with both automatic fire alarm system such as smoke or heat detector system and manual fire alarm system, regardless of the floor area per storey.

The main reason for having more stringent requirement in respect of the provision of fire alarm system for such premises is to address the concerns of sleeping risk.

2. Without stay-in facilities:

Single storey building used as healthcare occupancy without stay-in facilities and regardless of the floor area is not required to be provided with fire alarm system unless otherwise specified by the SCDF. The main reason is that the building is single storey without sleeping accommodation, hence escape to the exterior via exit doors would be straight forward.

Building of 2 to 4 storeys and having a total floor area (per storey) of greater than 200m2 shall be provided with manual fire alarm system. This alarm system is not required to be connected to an approved alarm monitoring company. The total floor area per storey of a 2 to 4 storeys building shall not exceed 4000m² unless automatic and manual fire alarm system are provided. See *Cl.6.3.1a.(2)*.

Building of more than 4 storeys is required to be provided with both automatic fire alarm system such as smoke or heat detection system and manual fire alarm system, regardless of the floor area per storey. This is in compliance with column (4) of *Table 6.3A*. The complementary manual fire alarm system would allow occupants to activate the system before the automatic smoke or heat detection system is set-off by the smoke or heat from the fire.

3. Dormitories/Hostels:

Building of single storey used as dormitory/hostel shall be provided with manual fire alarm regardless of the floor area subject to *Cl.6.3.1a.(2)*, which stipulates that the total floor area per storey of a 2 to 4 storeys buildings shall not exceed 4000m² unless both automatic and manual fire alarm system are provided.

Building of more than 1 storey used as dormitory/hostel shall be provided with both automatic and manual fire alarm system.

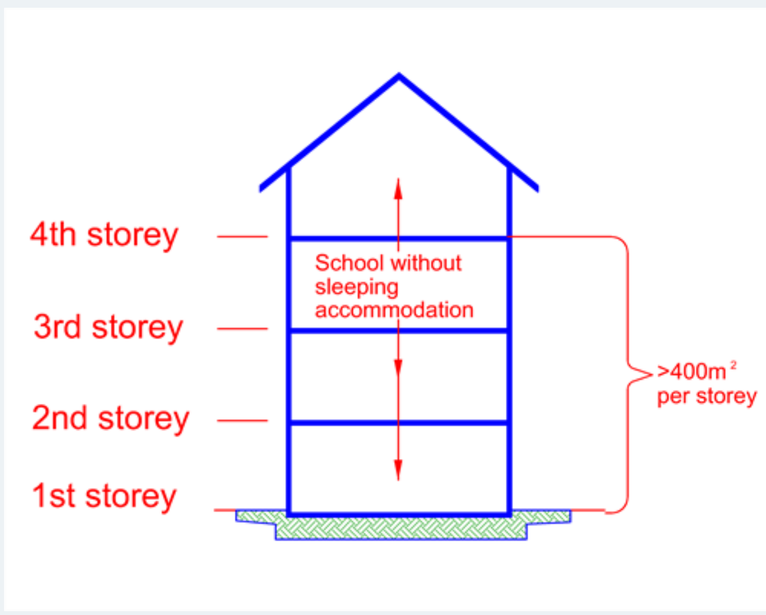


Figure 6.3.1a.(1) - 8 : School building of 2 to 4 storeys with floor area per storey more than 400m^2

School buildings exceeding 4 storeys but not exceeding 24m in habitable height shall be provided with automatic fire alarm system. If the above 4 storey building is provided with sleeping accommodation, then both automatic and manual fire alarm system shall be provided, regardless of the floor area per storey.

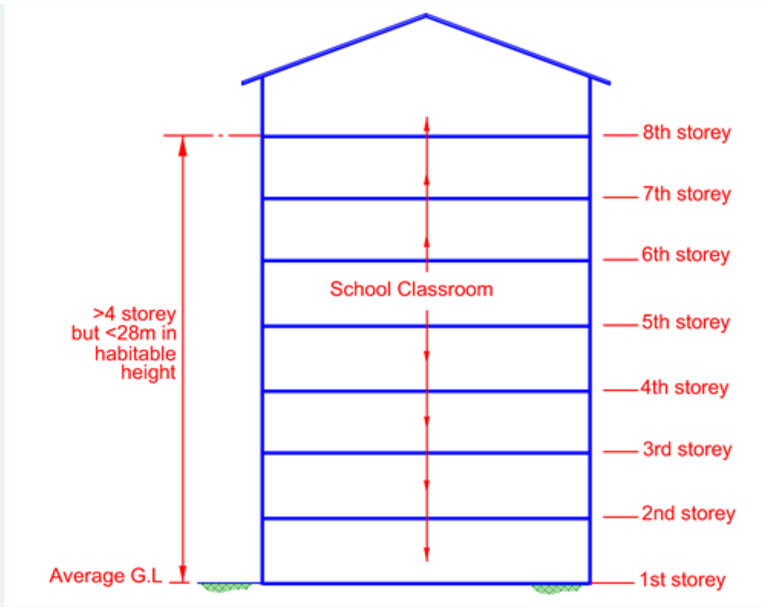


Figure 6.3.1a.(1) – 9

School buildings exceeding 4 storeys but not exceeding 24m in habitable height shall be provided with both automatic and manual types of fire alarm system.

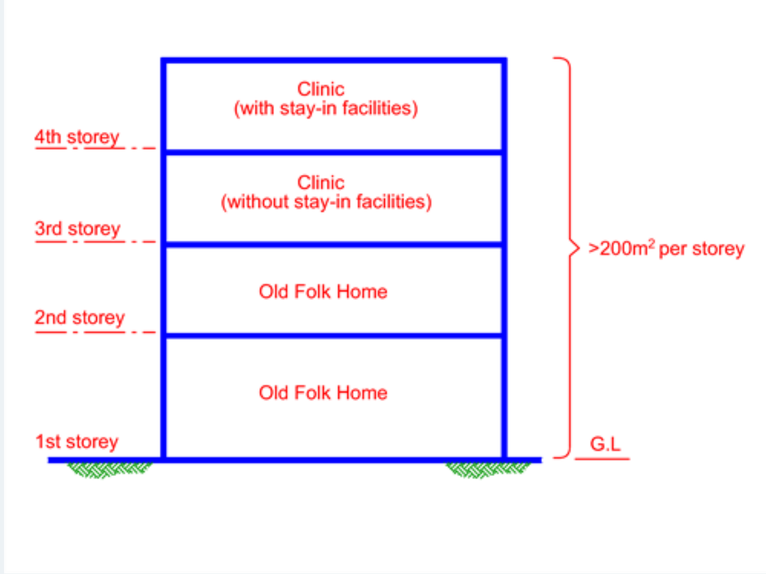


Figure 6.3.1a.(1) – 10 : Mixed occupancy

Owing to the sleeping risk in the homes, the building is required to be provided with both automatic fire alarm system and manual fire alarm system.

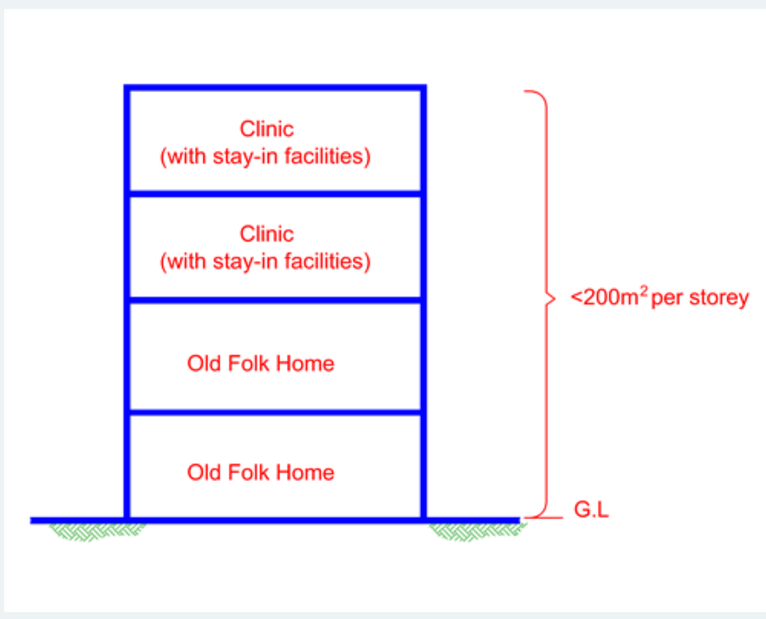


Figure 6.3.1a.(1) – 11

Although the floor area of each floor is less than 200m², the building is required to be provided with both automatic fire alarm system and manual fire alarm system because of clinic with stay-in facilities and old folk homes.

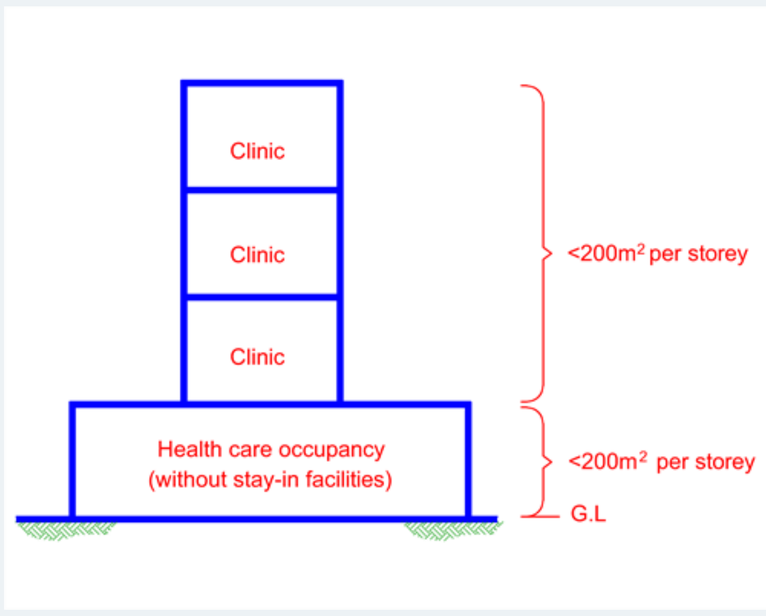


Figure 6.3.1a.(1) – 12

As the area per storey is less than 200m^2 and the clinic and health care occupancies do not have stay-in facilities, there is no need to provide automatic fire alarm system unless otherwise required by the SCDF.

(2) Notwithstanding *Cl.6.3.1a.(1)* above, if the total floor area per storey of a 2 to 4 storey building of any of the PG III to VIII exceeds the sizes as stipulated in column (2) of *Table 3.2A*, the building shall be provided with an automatic fire alarm system.

Explanation and Illustrations

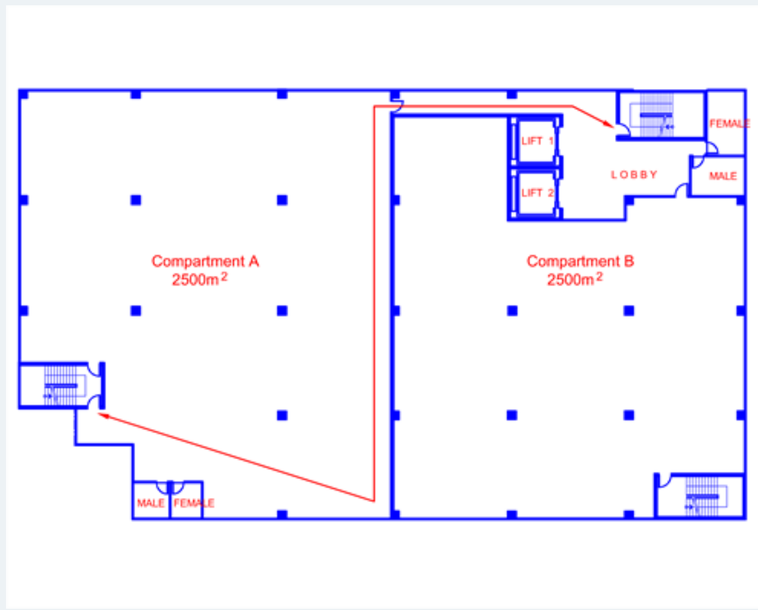


Figure 6.3.1a.(2)

The above figure shows a typical floor area exceeding 5000m², accordingly it requires sprinkler protection for such excessive floor area. By compartmentalising the floor area with each compartment not exceeding 4000m², sprinkler installation will be waived. In its place, automatic fire alarm system is required to be provided. Therefore, notwithstanding the provision of compartmentation, if the total floor area per storey of a 2 to 4 storey building exceeds 4000m², the building shall be provided with automatic fire alarm system. This requirement will not apply to a single storey building. The automatic fire alarm system serves to provide early detection to the occupants. Hence, it allows more time for occupants to evacuate.

b. PG II mixed occupancy

For PG II mixed occupancy buildings where an automatic sprinkler system and/ or electrical fire alarm system is provided to the non-residential part of the building:

(1) Alarm sounders shall be able to produce a minimum sound level of 65dBA, or 5dBA above the ambient noise level, whichever is greater but not more than 120dBA, at all parts of the following areas:

(a) the non-residential units;

(b) the common areas of the non-residential floors; and

(c) the common areas of the immediate two residential floors above the non-residential floor.

(2) Connection of the fire alarm system to an approved alarm monitoring company stipulated under Cl.6.3.8 is not required if the number of non-residential floors is not more than one storey.

c. Dormitories

For dormitories, including workers' dormitories, an electrical fire alarm system shall be provided as follows:

(1) For single storey dormitory buildings, manual fire alarm system is to be provided to comply with *SS 645*.

(2) For dormitories exceeding one storey, both automatic and manual fire alarm systems shall be provided to comply with *SS 645*.

d. The following are not required to be provided with electrical fire alarm system:

(1) Roof of single storey buildings with roof height not more than 12m or roof of any buildings with inaccessible pitched roof up to 24m from grade level used solely for roof-mounted PV installations in accordance with *Cl.10.2.1b.(1)*.

(2) Roof of an external/ open-sided overhead bridge/ shed/ linkway/ walkway with clear width less than 6m, roof height not more than 12m and used solely for roof-mounted PV installations in accordance with *Cl.10.2.1b.(1)*

Rationale

During a fire emergency in non-residential spaces, the building occupants closer to these spaces should be notified via fire alarm sounding. As each residential unit is a fire compartment by itself, total evacuation of the building occupants is not necessary. However, those units closer to the fire source could be affected by smoke and fire and hence need to be alerted to be prepared for evacuation. For units located further away from the fire floor, it is safer for the occupants to remain within their units. These occupants will have sufficient time to evacuate if the fire cannot be controlled/contained. Phased evacuation could reduce the risk of stampede and injury as compared to total evacuation.

6.3.2 Fire alarm panel

a. An electrical fire alarm system of the automatic or manual type shall be provided with a fire alarm panel to indicate the location of the alarm which has been actuated or operated. Such an alarm panel shall be accurate to the maximum allowed alarm group area limitations specified in *SS 645*.

b. The associated control and supervisory equipment, indicating equipment, wiring and arrangement of power supplies for the fire alarm panel shall comply with the requirements in *SS 645*.

c. All automatic systems which are activated via the general building alarm shall be connected directly to the fire alarm panel.

Explanation and Illustrations

(No illustration)

1. Fire fighters responding to a fire call would first, on arrival at the scene, need to check the fire alarm panel to confirm the location of the alarm, which has been actuated or operated before proceeding to the fire site.

2. The Fire alarm panel monitors the actuation of detectors, call-points and sprinkler flow switch.

3. A permanent fire zone chart or minic panel shall be displayed at the Fire alarm panel location to provide information on originality of the alarm. The fire zone chart or minic panel shall be installed in accordance with the floor or building orientation. All the alarm zones and Fire alarm panel zones if provided should be clearly depicted on the fire zone chart/minic panel. Additional information such as, fire engine accessway, location of breeching inlets, fire hydrant, sprinkler control valve, hosereel and fire extinguisher should be provided on the fire zone chart/minic panel where applicable. This would help the fire fighters to identify the location of fire engine accessway, breeching inlets etc., when they arrived at the fire site.

4. Where addressable fire alarm system is used, fire alarm panel shall be provided additional to the programmable message on display.

d. The fire alarm panel shall be located near the main entrance of the building, in the Fire Command Centre (FCC), in the guardhouse or in the fire lift lobby.

e. Sub fire alarm panel, where provided, shall comply with the requirements in *SS 645* be located at the fire lift lobby, smoke-free lobby, or protected staircase, in that order of priority, or at the main point of entry into the area covered by the alarm zone.

Explanation and Illustrations

(No illustration)

Where FCC is not provided, the fire alarm panel is usually near the main entrance of the building or in the guardhouse.

Where sub-fire alarm panels are provided, they shall be located at the fire lift lobby, smoke-stop lobby, protected staircase in that order of priority or at the main point of entry into the area covered by the alarm zone.

6.3.3 Manual alarm call points

Explanation and Illustrations

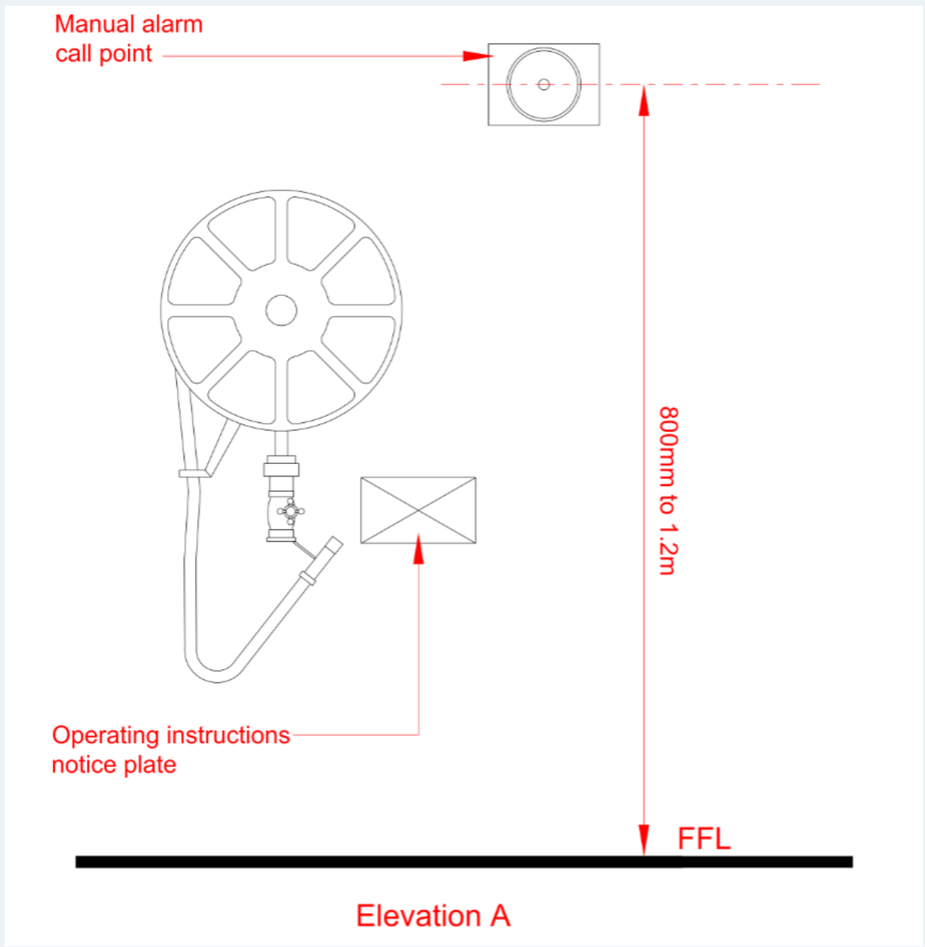


Figure 6.3.3

1. Manual call points shall be located:

    (a) along exit routes leading to exit staircase;

    (b) adjacent to hose reels;

    (c) at floor landing of exit staircases; and

    (d) at exits to the street.

2. Manual call points shall be so located such that no occupant needs to run more than 30m, measured from any position within the building to a manual call point.

a. In a manual alarm system, except as otherwise exempted in Cl.6.3.1, the manual call points shall be provided on every storey of the building or part of the building and shall be so located that no person need travel more than 30m from any position within the building to activate the alarm.

b. Manual call points shall be located on exit routes preferably next to hose reels and in particular on the floor landings of exit staircases and at exits to the street. In the case where an automatic fire alarm system is provided, grouping for indication of location of the manual call points shall comply with the requirements in *SS 645*.

c. Manual call points shall be located between 800mm and 1.2m above the finished floor level and shall be located at easily accessible and conspicuous positions free from obstructions. The installation of the sounding device shall be in accordance with *SS 645*.

d. Exemption

Manual call points can be omitted for the following:

(1) car parks, regardless whether the parking facility is standalone type or forms part of a building;

(2) open-to-sky roof gardens/terraces, provided an alarm sounder is extended to this level and positioned near the exit staircase except for developments where fire alarm system is not required; and

(3) mezzanine floor of factory or warehouse unit, subject to compliance with *Cl.9.6.1a(2)* or *Cl.9.8.1a.(2)*, respectively. No person on the mezzanine floor shall need to travel more than 30m to activate the nearest manual call point located on the main floor.

e. Manual call point shall be provided for buildings protected with an automatic fire sprinkler system or automatic fire alarm system.

6.3.4 Automatic fire alarm

Explanation and Illustrations

(No illustration)

Automatic alarm system would not normally be provided to solely PG II buildings. However, there is an advantage of providing smoke detectors, as the detectors could detect the generation of smoke from even incipient fires, hence providing occupants early warning and adequate lead-time in evacuation. Automatic fire alarm system is required in buildings of more than 4 storeys having commercial cum residential mix, for example, shops with apartment/maisonette units above.

SS CP 10 gives general guidance for selection of detectors. Whenselecting the type of detectors, the likely fire behaviour of the contents of each part of the building, the processes taking place and the design of the building should be considered. The effective coverage of each type of detectors differs from each other. The location of placing the detectors and the spacing between detectors shall apply with the requirements in SS CP 10. Detectors shall be zoned into alarm group and be properly wired to achieve electrical supervision of the alarm circuit.

Where an automatic fire alarm system is required by this Code, the type, location, spacing and installation of the detectors shall comply with the requirements in *SS 645*.

6.3.5 Alarm device

Explanation and Illustrations

(No illustration)

It is important that the sounding from the electrical fire alarm system, for example, installed in the office/shop/places of public resort, should be audible and readily distinguishable to all occupants.

All fire alarm sounders must generate the continuous ringing tone of the bell. In special environment where the use of bell tone is impractical or in area of high background noise level, other tone may be used, in which case SCDF's permission must be sought.

The number of fire alarm sounders used should be sufficient to produce a minimum sound level of either 65 dBA, or 5 dBA above any other noise likely to persist for a period longer than 30 seconds, whichever is greater, in all parts of the buildings which are normally occupied.

In areas where a normal type of sounder may be ineffective, e.g. where the background noise is excessive, where the occupants are deaf or where hearing protection is likely to be worn, visual signals shall be provided. In general, visual signals shall not be used in place of audible alarms. The intensity of the light shall be sufficient to draw the attention of people in the vicinity.

In discos, nightclub and other places of entertainment, it is recommended that the sound system be electrically interlocked with the fire alarm system to enable the sound system to be automatically cut-off in the event that the fire alarm is activated.

a. General

(1) The alarm device, which should normally issue an audible or visible signal, unless specifically allowed or required otherwise by the SCDF, shall be actuated if the electrical fire alarm system is activated or operated. The type, number and location of the alarm device shall comply with the requirements in *SS 645*.

(2) All sounders and visual alarm signals in the building shall be actuated simultaneously in the event of an activation. However, in cases permitted or required by the SCDF where the operation of alarm sounders are grouped or activated in stages, the arrangement shall comply with the requirements in *SS 645*.

b. Audio alarm

The fire alarm sounder shall have a sound that is readily distinguishable from any other alarm systems. In places of entertainment or areas where sound and/or special effects lighting systems are installed, including KTV kiosks/booths placed within building premises, the sound systems shall be electronically interlocked with the fire alarm system to enable these systems to be automatically cut-off when the fire alarm system is activated

c. Visual alarms

(1) Visual alarms shall be provided in addition to the audible alarms for buildings protected by fire alarm systems and separate visual alarm(s) shall be provided in the following:

(a) Where persons with hearing impairment can be isolated, especially when they are not in their identified locations, visual alarm(s) shall also be provided:

(i) in toilets and inside full-height partitioned cubicles;

(ii) car park floors;

(iii) lift lobbies; and

(iv) in places of entertainment, e.g., dance halls, gaming outlets, internet games cafes, arcades where users use headgear that affect hearing or areas where sound and/ or special effects lighting systems are installed.

(2) Visual alarms shall not be used in place of audible alarms.

(3) Siting of visual alarms

Visual alarms shall be located together with fire alarm sounder. Where they are not readily visible from areas accessible to persons with hearing impairment who may be in isolation, additional visual alarms shall be provided. The height of the visual alarms shall be between 2m to 3m above finished floor level.

(4) Technical specifications

Visual alarms shall comply with all of the following requirements:

(a) They shall take the form of a flashing beacon or strobe light for use in conjunction with the conventional fire alarm system.

(b) They shall be clearly distinguishable from any other visual indicator used in the premises.

(c) They shall be labelled with the word “Fire” of at least 15mm in height and lettering colour shall contrast with the background.

(d) The flashing rate shall be within 30 to 130 flashes per minute.

(e) The visual alarm signal shall be in white or red.

(f) The flashing of all visual alarm signals within a same space/ room shall be synchronised.

(g) The intensity of the light signal shall be sufficient to draw the attention of people in the vicinity.

6.3.6 Home Fire Alarm Device (HFAD)

Rationale

Home Fire Alarm Devices (HFAD) provide occupants with early warning of fire and enable occupants to extinguish the fire before it escalates. At the same times, enable occupants to evacuate safely.

Note

There is no need for building owners to engage a QP for submitting plans to the SCDF solely for the voluntary installation of HFAD. However, if QPs are submitting plans to the SCDF or other government agencies for other fire safety works carried out for residential homes, then QPs shall indicate the locations of the fire alarm device(s) on the submitted plans.

For individual residential units under PG I or II, HFAD shall be installed in accordance with all of the following requirements:

a. HFAD shall possess the following features and comply with all the requirements stated below:

(1) operate on smoke detection technology alone, or have a multi-sensor detector (a detector with multiple sensors built into the device) with smoke detection capability;

(2) indicator lights to inform users on the status/ condition of the device(s);

(3) temporary silence/ reset feature to address false alarms;

(4) alarm sounder with sound level compliant with any standard listed in item (7);

(5) test button to allow the device(s) to be tested/checked periodically;

(6) to be powered by long-life built-in battery (i.e., battery that lasts at least 10 years) with low battery alert capability, or to be wired to household electrical supply;

(7) detector design to comply with any of the following standards (*EN 14604, AS 3786, UL 217*);

(8) where two or more HFADs are installed, all devices shall be interconnected (either wired or wirelessly) such that when one of the HFADs is triggered, all connected HFADs shall sound an alarm simultaneously (see *Diagram 6.3.6a.(8)*); and

(9) the HFAD shall be either:

(a) listed by any accredited certification body accepted by the SCDF, or

(b) listed by Underwriters Laboratories (UL), or

Explanation and Illustrations

(No illustration)

Such wireless connectivity shall comply with IMDA’s Technical Specification for Short Range Devices. It is also preferred that the devices adhere to requirements in the TR40 Technical Reference for Sensor Network for Smart Nation (Homes).

(c) listed under the ActivFire Scheme, or

(d) CE marked with certification from approved 3rd party Notified Bodies, or

Note

For HFAD listed under ActiveFive Scheme, visit website *https://activfire.csiro.au/outline.asp*

(e) listed under BSI Product Directory.

b. Additional independent functions to enhance the operation of the HFAD may be included as optional features (Such as connection to smart home systems, remote controls, visual alarms, vibrating pads, etc.) of the HFAD, given that the requirements indicated in *Cl.6.3.6a.* are met.

c. Table 6.3.6 states the minimum number of HFAD required for different home types, as well as the locations in which the detectors shall be installed.

Note

For HFAD listed under BSI Product Directory, visit website *https://www.bsigroup.com/en-GB/Product-Directory/*

TABLE 6.3.6 MINIMUM NUMBER OF HFAD TO BE INSTALLED FOR DIFFERENT HOME TYPES	
Home type	**Number and location of detectors (Also refer to Diagram 6.3.6 c. - 1 & 2)**
Single storey homes: (1) HDB flats (2) Apartments/Condominium (3) Single storey landed dwellings	(1) Minimum 1 smoke detector (2) Installed along circulation area / escape route, e.g. living room, corridor (3) Optional: Additional detectors can be installed in other spaces for enhanced protection.
Multi-storey homes: (1) Landed/Non-landed dwellings (2) HDB flats (3) Apartments/ Condominiums	(1) Minimum 1 smoke detector per storey (2) For storeys with circulation area > 70m², at least 2 smoke detectors need to be installed on that storey. (3) Installed along circulation area / escape route e.g. living room, corridor, and/or staircase landing (4) Optional: Additional detectors can be installed in other spaces for enhanced protection.

6.3.7 Alarm system for cinema

A theatre or cinema shall be provided with an electrical fire alarm system of the manual type complying with all of the following:

a. The manual alarm system shall be installed in the lobbies and other areas adjoining the hall and shall be connected to the SCDF Operations Centre through an approved alarm monitoring company

Explanation and Illustrations

(No illustration)

Manual alarm call points are required to be provided in the lobbies and other areas adjoining the cinema hall. Occupants escaping from a fire in the hall could break the glass of the call point to activate the alarm.

Manual alarm call points and sounding devices are not allowed to be installed in the hall owing to the nature of the occupancy, the lighting level and seating arrangement. The sounding of any alarm bells in the cinema hall when a show is in progress would cause confusion and panic to the occupants.

b. Visual indicators and audible sounders shall be installed in the projection room and in another room where a designated staff member can alert the audience in case of a fire.

Explanation and Illustrations

(No illustration)

In place of general sounding alarm, visual alarm indicator such as beacon lights and audible alarm indicator, instead of alarm bells are required to be installed in the projection room and cinema manager office to alert both the projectionists and the manager immediately, so that occupants in the cinema hall would be advised through the projection screen and or public address system to evacuate the hall in an orderly and calm manner.

c. The provision of the fire protection system in cinema which forms part of a building shall be similar to that of the building.

Explanation and Illustrations

(No illustration)

In situations where the cinema hall or halls are located within a commercial building, the fire protection system of the commercial building such as sprinkler system, would be required to be extended to cover the cinema hall, lobbies, projection room and other ancillary areas.

6.3.8 Connection to the SCDF Operations Centre

The electrical fire alarm system required to be installed in a building or premises under this clause shall be connected to the SCDF Operations Centre through an approved alarm monitoring company when the building or premises is:

a. a health care occupancy, hotel or other similar occupancies, or

b. an oil refinery, oil depot, general warehouse, chemical plant or other high hazard factory or premises, or

c. a theatre, cinema or concert hall as specified in Cl.6.3.7, or

d. a building required under the provisions of this Code to be protected by an automatic fire alarm (except those exempted under *Cl.6.3.1b.*) or fire extinguishing system.

6.3.9 Sprinkler-protected building

Explanation and Illustrations

(No illustration)

Where sprinkler system is provided in any building, there is no necessity to provide automatic fire alarm system (heat or smoke detection system). Exception is for electrical rooms, AHU room, lift motor room, battery room, MDF room, PABX room where sprinkler system is replaced by electrical fire alarm system. Smoke detectors are also required to be installed in sprinkler-protected buildings to operate the smoke control system in atria, smoke purging system or control system in basement occupancies.

Where sprinkler system is required by this Code, provision of automatic thermal/ smoke detectors in sprinkler-protected premises is exempted except where such detectors are required to activate/ operate the sprinkler, engineered smoke control system or other systems.

6.3.10 Exemption of automatic fire alarm protection

The following areas are exempted from automatic fire alarm protection in an automatic fire alarm building:

a. External open-sided linkways not exceeding 5m in width measured from eave to eave, provided these areas are not for commercial activities or storage.

b. Areas which are covered with trellises, louvres or perforated panels having 50% or more evenly distributed effective free openings. An alarm sounder and visual alarm shall be provided near the exit staircase in accordance with *SS 645*.

c. Open-to-sky roof gardens/ terraces located within PG II buildings or mixed-use residential buildings, provided there are no covered commercial activities/ spaces at the open-to-sky roof gardens/ terraces. When there is other non-residential occupancy other than the open-to-sky roof gardens/ terraces located within the same PG II building, the alarm sounder and visual alarm shall be extended to the open-to-sky roof gardens/ terraces and positioned near the exit staircase in accordance with *SS 645*.

6.3.11 Video Image Fire Detection System (VIFDS)

Rationale

This new clause allows VIFDS to be used to complement conventional smoke, heat and flame detectors in an electrical fire alarm system. It is best installed in premises with large open space and high roofs such as production areas, halls, warehouses etc.. VIFDS can cover gaps where smoke detectors are unable to detect particles due to high air flow and can help reduce false alarm. It is compulsory to install VIFDS in unmanned buildings as there are no security or operation personnel to check and confirm whether there is an actual fire when the fire alarm system is activated after office/operating hours.

a. VIFDS shall be installed in addition to the electrical fire alarm system for buildings which meet all of the following conditions:

(1) It is an unmanned buildings belonging to PG III to VIII.

(2) It has an internal open space of more than 2000m^2 or a ceiling height of more than 12m.

(3) It requires the provision of automatic fire alarm system in accordance with *Table 6.3A*.

b. VIFDS shall comply with SS 645 and can be used to complement smoke, heat and flame detectors in an electrical fire alarm system.

c. It shall be connected to the SCDF Operations Centre through an approved alarm monitoring company. Alarm signals and live video images of fire and/or smoke captured shall be transmitted to the approved alarm monitoring company upon activation of the building fire alarm system.

CLAUSE 6.4 FIRE SPRINKLER INSTALLATION

6.4.1 Provision

Every storey/ room of a building, unless otherwise exempted by this Code, shall be protected by an automatic sprinkler system under the following situations:

a. Compartment size

Whenever compartmentation requirements under *Table 3.2A* of *Chapter 3* of this Code cannot be complied with.

b. Buildings other than PG I and II

Every storey of buildings of more than 24m in habitable height, except for PG I and II, regardless of whether the compartmentation requirements are complied with.

Explanation and Illustrations

The provision of automatic sprinkler system is required in residential buildings under PG II under the following conditions:

a. Compartmentation requirements under Chapter 3 of the Fire Code cannot be complied with, for example, a building exceeding 24m in habitable height having 3-levels maisonette or penthouse units, or

b. Residential apartment/maisonette or penthouse unit being located within a commercial tower block exceeding 24m in habitable height

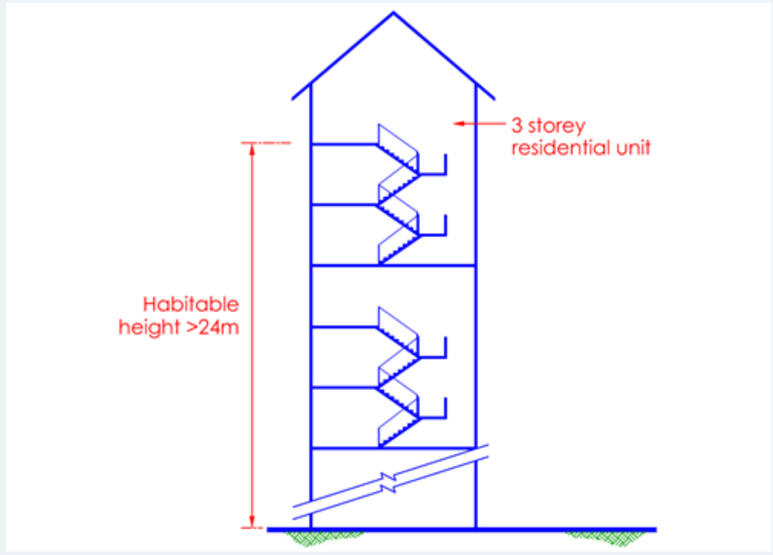


Figure 6.4.1a. - 1 : Residential building exceeding 24m habitable height

Cl.3.2.4 permits only residential maisonette or penthouse to have maximum 2-storey levels above 24m habitable height. In designing 3 floors per unit, it would be contravening the compartmentation requirement under *Table 3.2A*. To overcome the problem, automatic sprinkler system should be provided to the whole building.

The provision of automatic sprinkler system is required in factory or warehouse under the following conditions:

(a) Compartmentation requirements under Chapter 3 of the Fire Code cannot be complied with, a building not exceeding 24m in habitable height having more than 3 –levels or excessive cubical extent or floor area.

(b) Engineered smoke control system is required to be installed.

(c) High bay storage warehouse

Cl.3.2.4a permits max. 3 storeys to form a single compartment up to a habitable height of 24m. In designing more than 3 floors per compartment, it would be breaching the compartmentation requirement. To overcome the problem, automatic sprinkler system should be provided to the whole building. However, building owners are at liberty to provide the sprinkler system to their buildings as an added fire safety. The system could be used as a trade-off for extended travel distances.

No sprinkler system is required if all of the following is satisfied:

(a) habitable height < 24m

(b) compartment area < 4000m²

(c) cubical extent of each compartment < 15000m³

(d) not more than 3 storeys interconnected.

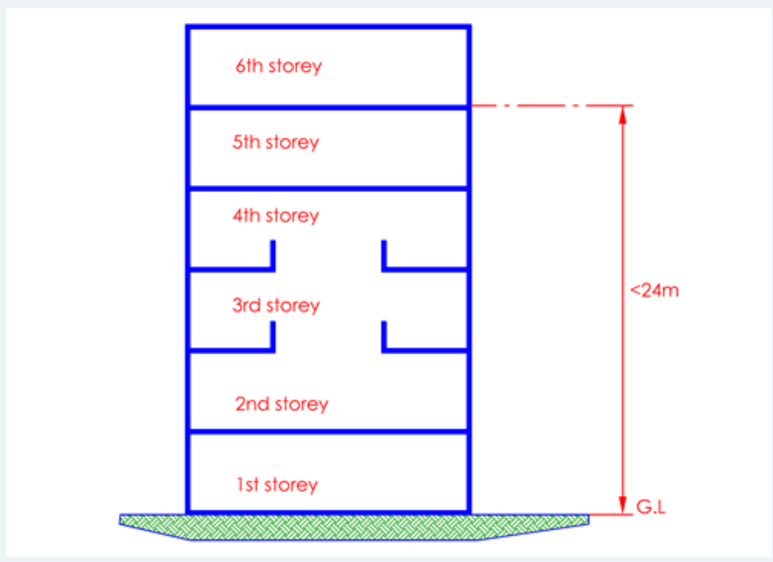


Figure 6.4.1a. - 2

Not more than 3 storey per compartment

Area of compartment < 4000m² & cubical extent < 15000m³

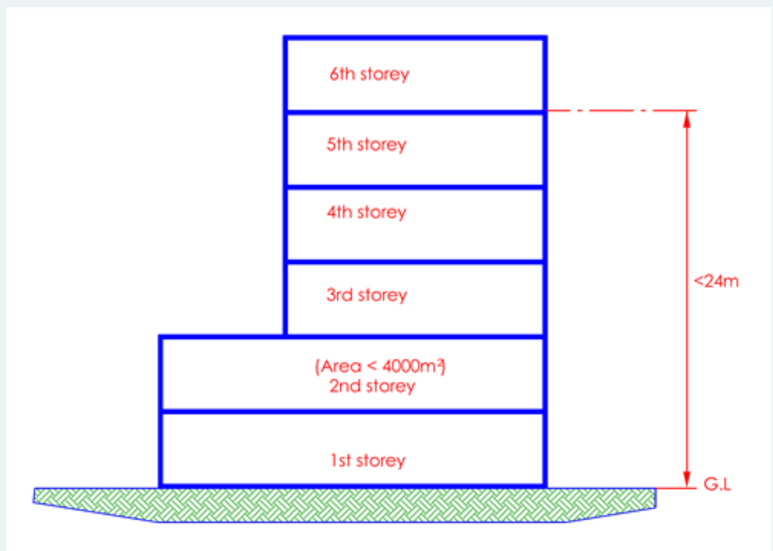


Figure 6.4.1a. – 3 : Floor area per compartment not exceeding 4000m^2

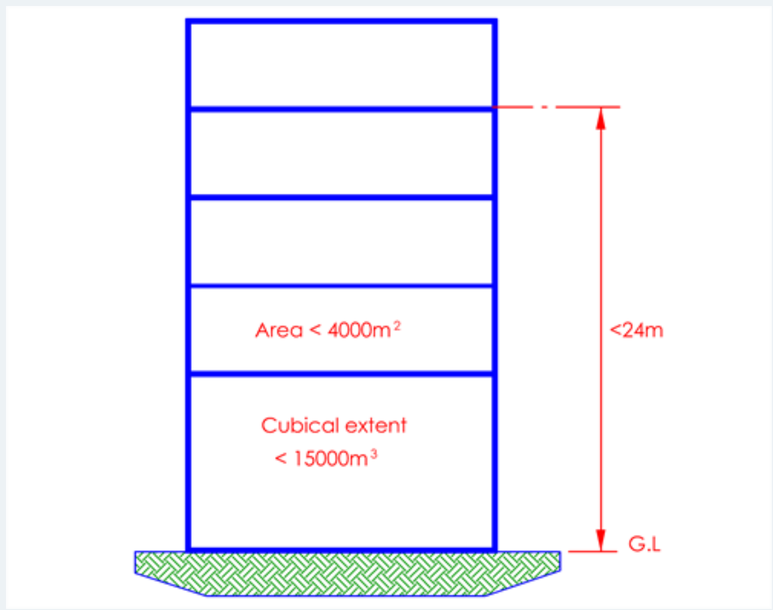


Figure 6.4.1a. – 4 : Cubicle extent per compartment not exceeding 15000m^3

c. PG II mixed occupancy

(1) For PG II mixed occupancy buildings exceeding 24m in habitable height, the non-residential parts shall be protected by an automatic sprinkler system if they:

(a) comprise more than one storey, or

(b) are located above the first storey.

(2) For PG II mixed occupancy buildings regardless of habitable height, the non-residential parts shall be protected by an automatic sprinkler system if they are not compartmented from the basement storeys.

(3) Exemption

(a) Intermediate sky terraces used as communal areas without commercial activities, or storage, provided the ventilation openings for the sky terraces are evenly distributed around the external walls, excluding perimeter walls to air wells, with ventilation openings not less than 50% of all external walls.

(b) Open-sided pavilion/ shed used as communal areas in accordance with *Cl.6.2.8a.(3)(c)(iv)*.

(4) For non-residential parts where sprinkler protection is not required under sub-clauses *(1), (2) & (3)* above, an automatic fire alarm system shall be provided for the non-residential parts in accordance with *Cl.6.3.1b.*.

d. Basement

(1) All basement storeys irrespective of compartment size, except for those used as PG I or II, shall be provided with an automatic sprinkler system. Where the upper storeys of the building are fully compartmented from the basement storeys, the requirement for provision of an automatic sprinkler system for floors above the basement shall be considered separately and in accordance with *Cl.6.4.1a., b. and c*.

(2) Exemption

(a) Where the basement storey is effectively cross ventilated to prevent smoke logging, the basement storey can be exempted from providing an automatic sprinkler system.

(b) In the case of residential developments located over basement car parks, relaxation on the provision of these sprinkler system and smoke purging systems to the basement car park can be granted if all of the following conditions are met:

Rationale

The ventilation openings provided at the basement car parks minimizes the risk of smoke-logged situation. These dimensions have been validated through a fire engineering study.

(i) The basement car parking shall consist of one level only.

Explanation and Illustrations

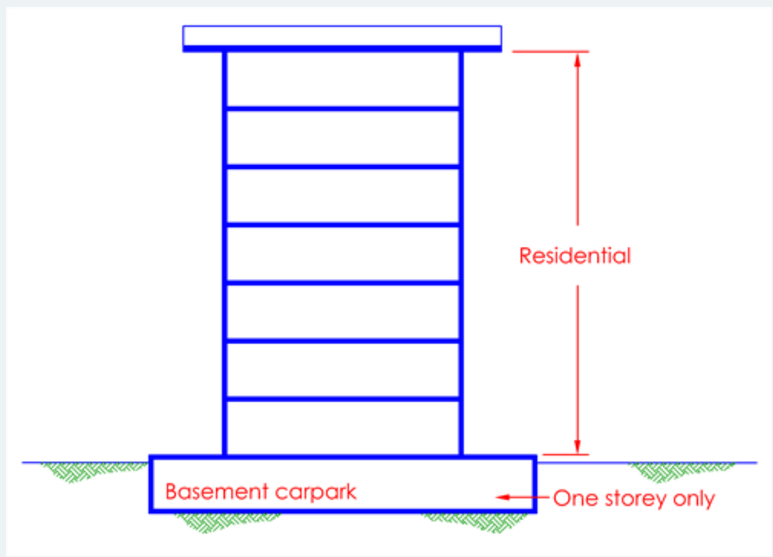


Figure 6.4.1d.(2)(b)(i)

Provision of sprinkler and smoke purging system in this situation can be exempted.

(ii) External openings shall be provided to achieve effective cross ventilation by means of evenly distributed vertical openings along the perimeter walls and evenly distributed voids over the basement in such manner that:

- no point within the basement is more than 12m from any vertical opening or void for spaces that are in between two openings or voids;
- no point shall be more than 6m from any opening or void for spaces that are ventilated by such opening or void on only one side; and
- such vertical openings shall be at least 600mm in height.

Explanation and Illustrations

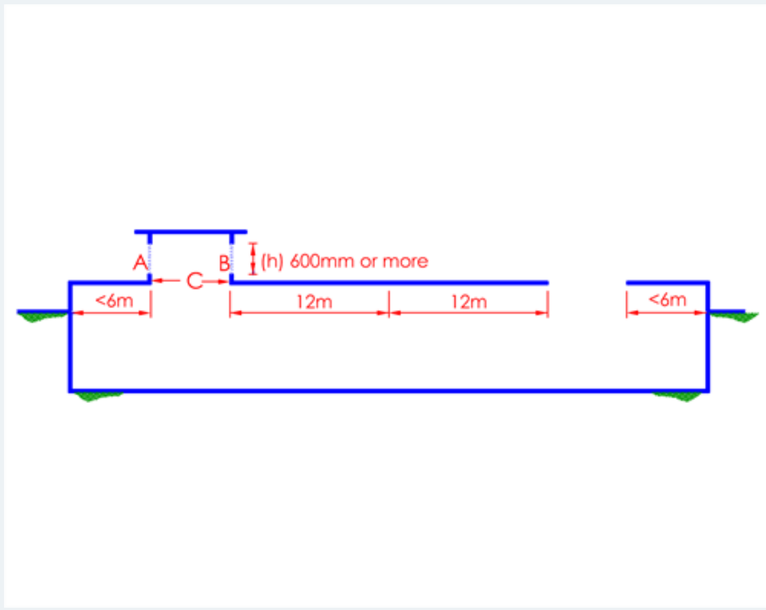


Figure 6.4.1d.(2)(b)(ii) : Ventilation openings to basement car park of residential buildings

1. Area between two voids/ vertical openings – no point within the basement is more than 12m from such voids/ openings.
2. When the opening or void is only on one side, no point shall be more than 6m from the edge of such opening or void.
3. The clear height (h) in *Figure 6.4.1d.(2)(b)(ii)* of vertical openings, A & B, shall be at least 600mm in height.
4. The lesser of areas, A+B, or C, of the ventilation opening shall be considered as the effective area of ventilation.

(iii) The total aggregate area of these voids and vertical openings shall be not less than 20% of the total basement floor area.

Explanation and Illustrations

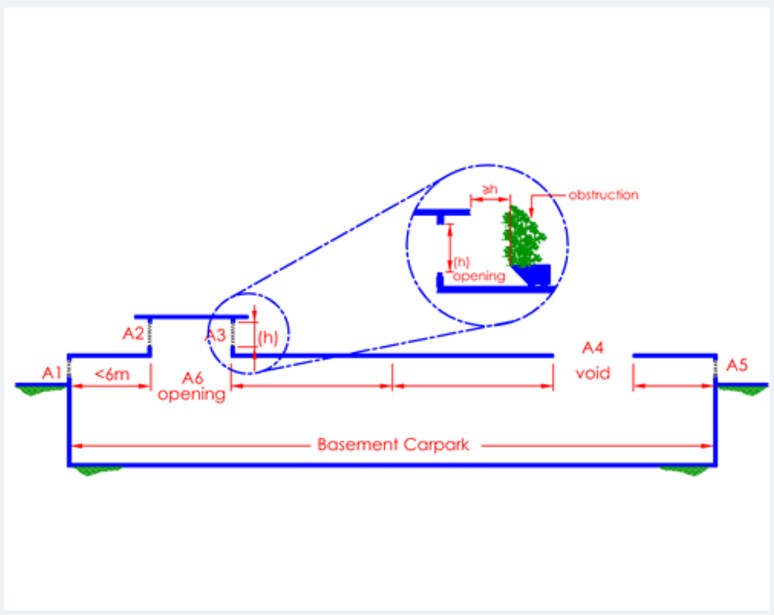


Figure 6.4.1d.(2)(b)(iii)

Total aggregate area of voids and vertical openings shall not be less than 20% of the floor area.

i.e. 20% of A > A1 + { lesser of (A2 + A3) or A6 } + A4 + A5

(where A is the area of basement, and A1 to A6 are areas of ventilation openings)

(iv) An automatic fire alarm system shall be provided for the basement car parks with extension of alarm bells to the common/lobby areas of the upper storeys in accordance with *Cl.6.3.1a. and b*.

Explanation and Illustrations

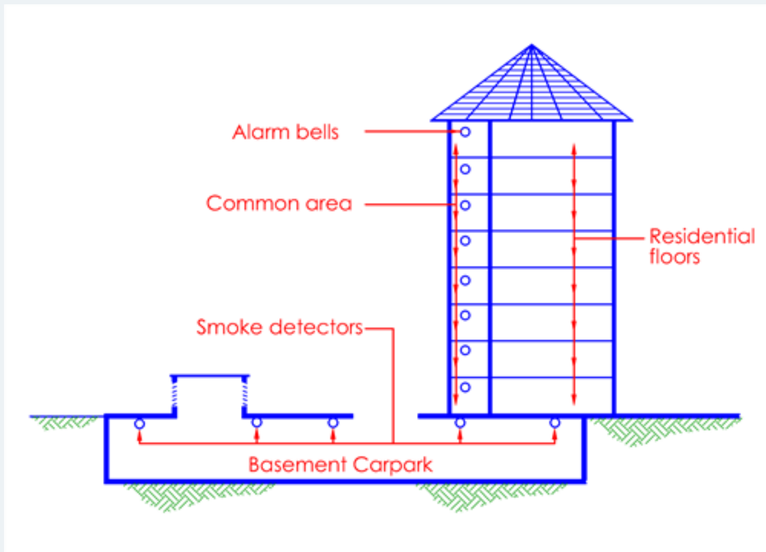


Figure 6.4.1d.(2)(b)(iv) – 1

Basement shall be provided with automatic fire alarm system. The alarm bells of the system shall be extended to the common / lobby areas of the upper storeys.

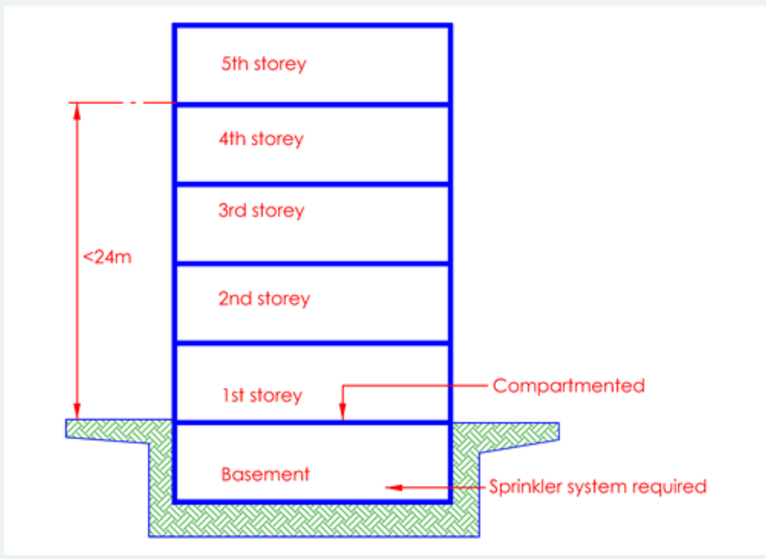


Figure 6.4.1d.(2)(b)(iv) – 2

All basement storeys shall be provided with automatic sprinkler system irrespective of the compartment size.

(a) Floor area and cubical extent of each storey do not exceed 4000m² and 15000m³ respectively;

(b) Habitable height of the highest floor does not exceed 24m.

(c) Upper storeys are fully compartmented from the basement storey.

e. Atrium space

A fire sprinkler system shall be provided for an atrium space not exceeding 18m in height. Water monitor, deluge and/ or extended-throw sprinkler systems shall be provided to cover the portion of atrium space that exceeds 18m.

f. Exemption of sprinkler protection

(1) All of the following areas are exempted from sprinkler protection in a sprinkler-protected building:

(a) Covered areas

Areas which are covered with trellises, louvres or perforated panels, which have 50% or more evenly distributed effective free openings. An alarm sounder and visual alarm shall be provided near the exit staircase in accordance with *SS 645*.

(b) Areas under roof-mounted PV installations on non-habitable roof

Each sub-array of PV installation shall not exceed 5m in width, with maintenance aisle of minimum 400mm width in between the sub-arrays. Each sub-array shall be open-sided without any commercial activities or storage within these areas. The maximum dimensions of PV arrays shall be in accordance with *Cl.10.2.1d.*.

(c) Staircase storey shelter

A sprinkler head shall be provided outside the door of the staircase storey shelter on sprinkler-protected floors. The sprinkler head shall be within a horizontal distance of 1m from the centre of this door.

(d) Booths/ pods

Booths/ pods shall be for use in a work environment and comply with all the following requirements:

(i) The booth/ pod shall not extend to the soffit of the ceiling or roof.

(ii) The area of each group of booths/ pods placed together shall not exceed 3m^2.

(iii) A separation distance of at least 3m shall be provided between each group of booths/ pods.

(iv) Each booth/ pod shall be equipped with an automatic smoke detector that is directly connected to the building's fire alarm system, either through a wired or wireless connection. The detector shall be capable of activating the building's fire alarm system upon fire detection. Wireless transmission systems shall be equipped with appropriate transmitters/ receivers to ensure reliable connectivity in accordance with international standard and shall comply with the prevailing IMDA frequency bandwidth requirements.

(v) The booths/ pods shall not be used for storage purposes.

(2) All of the following areas not located within PG VI or VIII buildings are exempted from sprinkler protection in a sprinkler-protected building:

(a) Canopies/ car porches

(i) Such areas are to be used solely for the purpose of passengers pick-up and drop-off.

(ii) There shall be no commercial activities or storage within these areas.

(iii) Cut-off sprinklers and fire-rated walls are not required to be provided to separate the sprinkler-protected and non-sprinkler-protected areas.

(b) External corridor

External corridors shall not exceed 4m in width, and there shall be no commercial activities or storage within these areas.

(c) External/ open-sided linkways

External/ open-sided linkways shall not exceed 5m in width, and there shall be no commercial activities or storage within these areas.

Explanation and Illustrations

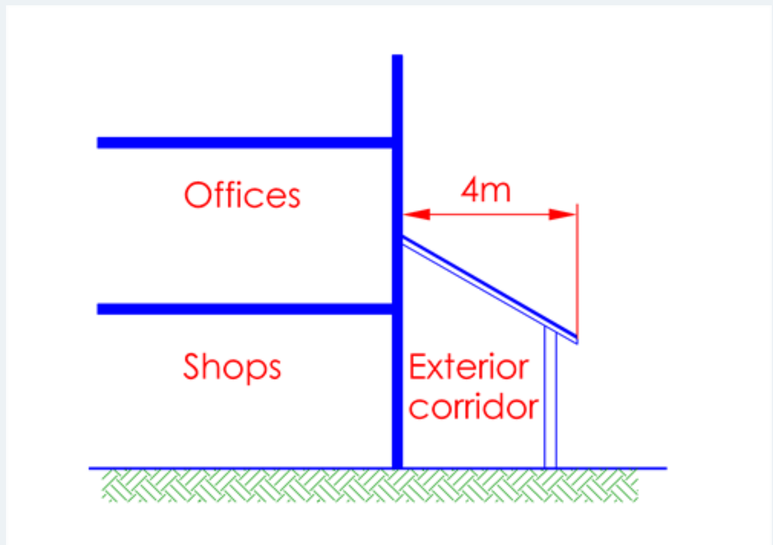


Figure 6.4.1f.(2)

The width of the external corridor shall not exceed 4m, measured from the external wall of the building to the edge of the roof cover of the corridor.

(d) Open-to-sky roof gardens/ terraces

Open-to-sky roof gardens/ terraces provided there are no covered commercial activities/ spaces at the open-to-sky roof gardens/ terraces. An alarm sounder and visual alarm shall be extended to the open-to-sky roof gardens/terraces and positioned near the exit staircase in accordance with *SS 645*.

6.4.2 Standard

Explanation and Illustrations

(No illustration)

(a) Sprinkler system to maisonette or apartment units under PG II is not a requirement. However, where basement car park cannot comply with the requirements of Cl.6.4.1 and Cl.3.2.5, sprinkler system shall be provided as illustrated under PG VIII.

(b) Building owners are also at liberty to provide the sprinkler system as an added fire safety. The system could be used as a trade-off for extended travel distances and other fire safety requirements at the discretion of the SCDF.

In view of other system not covered under SS CP 52 for example like Early Suppression Fast Response Sprinkler System could be adopted provided it is over and above the mentioned SS CP 52.

Installation of the sprinkler system and its associated water supply, and control and testing requirements shall comply with the *SS CP 52*.

6.4.3 System design

Explanation and Illustrations

(No illustration)

Where the provision of the sprinkler system to a building is a requirement under the Fire Code or at the direction of the SCDF, the system shall be linked to an approved alarm monitoring company. All transmitting equipment shall be approved by the authority having jurisdiction. The transmitting equipment shall have at least the following features:

(a) Transmission of signal via “leased-line”

(b) Alternative transmission path via telephone which serve as back-up

(c) Indications for status of “leased-line”, phone line, system test, alarm, power supply, and unauthorised opening of the panel box

“Leased- line” shall be the primary means of signal transmission with an automatic switch over to normal telephone line upon leased-line failure. Refer to SS CP 10 for further references/details.

a. Connection to the SCDF Operations Centre

The sprinkler system shall be electrically monitored so that on the operation of any sprinkler head, the fire signal is automatically transmitted to a fire station through an approved alarm monitoring company.

b. Fire pumps

Installation of fire pumps for sprinkler systems shall comply with requirements of *SS CP 52*. Sprinkler pumps shall be installed within a fire compartmented fire pump room, whose fire rating shall be in accordance with *Table 6.4A*. The sprinkler pump room floor level shall not be lower than the main floor level.

c. Sprinkler control valve

The sprinkler control valve(s) shall be located in one of the following areas:

(1) Facing an external space within a travel distance of 10m from entrance to the FCC.

(2) Within a fire lift lobby/ smoke-free lobby.

(3) Within a sprinkler pump room.

(4) Within a 1-hr fire-rated enclosure, located at most 10m travel distance from the entrance to the exit staircase.

d. Location plan

A floor plan showing the locations of the sprinkler tank room, sprinkler pump room, breeching inlets and control valves shall be prominently displayed within the FCC. In the absence of the FCC, the floor plan shall be located in the following order of priority:

(1) within the guard house, or

(2) next to the main fire alarm panel

6.4.4 Special purpose rooms

a. Where a building is required to be provided with an automatic sprinkler system under this Code, parts of the building which are used for purposes stipulated in *Table 6.4A* shall be compartmented in accordance with columns 3(a) and 3(b) of the table.

Explanation and Illustrations

(No illustration)

Openings of these special purpose rooms for example lift motor room at the roof top need not to be provided with fire resistance door as stipulated in *Table 6.4A*. This arrangement is allowed only if the door is located at the external wall and opened directly to the exterior and subject to compliance with Cl.3.5 to be unprotected opening. In addition there is no possible fire risk to other room usage.

Compartmentation and door rating of the special purpose rooms shall not be less than the fire resistance of the elements of structure of the building where the room is located. For storeroom, kitchen, emergency lighting battery room and FCC, the fire resistance for the compartment walls, floors/ceilings and doors shall have the min. periods specified in *Table 6.4A*.

b. Where a building is not required to be provided with an automatic sprinkler system under this Code, special purpose rooms stipulated in *Table 6.4A* shall be compartmented in accordance with columns 2(a) and 2(b).

Explanation and Illustrations

(No illustration)

Columns 2(a) and 2(b) of *Table 6.4A* spell out the minimum periods of fire resistance rating for storeroom, kitchen, emergency lighting battery room and FCC. Actual period may be higher, and shall comply with the elements of structure of the building where the room is located.

c. For the protection of communication nerve centres, data process centres and process control rooms composing of high value computers or telecommunication equipment, if automatic sprinklers are to be replaced by an automatic fire extinguishing system, the enclosure to the hazard or occupancy shall comply with the following:

(1) it shall be constructed to have 1-hr fire resistance rating;

(2) any door opening shall be protected with a 1-hr fire door;

(3) it shall not be provided with more than two exits;

(4) the direct travel distance to any exit door of the enclosure shall not exceed 15m; and

(5) the fire extinguishing system shall use clean agent and shall conform to Cl.6.5.2.

Explanation and Illustrations

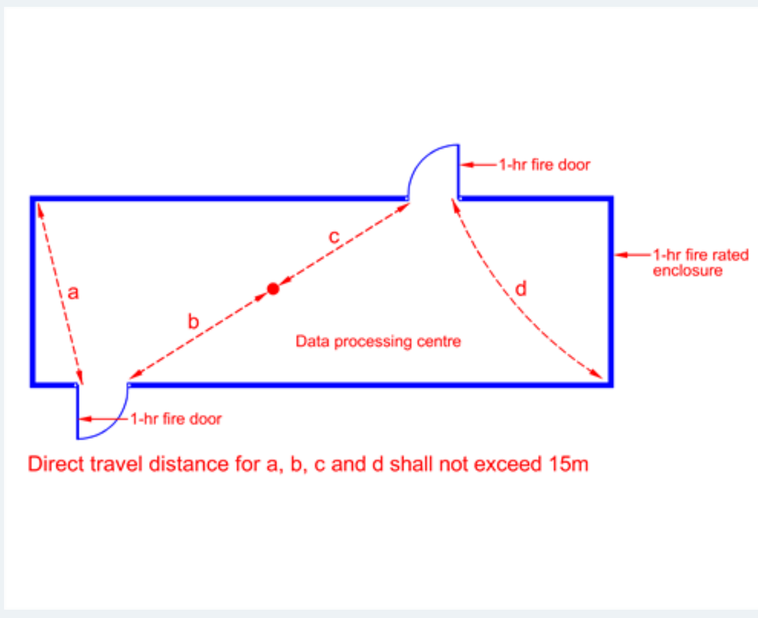


Figure 6.4.4c.

Since the sprinkler heads in the room would be omitted, it is necessary to use the direct one-way travel distance requirement to limit the room size, hence the direct one-way travel distance of maximum 15m shall be strictly complied with.

6.4.5 Car park

In multi-storey buildings under PG II to VIII with an aboveground car park, the provision of fire protection and smoke control systems for the car park shall be in accordance with *Table 6.4B*.

6.4.6 Water mist systems

Water mist systems can be permitted as a substitute for automatic sprinklers in sprinkler-protected buildings, provided all of the following requirements are complied with:

a. The water mist system shall be of a propriety design that has been tested to meet the performance requirements of a standard acceptable to the SCDF.

b. The design and installation of water mist system shall conform to *NFPA 750* or *AS 4587*.

c. The components of the water mist system shall be listed by a recognised testing laboratory.

6.4.7 Reduced water storage for automatic fire sprinkler system

This reduced water storage is only applicable to existing buildings of habitable height not exceeding 60m, and which have a hazard classification of Ordinary Hazard Group I, II or III under *SS CP 52*. It shall not apply to new buildings, any building housing storage risks and chemical processes.

a. Design considerations

(1) Tank sizing

The minimum water storage capacity of the sprinkler tank shall be capable of providing adequate water supply for 30 mins of the sprinkler pump operation.

(2) System with reliable inflow

For sprinkler systems with a constant reliable inflow from the town mains to replenish the sprinkler tank, the effective tank storage capacity for the various hazard categories shall be as follows:

TABLE 6.4.7a.(2): EFFECTIVE TANK CAPACITY FOR RELIABLE INFLOW OF NOT LESS THAN 1.0m³/min, & WATER INLET POINT AT REDUCED LEVEL OF 125m OR BELOW		
Occupancy group	System demand**	Minimum effective capacity of storage tank, or 30 mins' storage, whichever is greater
OH1	540 L/min	12.5m³
OH2	1000 L/min	25.0m³
OH3	1350 L/min	37.5m³
Note: ** = the upper limit in column 6 of Table 17 of SS CP 52		

(3) System with unreliable inflow

For sprinkler systems with an unreliable inflow from the town mains to replenish the sprinkler tank, the effective tank storage capacity for the various hazards categories shall be as follows:

TABLE 6.4.7a.(3): EFFECTIVE TANK CAPACITY FOR UNRELIABLE INFLOW OF LESS THAN 1.0m³/min, OR WATER INLET POINT AT REDUCED LEVEL GREATER THAN 125m		
Occupancy group	System demand**	Minimum effective capacity of storage tank, or 30 mins' storage, whichever is greater
OH1	540 L/min	16.2m³
OH2	1000 L/min	30.0m³
OH3	1350 L/min	40.5m³

Note:
** = the upper limit in column 6 of Table 17 of SS CP 52

(4) Pipe sizing

Full hydraulic calculation methods shall be adopted for the design of the sprinkler system pipework. The sprinkler design must ensure that the flow does not exceed the system demand as stipulated in *Table 6.4.7a(2)* and *Table 6.4.7a(3)*, throughout the installation. The flow and pressure limitations can be overcome by employing constant flow pressure reducing valves or by including orifice plates at connections to main distribution pipes.

b. Water supply

(1) Size of incoming mains

The pipe size of the replenishing water mains to the sprinkler storage tank shall not be less than 150mm in diameter. Hydrants, hose reels and external drenchers shall not be connected to the sprinkler system or draw from the sprinkler water supply.

(2) Inlets to storage tank

The inlets to the storage tank shall be fitted with a non-modulating type of pilot float valve listed by the authority having jurisdiction.

6.4.8 Combined firefighting water tank for sprinkler and wet riser systems

a. Combining firefighting water tank for sprinkler and wet riser systems is permitted for buildings of ordinary hazard category classification provided their designs comply with the provisions stipulated in *SS CP 52* and *SS 575*, respectively.

b. The water storage shall be based on the larger water storage demand of the systems.

c. Separate pump sets shall be provided to allow for the simultaneous operation of the sprinkler and wet riser systems.

d. The combined systems' sprinkler riser and wet riser stacks shall not be interconnected by sprinkler system piping or a single riser that serves both systems.

CLAUSE 6.5 FIXED AUTOMATIC FIRE EXTINGUISHING SYSTEMS

6.5.1 Installation

Installation of any fixed automatic fire extinguishing systems which are not deemed to be required by this Code shall not be accepted as substitute of any provision stipulated in this Code unless otherwise approved by the SCDF. Such systems will be considered additional protection for property safety and their installation shall not adversely affect the performance of the stipulated systems.

6.5.2 Design standard

Explanation and Illustrations

(No illustration)

Fixed automatic fire extinguisher systems include, fixed water spray, gas flooding system & wet chemical suppression system for kitchen hood etc..

Where a building is provided with automatic sprinkler system, the provision of any of the above system for added protection to property shall not affect the operation and performance of the sprinkler system in the building. For example, a computer room is provided with gas flooding system, in addition to the sprinkler system.

Any fixed automatic fire extinguishing system such as gas flooding system which are not deemed to be a requirement under the Fire Code for a particular building shall not be accepted as replacement or substitute of any system required by the Fire Code unless approved by the SCDF.

Such automatic fire extinguishing systems if not properly installed or incorrectly maintained could pose additional hazard to the occupants. Warning signs are to be visibly displaced at strategic position. Features such as stopping of air handling units or other safety features are needed to be incorporated in the installing of the above. QPs are to seek clarification/consultation with the SCDF before carrying out any such installation in their developments.

The design and installation of such automatic fire extinguishing systems shall comply with corresponding Codes of Practice acceptable to the SCDF.

CLAUSE 6.6 LIFTS

6.6.1 General

All lift installations and operations shall comply with *SS 550*.

6.6.2 Lift well ventilation

Explanation and Illustrations

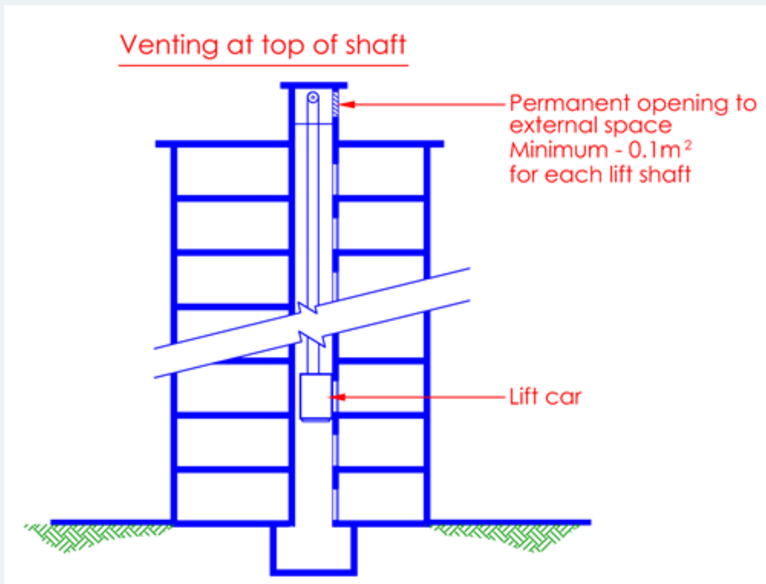


Figure 6.6.2 – 1

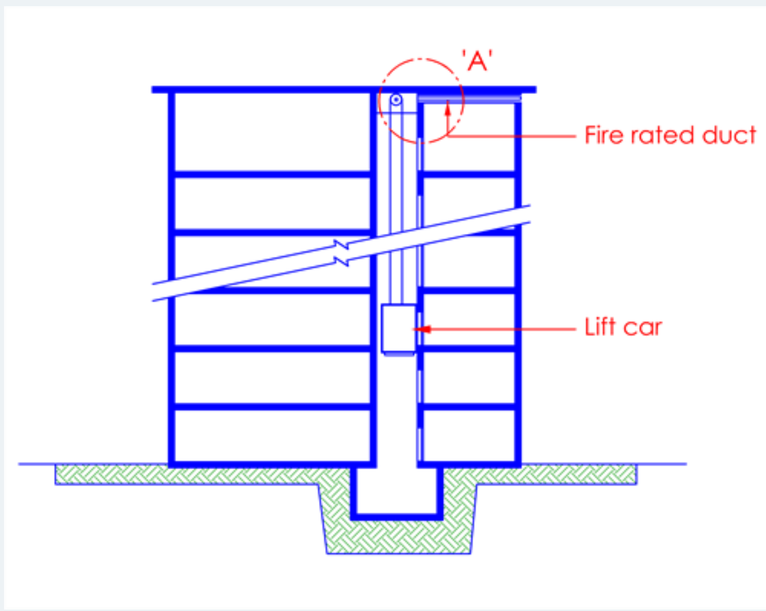


Figure 6.6.2 - 2

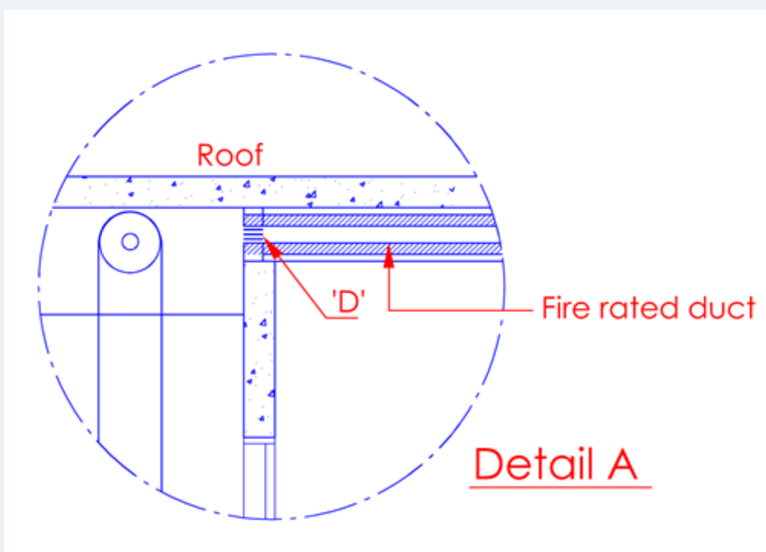


Figure 6.6.2 - 3

If the duct is not to be fire-rated, fire damper shall be provided at the wall of the lift shaft at location indicated as 'D' in the above figure. The provision of duct to ventilate the lift shaft shall not apply to lift shaft containing fire lift. The main purpose of the vents or ducts is to provide exhaust ventilation for the shaft.

Lift well shall be vented in accordance with *SS 550*.

6.6.3 Emergency power supply

a. Emergency power supply for lighting, ventilation and alarm systems for all lifts shall comply with the requirements in *SS 550*.

b. A standby generating plant shall be provided for: (1) homing of lifts during an emergency for:

(1) homing of lifts during an emergency for:

(a) PG II buildings with private lifts or that which exceed the habitable height of 60m;

(b) mixed-use residential buildings where the lifts serve the residential and/or non-residential floor(s);

(c) PG III to VIII buildings exceeding four storeys; and

(d) all basement occupancies (excluding PG I buildings or basements within single household dwelling houses classified as cluster housing within PG II developments).

(2) operating of the following lifts during an emergency:

(a) fire lifts;

(b) PWD evacuation lifts for buildings exceeding four storeys and buildings which require the provision of such lifts; and

(c) fire escape bed lifts.

c. The power supply to the lift shall be connected to a sub-main circuit exclusive to the lift and be independent of any other main or sub-main circuits. The power cables serving the lift installation shall be routed through an area of negligible fire risk.

6.6.4 Fire lift

a. General

(1) The installation of the fire lift shall be in accordance with *SS 550*.

(2) The fire lift(s) shall be contained within a separate protected shaft. Alternatively, the fire lift(s) can be contained within a common protected shaft containing other lifts, provided such other lifts are served at each storey by the fire lift lobby.

(3) The fire lift shaft shall be continuous throughout the building and serve every storey.

(a) Exemption

(i) Non-habitable roof.

(ii) Mezzanine floor of factory or warehouse unit, subject to compliance with *Cl.9.6.1a(2)* or *Cl.9.8.1a.(2),* respectively.

(4) A lift mainly intended for the transport of goods shall not be designated as a fire lift.

Explanation and Illustrations

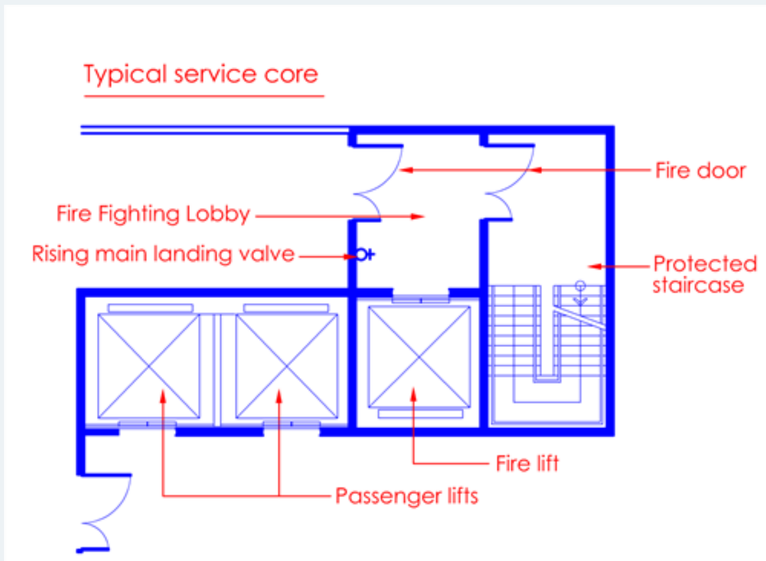


Figure 6.6.4a(2) – 1: Fire lift located within a protected shaft

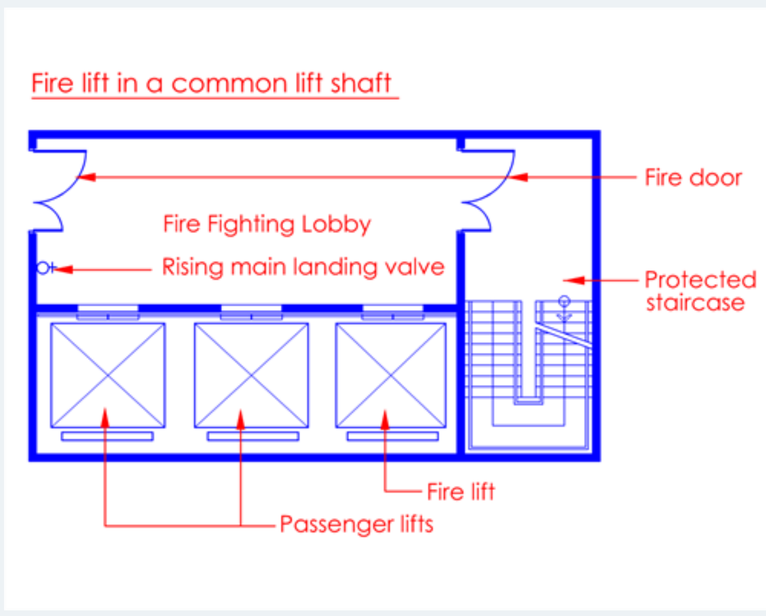


Figure 6.6.4a(2) – 2 : Fire lift located within a common lift shaft

The fire lift lobby as shown in the two situations above, shall be served by a protected staircase located adjacent to it, and directly accessible from it.

In the second situation in *Figure 6.6.4a.(2) – 2,* the lift shaft is shared with other passenger lifts as a relaxation, provided that the common lobby must be protected at every level and the floor area shall be more than $6m^2$.

(5) Cargo lift shall not open into a fire lift lobby.

(6) In the case of motor-room-less fire lifts, the fire lift control panel enclosure located at the fire lift lobby shall be compartmented with a fire-rated door of same rating as the lift shaft.

Rationale

It is common to find goods being stacked in lobby outside goods lifts. This would affect the firefighters while carrying out firefighting operations during an emergency.

b. Number of fire lifts

(1) With the exception of PG I and II buildings, all other buildings shall be provided with at least two fire lifts if the habitable height exceeds 24m.

(2) For PG II buildings, at least one fire lift shall be provided if the habitable height exceeds 24m. In the case of super high-rise (above 40 storeys) residential buildings, at least two fire lifts shall be provided.

(3) All buildings, except PG I, shall also be provided with at least two fire lift if the depth of the basement exceeds 9m below the average grade level.

c. Accessibility and coverage

Explanation and Illustrations

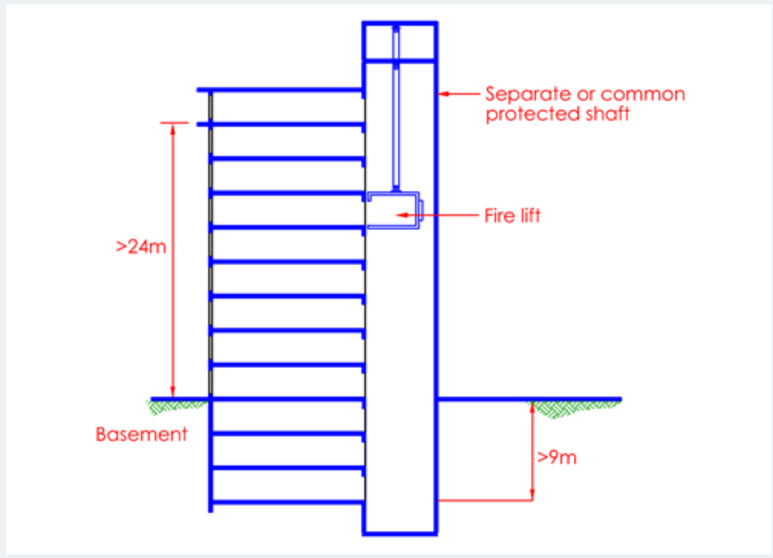


Figure 6.6.4b. - 1

Fire lift is required as the habitable height exceeded 24m.

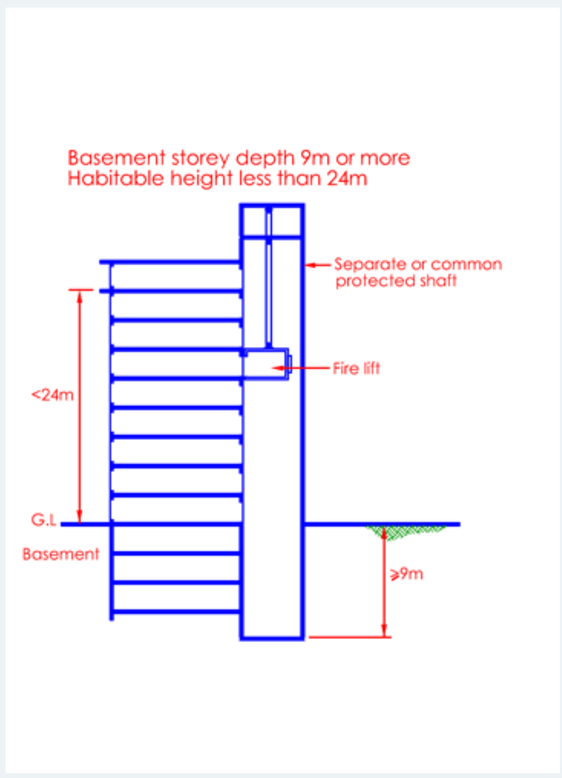


Figure 6.6.4b. - 2

In *Figure 6.6.4b.-2*, fire lift is required to serve the basement floors as the depth of the basement is more than 9m below the average ground level.

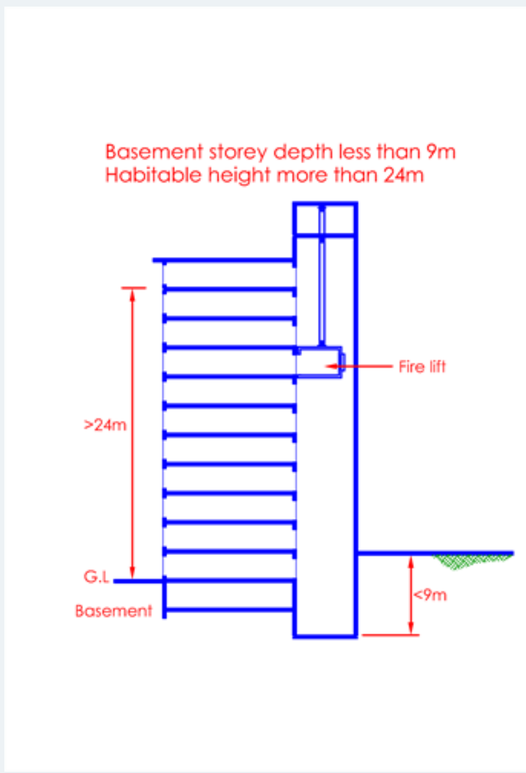


Figure 6.6.4b. - 3

In *Figure 6.6.4b. - 3*, the fire lift is required to serve the basement, even though it is less than 9m in depth. Where a building is required to be provided with a fire lift, the lift shall serve all floors, upper storeys and basement(s), in a vertical shaft running through the entire building.

(1) A fire lift shall be located such that the travel distance between the nearest edges of the lift landing door and exit staircase door is not more than 5m. In addition, the exit staircase shall be approached through a fire lift lobby or a corridor connected directly to a fire lift lobby at each storey. This corridor shall comply with fire lift lobby requirements except that the width can be at least 1.2m.

Exception:

(a) The final discharge of exit staircase at ground level for all buildings, the travel distance between the nearest edge of the fire lift landing door and exit staircase door can be extended to at most 10m. Where the travel distance between the nearest edge of the fire lift landing door and exit staircase door exceeds 5m, additional signage shall be displayed prominently at the fire lift lobby to indicate the location of exit staircase door.

(b) In cases when two fire lifts are located adjacent to each other, only one of the two fire lifts need to comply with the 5m requirement.

Explanation and Illustrations

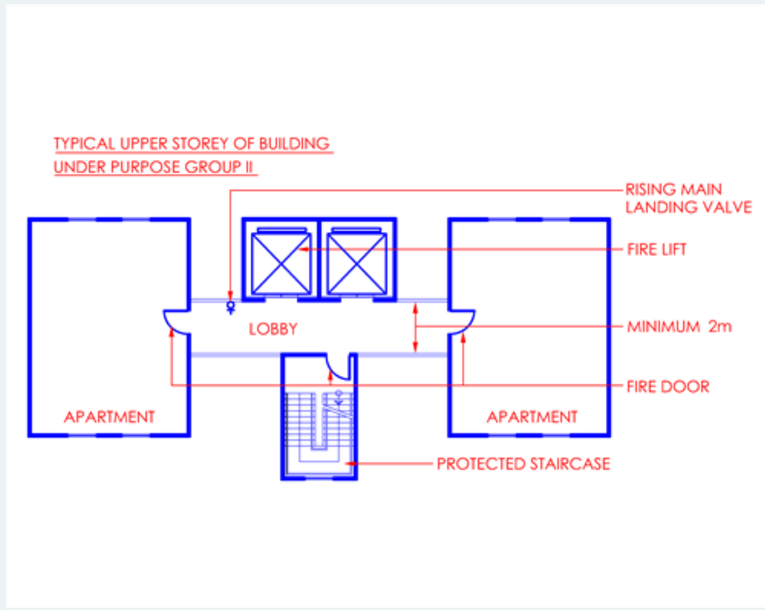


Figure 6.6.4c.(1)

Fire lift is located in a protected shaft.

The fire lift lobby as shown above, shall be served by a protected staircase located adjacent to it, and directly accessible from it.

Where a fire lift is provided to the upper storeys of a building with basement storey(s), the lift shall be extended to serve the basement storey(s).

(2) The fire lift shall be located such that any part of every storey shall be accessible by firefighters from the fire lift.

(3) Regardless of whether the building is installed with an automatic sprinkler system, the number of fire lifts required shall be such that any part of a storey of the building is within 60m coverage from the fire lift door, subject to the provision of at least two fire lifts in accordance with *Cl.6.6.4b.(1)* & (3).

d. Fire lift switch

(1) The operational features of the fire lift shall be provided in accordance with *SS 550*, including the provision of a fire lift switch.

Explanation and Illustrations

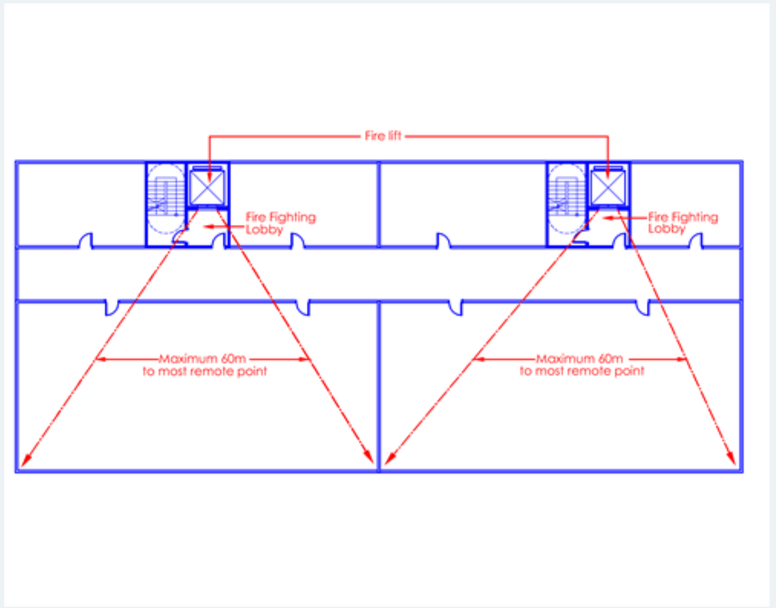


Figure 6.6.4c.(2) - 1

Number of fire lifts shall be such that any part of a storey is within 60m coverage from the fire lift door.

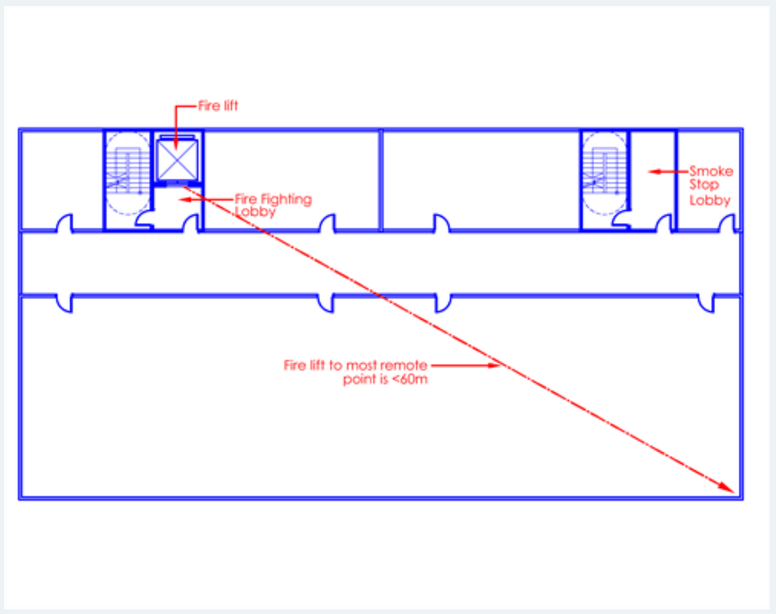


Figure 6.6.4c.(2) - 2

Even though the most remote point is within 60m of the fire lift, 2 nos. of fire lifts would still need to be provided.

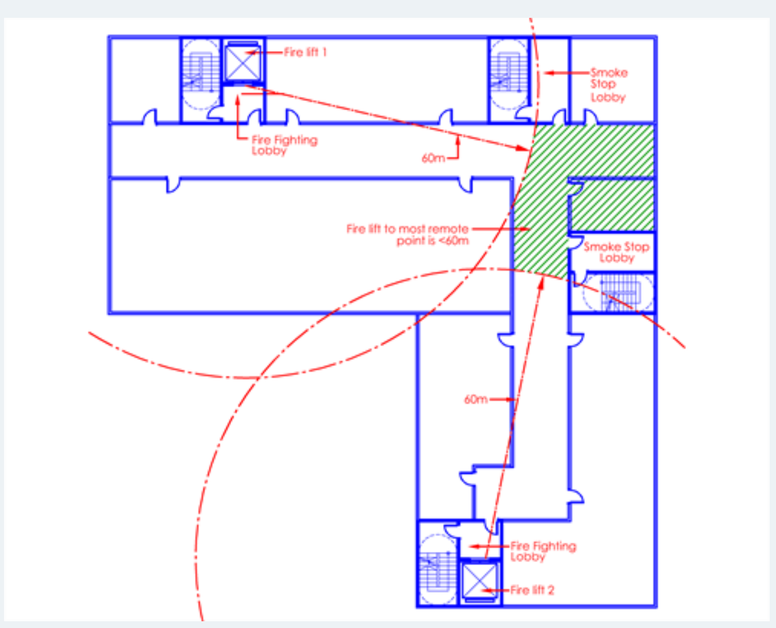


Figure 6.6.4c.(2) - 3

There are some areas that are beyond 60m of the fire lifts, see shaded. As such, a 3rd fire lift is required.

(2) A fire lift switch shall be provided at both the designated and alternate designated floors.

6.6.5 Evacuation lift

a. General

Evacuation lifts shall be provided for evacuation of occupants requiring assistance during an emergency. The requirements stipulated herein shall be applicable to all, except PG I and II, buildings:

(1) exceeding 24m in habitable height, or

(2) accessible to PWDs, except those stipulated under *Cl.2.4.1a.*.

b. Provisions

(1) For buildings provided with at least two fire lifts, one of the fire lifts can be used for the evacuation of occupants, including PWDs.

(2) Where a fire lift serves the dual purpose of an evacuation lift for PWDs, it shall have a clear car platform area of minimum 1.2m by 1.4m instead of 1.45m^2. For PG II buildings having more than 40 storeys, the minimum clear car platform size of the fire lift shall be at least 1.7m by 1.5m.

(3) For buildings without a fire lift, at least one of the passenger lifts shall be designated as a PWD evacuation lift.

(4) All passenger lifts in buildings exceeding 24m in habitable height shall be designed for use together with the fire lifts so as to speed up occupant evacuation.

c. Communication

(1) A lift monitoring system shall be provided within the FCC. It shall monitor the floor location of the lift, direction of travel, status with respect to occupation, both the normal and emergency power supplies to the lifts, and activation of a fire alarm within the lift shaft or lift motor room or lift lobby. Provision to manually override the lift shall be installed in the FCC for use by the firefighters/ CERT if required.

(2) A voice communication system shall be provided in the building.

(3) An intercom system in the lift car shall be provided for communication between the lift operator and the FCC.

(4) CCTV cameras shall be installed at lift lobbies to facilitate situational awareness for the authorised personnel overseeing the evacuation at the FCC or 24-hourly manned station. Alternatively, a suitable means of communication to call for assistance during a fire can be provided between the protected lobby and FCC or any 24-hourly manned station. It can be in the form of a distress button or voice communication.

(5) The means of communication shall be:

(a) located between 800mm and 1200mm above ground level;

(b) appropriately labelled;

(c) provided with prominently displayed clear instruction signage on its operation; and

(d) when activated, generate a clear visual indication for the person requesting for assistance to know that the distress signal has been relayed.

d. Evacuation switch

(1) A switching device, similar to the fire lift switch, shall be installed next to each evacuation lift landing door on the designated floor (and the alternate designated floor, if provided) for persons authorised by the building owner or firefighters to activate the evacuation mode of the lift.

(2) Under the evacuation mode, the lift operation shall be similar to the firefighters service operation as stipulated in the *SS 550*.

(3) The switching device shall be housed in a breakable glass-fronted box marked "Evacuation Switch".

e. Signage

(1) For buildings provided with a PWD evacuation lift, a prominent sign marked "Evacuation Lift" shall be affixed onto the wall adjacent to the lift door at every landing of the evacuation lift.

Rationale

The purpose is to enable the person requiring assistance to alert the FCC or the manned station that they are in need of assistance and for them to be reassured that this assistance will be forthcoming

(2) The size of the letters shall not be less than 25mm in height.

f. Protected lobby

(1) Evacuation lifts shall be located within a protected lobby such as a smoke-free lobby, external exit passageway or external corridor.

(2) For buildings not exceeding 4 storeys, the provision of a protected lobby for PWD evacuation lift is not required. However, should passenger lifts be installed in such buildings, these lifts shall be provided with a lift evacuation switch for use by emergency responders. If there is no protected lift lobby provided for the said passenger lifts, the PWD Holding Point shall be located inside a protected exit staircase or along the external corridor.

g. Secondary evacuation lifts

(1) All passenger lifts in buildings exceeding 24m in habitable height shall comply with all of the following requirements:

(a) A secondary evacuation switch (labelled accordingly) shall be provided at the FCC for each passenger lifts.

(b) Power cables shall be routed through an area of negligible fire risk.

(c) Close circuit television shall be provided at all lift lobbies.

(2) The passenger lifts provided with a secondary evacuation switch need not be backed up by a secondary source of supply for evacuation operation.

6.6.6 Homing of lifts

a. For buildings requiring fire alarm system

(1) In a fire emergency, when any one of the fire detection devices or fire alarm systems is activated, all the lifts, including passenger, service, designated fire and designated evacuation lifts, shall be brought to the designated floor (usually 1st storey). Otherwise, the lifts shall home to an alternate designated floor (if the designated floor is a fire floor) and park with the lift landing doors remaining opened.

(2) Goods lifts with automatic doors shall be similarly homed to the designated floor.

(3) Goods lifts with manual doors shall be homed if the doors are closed.

b. For buildings requiring standby generating plants

(1) In the event of power failure or power interruption in the building, the supply to the lifts shall be automatically switched over to the emergency power supply from the generating plant.

(2) The lifts shall be brought to the designated floor and park with the lift landing doors remaining open until all the lifts have been brought down to the designated floor.

(3) Thereafter, one or more lifts can resume operation depending on the capacity of the emergency generating plant, in addition to the fire lift.

(4) Normal operation of the lift shall be automatically reset on the return of normal power supply.

c. For buildings which do not require standby generating plants, and for buildings with standby generating plants but without automatic fire alarm or sprinkler system

(1) For buildings without standby generating plants, the smoke/ heat detectors shall form part of the lift system and shall be connected to the lift control panel to home the lift under normal power upon activation. All lifts, including hydraulic lifts, shall be provided with Automatic Rescue Device (ARD). The ARD shall permit the lifts to move and park at the nearest lift landing floor with the lift/ landing doors open in the event of power failure. Homing any of the lifts to a basement storey is not permitted.

(2) Smoke/ heat detectors shall be provided at all lift lobbies such that all lifts serving the same lobby shall be brought to the designated floor or alternate designated floor upon activation of the detectors. The smoke/ heat detectors shall form part of the lift system and shall be connected to the lift control panel to home the lift under normal power upon activation.

(3) The above requirements on homing of lifts need not be applied to residential buildings under PG I or lifts serving within single household dwelling houses classified as cluster housing within PG II developments.

d. For mixed developments comprising residential and non-residential components

(1) All lifts which serve the residential and non-residential floors shall be required to home to the designated or alternate designated floor (if the designated floor is a fire floor) in the event of power failure and/ or fire. The lifts shall be provided with secondary power supply from standby generating plant of sufficient capacity.

(2) Where the passenger lifts serve only the residential floors and by-pass the non-residential floors in a protected shaft, the lifts shall be required to be installed with Automatic Rescue Device (ARD), provided the habitable height of the highest floor does not exceed 60m.

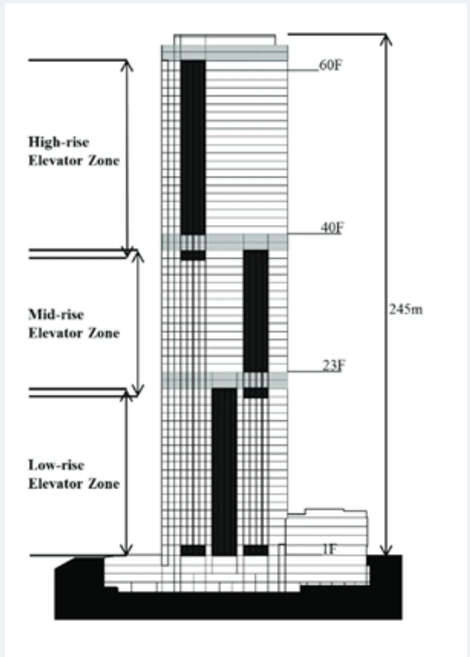
(3) Where the lifts serve the upper residential floors and the basement non-residential floor(s), including car parks, the lifts shall be provided with emergency power supply from a standby generating plant for homing to the designated floor when there is a power failure in the building. In a fire emergency, the lifts shall be brought to the designated floor or alternate designated floor (if the designated floor is a fire floor) when any of the fire alarm systems in the basement non-residential floor(s) is activated.

e. Requirements for alternate designated floor

(1) An alternate designated floor (e.g., 2nd storey) shall be identified.

(2) The lifts shall be brought to the alternate designated floor in the event of a fire at the designated floor.

Explanation and Illustrations



In general, alternate designated floor is preferably 2nd storey as it is the next nearest lift landing floor. However, there are scenarios where lift(s) do not serve the 2nd storey e.g., lifts serving certain zones of a building such as mid-rise and high-rise. For such scenario, the alternate floor will be the next nearest landing within the zone. Hence, alternate designated floor may not be 2nd storey in some buildings.

(3) Localised detectors

(a) Localised detector(s) shall be provided to cover the lift landing space at the designated floor.

(b) The activation of any of the localised detectors or any other detectors or sprinklers covering the designated floor shall cause all the lifts to be re-directed to home to the alternate designated floor.

(c) The localised detector(s) shall cover the area within at least 3m surrounding the lift landing door opening.

(d) Where the lift landing is protected by a fire-rated enclosure, only the space within the enclosure is required to be covered by localised detector(s).

(4) The alternative alternate floor shall have minimum fire hazard and pre-selected for the homing of passenger lifts, and where people can escape to safety in an exit staircase or other exit from the lift landing door.

(5) In building under *Cl.6.6.6c.* which are not provided with sprinklers or automatic fire alarm system, suitable sensors shall be provided at the ceiling level to cover the lift landing space. The activation of any sensor shall cause the lifts to be re-directed to home to the alternate floor.

(6) The above requirements on homing of lifts to an alternate designated floor need not be applied to standalone open-sided car parks and residential buildings under PG I.

6.6.7 Provisions for lift rescue

a. General

The following requirements shall apply to buildings with blind lift hoist ways exceeding 11m, except for PG I buildings. They shall be read in conjunction with *SS 550*.

b. Rescue hooks

(1) When the distance between consecutive lift landing doorsills is more than 11m but less than 18m (see *Diagram 6.6.7b.(1) – 1*), rescue hooks complying with *Cl.6.6.7b.(3)* shall be provided at the underside of the upper lift landing door head (see *Diagram 6.6.7b.(1) – 2*).

(2) Alternatively, these hooks shall be installed in the ceiling space directly above the upper lift landing door, such that the heights of these hooks are not more than 3m above the finished floor level of that upper lift landing, and at an approximate distance of 1m away from the lift shaft wall. The ceiling space shall be easily accessible, and a sign shall be provided to indicate the locations of the rescue hooks (see *Diagram 6.6.7b.(1) – 1 & 2*).

(3) Rescue hook design

Each rescue hook shall have pull-out strength of at least 1000kg (10kN) and a thickness of at most 14mm in diameter. The clear space between the hook and the emergency door frame shall not be less than 100mm, and the spacing between the two hooks shall be between 500 to 700mm. (see *Diagram 6.6.7b.(3)*).

c. Landing emergency doors

(1) Where the distance between consecutive lift landing doorsills exceeds 18m, intermediate landing emergency doors shall be provided, such that the distance between sills is at most 18m. However, for adjacent cars fitted with car emergency doors complying with *Cl.6.6.7d*, intermediate landing emergency doors are not required.

(2) The landing emergency doors shall conform to all of the following requirements (see *Diagram 6.6.7c.(2)*):

(a) The dimension of landing emergency doors shall comply with the requirements of *SS 550*.

(b) The dimensions of car emergency doors shall comply with the requirements of *SS 550*.

(c) They shall be either of the horizontally sliding or swinging single-leaf type.

(d) They shall be self-closing and self-locking and shall be marked in letters not less than 50mm high: “DANGER, LIFT WELL”.

(e) They shall be provided with a landing door lock which can be unlocked only from the landing side through the use of a key. The lock shall not be unlocked by any key which will open any other lock or device used for any other purpose in the building. The key shall be kept where it is accessible only to authorised persons.

(f) Each door shall be provided with an electrical contact, the opening of which will render the lift inoperable.

(g) Two rescue hooks complying with *Cl.6.6.7b.(3)* shall be provided at the underside of each emergency door head. Alternatively, these hooks can also be installed in the ceiling space as stipulated under *Cl.6.6.7b.(2)*.

d. Car emergency doors

(1) When car emergency doors are provided in adjacent cars to permit the lift-to-lift rescue and evacuation of passengers, there is no limit on the maximum allowable length of the blind lift hoist way. (See *Diagram 6.6.7d(1)*)

(2) When car emergency doors are provided, all of the following requirements shall be complied with (see *Diagram 6.6.7d(2)*):

(a) The horizontal distance between cars shall comply with the requirements of *SS 550*.

(b) The dimension of car emergency doors shall comply with the requirements of *SS 550*.

(c) Car emergency doors shall be openable from outside the car without a key and from inside the car using a key.

(d) Car emergency doors shall open towards the inside of the car.

(e) Car emergency doors shall not be located in the path of a counter-weight or in front of a fixed obstacle (except for beams separating the cars) preventing passage from one car to another.

(f) A portable/ movable bridge or a bridge integrated into the car complying with the requirements of *SS 550* shall be provided.

(g) Each car emergency door shall be provided with an electrical safety device, the opening of which will render the lift inoperable. A safety feature to prevent the lift from operating when the bridging plate or the handrail is deployed shall also be provided.

6.6.7 Provisions for lift rescue

a. General

The following requirements shall apply to buildings with blind lift hoist ways exceeding 11m, except for PG I buildings. They shall be read in conjunction with *SS 550*.

6.6.8 Basement corridor for lift pit access

a. Basement corridors used solely to access lift pits for maintenance purposes and are compartmented from the lift pits complying with Cl.3.8 are exempted from these requirements:

(1)Cl.2.2.11 on the provision of at least two independent exits.

(2) Cl.6.2.2 on the provision of rising main.

(3) Cl.6.2.8on the provision of hose reel, provided that all of the following conditions are complied with:

(a) a hose reel is located not more than 5m from the lift lobby above the lift pit; and

(b) the basement corridor is within the 36m coverage of the hose reel mentioned above.

(4) Cl.6.3 on the provision of electrical fire alarm system.

(5) Cl.6.4 on the provision of automatic sprinkler system.

(6) Cl.6.6.4 on the provision of fire lift.

(7) Cl.7.4 on the provision of smoke control system.

CLAUSE 6.7 COLOUR SCHEME OF FIRE PROTECTION SYSTEMS

6.7.1 Equipment, fixtures and fittings

The following equipment/fixtures/fittings for the fire protection systems shall be painted in red. For those equipment/ fixtures/ fittings not listed below, the colour scheme shall be in accordance with that specified in the relevant Codes of Practice.

a. Fire sprinkler system

(1) Fire pump & control panel

(2) Breeching inlet (excluding breeching inlet cabinet/ enclosure)

(3) Sprinkler control valve

(4) Sprinkler water proofing system/ device

b. Electrical fire alarm system

(1) Main fire alarm panel/ cabinet

(2) Sub fire alarm panel/ cabinet

(3) Manual call point

(4) Visual alarm light housing (Note: fire alarm bell need not be in red)

c. Private fire hydrant

(1) Wet pillar hydrant (with yellow band in accordance with *SS 575*)

(2) Dry pillar hydrant (whole hydrant in yellow)

d. Wet/ dry rising mains

(1) Fire pump & control panel

(2) Breeching inlet (excluding breeching inlet cabinet/ enclosure)

(3) Dry riser breeching inlet in yellow

(4) Wet riser breeching inlet in red

(5) Rising mains pipe

(6) Landing valve (except dry landing valve to be in yellow)

(7) Standby hose cabinet/ enclosure

e. Hose reel system

(1) Hose reel pump & control panel

(2) Hose reel drum (excluding cabinet/ enclosure)

f. Total flooding fire extinguishing system

Breathing apparatus cabinet/ enclosure

g. Emergency Voice Communication System

Handset/ cabinet/ enclosure

h. Fire extinguisher

Housing cabinet/enclosure

(Note: Alternatively, red graphic signage or red wordings “Fire Extinguisher” of minimum size 20mm shall be provided.)

6.7.2 Pipework, conduits, trunkings and cable trays

For fire protection systems pipework, conduits, trunkings and cable trays which are not required to be painted in red, red colour bands of width not less than 20mm and labelling shall be provided at an interval of not more than 6m apart.

6.7.3 Graphical symbols

Graphical symbols to depict fire safety equipment are allowed for use in buildings provided the signs comply with SS 508. Either graphic or text format can be used for the design of the signage. The Table below shows the different sizes of the graphical symbol with respect to the viewing distance.

TABLE 6.2.9 : SIZES OF GRAPHICAL SYMBOLS				
Viewing Distance	0 to 6m	> 6 to 9m	> 9 to 12m	12m or more
Minimum height of symbol (Z=100)	60mm	90mm	120mm	150mm
Note: The luminous factor (Z=100) from SS 563 is used to determine the size of the sign. It essentially dictates the size of the sign that varies with distance. The graphical symbol for firefighting equipment shall be sized such that the height and width are same. The size of symbol is not inclusive of borders.				

CLAUSE 6.8 REDUNDANCY FOR FIRE PUMPING SYSTEM

The pumping system for wet rising mains, hose reels, sprinklers and hydrants shall be provided with redundancy such that the system performance is not affected when one of the pumps and/ or the associated control system is out of operation due to routine maintenance or break-down.

Diagram 6.2.5a.(3): Dutch roll folding method

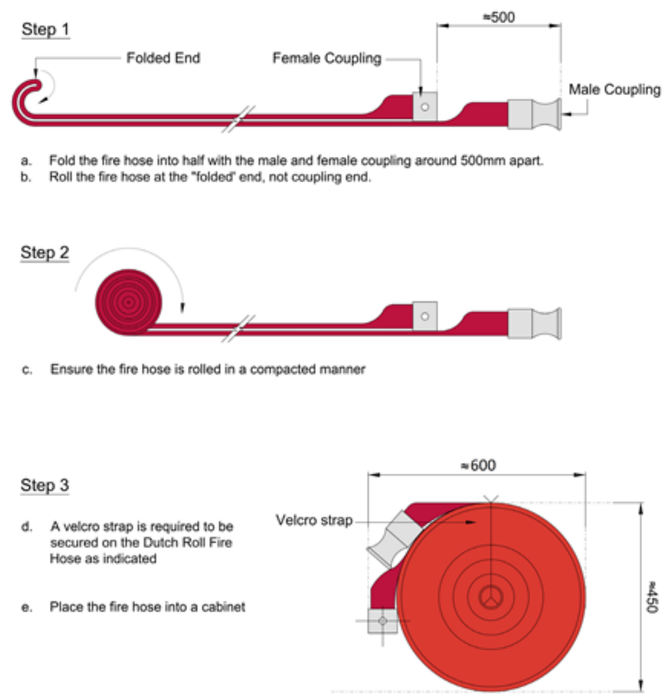


Diagram 6.2.5a.(3): Dutch roll folding method

Diagram 6.2.5b.(1): Dutch-rolled fire hose with cabinet (surface-mounted or recessed)

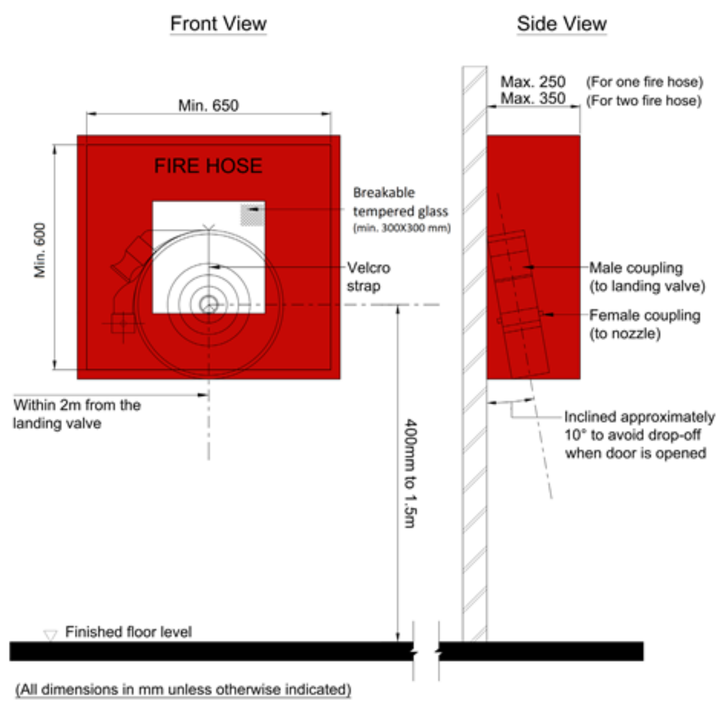


Diagram 6.2.5b.(1): Dutch-rolled fire hose with cabinet (surface-mounted or recessed)

Diagram 6.3.6a.(8): Home fire alarm system

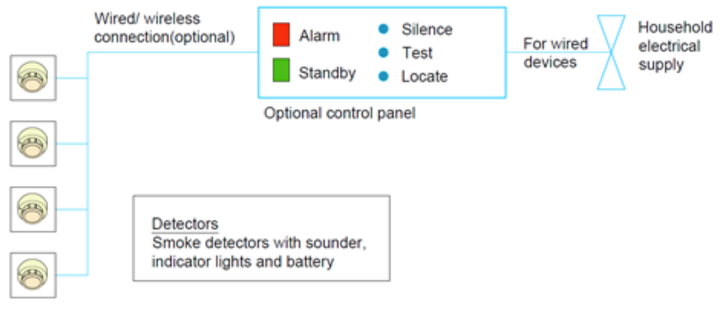


Diagram 6.3.6a.(8): Home fire alarm system

Diagram 6.3.6c. - 1 & 2: Location of HFAD installation

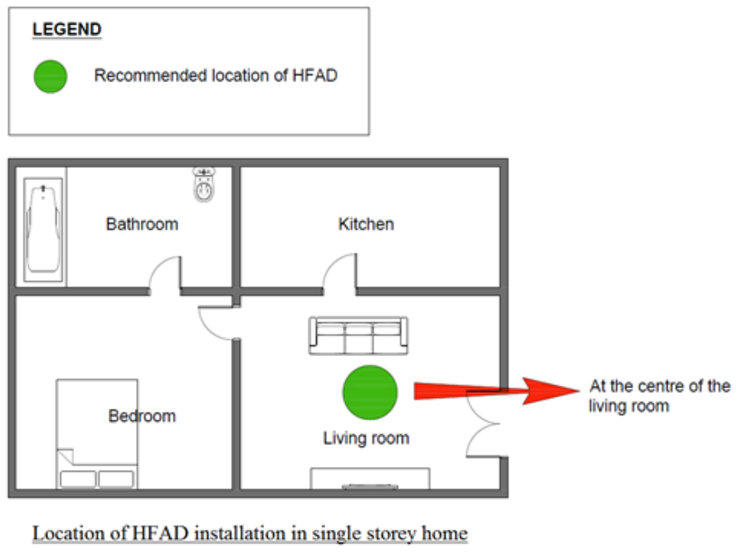


Diagram 6.3.6c. – 1: Location of HFAD installation in single storey home

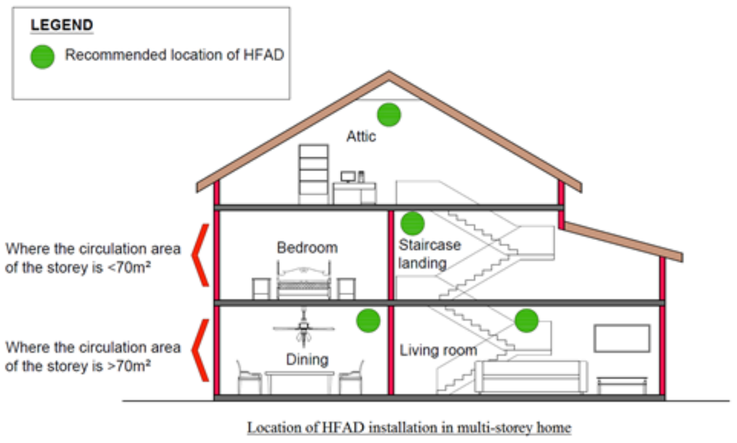


Diagram 6.3.6c. – 2: Location of HFAD installation in multi-storey home

Diagram 6.6.7b.(1) – 1: Lift landing sill to sill distance > 11m but < 18m

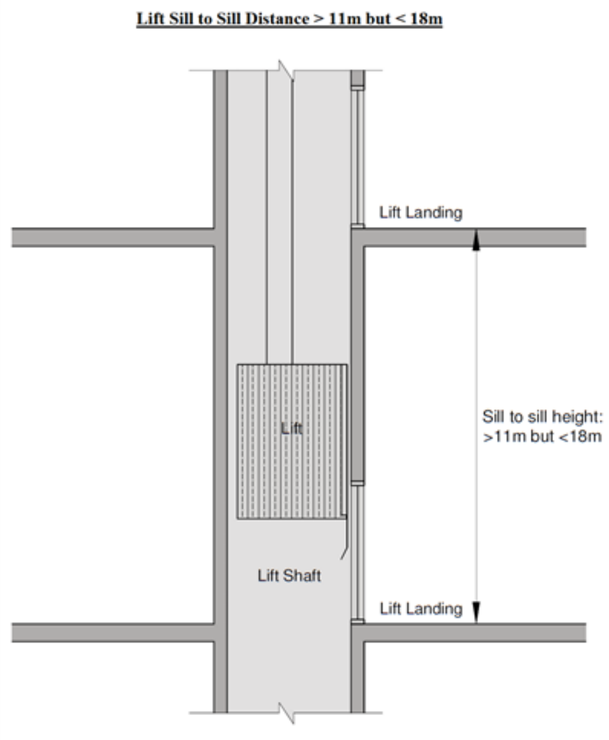


Diagram 6.6.7b.(1) – 1: Lift landing sill to sill distance > 11m but < 18m

Diagram 6.6.7b.(1) – 2: Rescue hooks located at lift landing

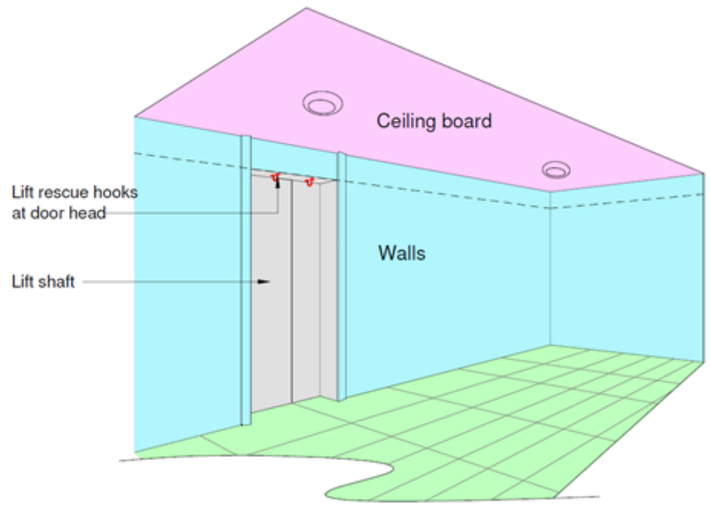


Diagram 6.6.7b.(1) – 2: Rescue hooks located at lift landing

Diagram 6.6.7b.(2) – 1 & 2: Rescue hooks located within lift landing ceiling space

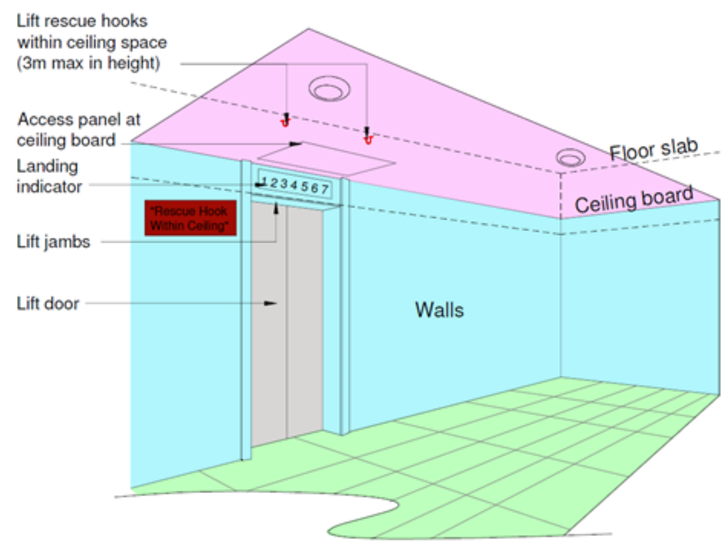


Diagram 6.6.7b(2) – 1: Rescue hooks located within lift landing ceiling space

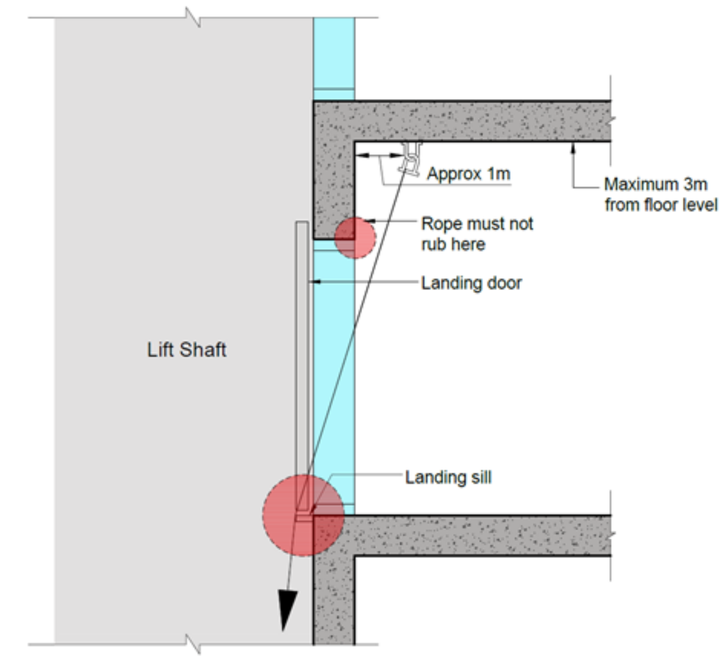


Diagram 6.6.7b(2) – 2: Rescue hooks located within lift landing ceiling space

Diagram 6.6.7b.(3): Rescue hook design

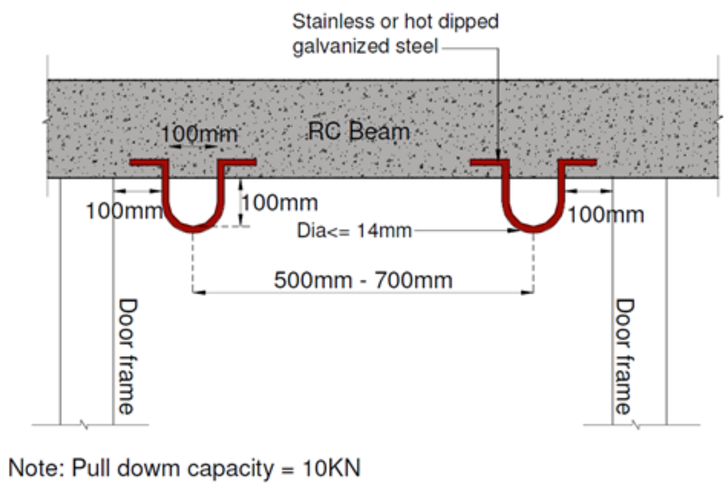


Diagram 6.6.7b(3): Rescue hook design

Diagram 6.6.7c.(2): Landing emergency door

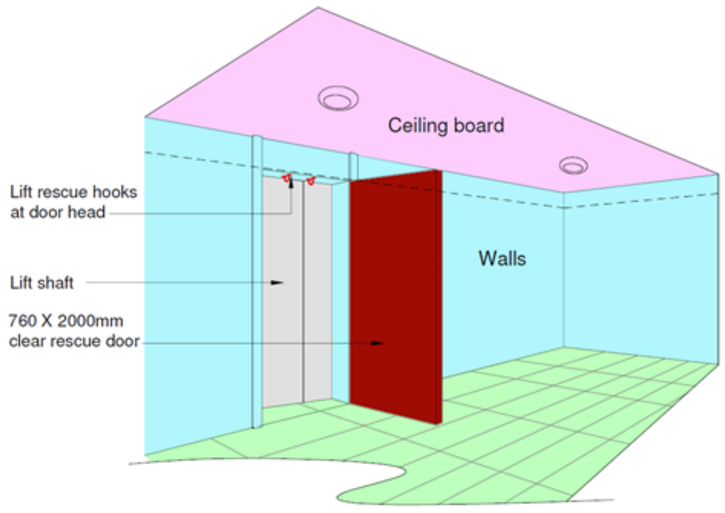


Diagram 6.6.7c(2): Landing emergency door

Diagram 6.6.7d.(1): Car emergency doors for lift-to-lift rescue

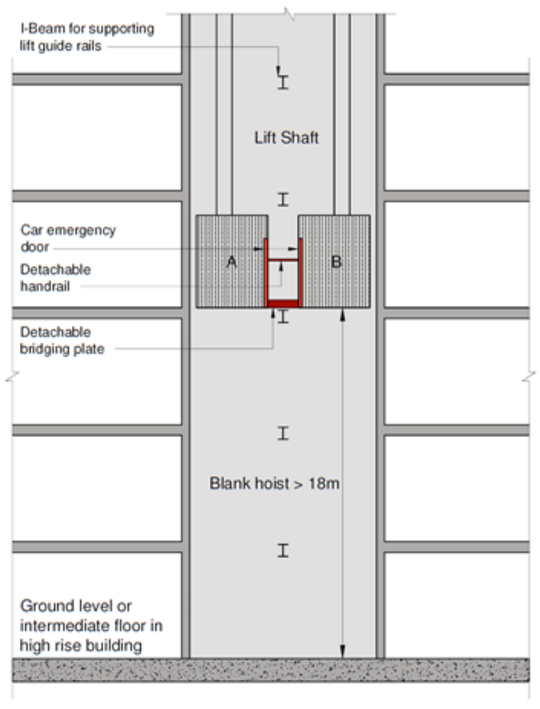


Diagram 6.6.7d(1): Car emergency doors for lift-to-lift rescue

Diagram 6.6.7d.(2): Car emergency doors - Deployment of bridging plate

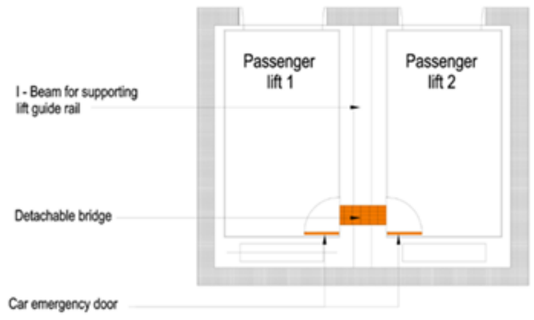


Diagram 6.6.7d(2): Car emergency doors - Deployment of bridging plate

TABLE 6.3A: PROVISION OF FIRE ALARMS ACCORDING TO PURPOSE GROUP, HEIGHT & SIZE OF THE BUILDING

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Purpose group (1)	**Building type (2)**	**Total floor area per storey (3)**	**Type of fire alarm systems (4)**
PG I & II	NR	NR	HFAD
PG III to VIII (Without stay-in facilities)	Single storey building	>400m²	Manual*
	Building of 2 to 4 storeys	>200m²	Manual*
	Building of more than 4 storeys	NR	Automatic + manual
PG III to VIII (With stay-in facilities)	Single storey building	NR	Manual**
	Building of more than one storey	NR	Automatic + manual

Note:
- When there are 2 or more purpose groups in a building, the strictest requirement for any one of the purpose groups shall be applicable to the whole building
- Where PG II forms part of a mixed-use building, Cl.6.3.1b.(1) shall be followed and HFAD shall be provided in the residential units.
NR - Not relevant
* - Except otherwise exempted under Cl.6.3.3d.
** - Healthcare occupancy with patient accommodation ward shall be provided with both automatic fire alarm system and manual fire alarm system. See Cl.9.3.2b.(5)(b)

TABLE 6.4A COMPARTMENTATION REQUIREMENTS FOR SPECIAL PURPOSE ROOMS IN BUILDINGS

TABLE 6.4A COMPARTMENTATION REQUIREMENTS FOR SPECIAL PURPOSE ROOMS IN BUILDINGS

Usage (1)	**Non-sprinkler protected building**		**Sprinkler-protected building**		
	Compartmentation (2a)	**Door rating (2b)**	**Compartmentation (3a)**	**Door rating (3b)**	**Sprinkler (3c)**
Store room(1)	1 hr	1 hr	N	N	S
AHU room(3)	N	N	N	N	S
Kitchen(2)	1 hr	1/2 hr	1 hr	1/2 hr	S
Boiler room (oil fired)	2 hr	2 hr	1 hr	1 hr	S
Low voltage switch room	B	B	B	B	Ex
High voltage switch room	B	B	B	B	Ex
Transformer room	2 hr	2 hr	1 hr	1 hr	S
Oil tank room	2 hr	2 hr	1 hr	1 hr	S
Generator room	2 hr	2 hr	1 hr	1 hr	S
A/C plant room	2 hr	2 hr	1 hr	1 hr	S
Electric lift motor room	2 hr	2 hr	2 hr	2 hr	Ex
Hydraulic lift motor room	2 hr	2 hr	1 hr	1 hr	S
Essential fan room	2 hr	2 hr	1 hr	1 hr	S
Electrical room	2 hr	2 hr	2 hr	2 hr	Ex
Battery room(6)	2 hr	2 hr	2 hr	2 hr	S(5)
Sprinkler/Wet riser tank room	B	B	B	B	S
Fire pump room	B	B	B	B	S
Fire Command Centre	2 hr	2 hr	2 hr	2 hr	S
Telecommunication/ Non-essential equipment room(4)	N	N	B	B	Ex
			N	N	S

Note:
The fire resistance rating stipulated in this table shall be the minimum
N - no specific requirement on compartmentation/ door rating
B - compartmentation and door rating of the special purpose room shall not be less than the fire resistance of the elements of structure of the building where the room is located
S - Sprinkler system has to be extended into such rooms
Ex - Sprinkler system is exempted from the corresponding area provided the area is fitted with an automatic fire alarm system installed according to SS 645
(1) - Requirements stated herein apply to store room which is required to be compartmentalised
(2) = Requirements stated herein apply to kitchens in hotel, restaurant, coffee house or other similar places where the preparation of food is required. However, special considerations will be given to the followings:
(a) kitchens where "open flame" cooking appliances are NOT used, or
(b) kitchens where all the cooking facilities are fitted with approved extinguishing systems
(3) - Where AHU rooms are vertically stacked, each AHU room shall be separated by a compartment floor at every level. In the case of AHU serving more than one compartment, fire dampers shall be provided in air ducts at penetration through the compartment wall and floors, see Cl.7.1.8
(4) - Requirements stated herein apply to non-essential equipment rooms such as a PABX/ MDF room, potable water tank/ pump, ejector room, Police Equipment Room (PER) or Electronics Parking System (EPS) room etc.
(5) - Water mist system can be considered in lieu of conventional automatic fire sprinkler system
(6) - This requirements of compartmentation shall apply to any room that is designated as a battery room or of Threshold Stored Energy exceeded the limits stated in Table 10.3.1. This does not apply to battery used in consumer products such as laptop, phone, etc.

TABLE 6.4B: REQUIREMENTS FOR VENTILATION, SMOKE PURGING SYSTEM & AUTOMATIC FIRE SPRINKLER SYSTEM IN ABOVEGROUND CAR PARKS (STANDALONE OR WITHIN BUILDINGS)

TABLE 6.4B : REQUIREMENTS FOR VENTILATION, SMOKE PURGING SYSTEM & AUTOMATIC FIRE SPRINKLER SYSTEM IN ABOVEGROUND CAR PARKS (STANDALONE OR WITHIN BUILDINGS)

Habitable Height		Aboveground Car Park							
		Criteria for the Largest Car park Compartment				Smoke Purging System	Automatic Fire Sprinkler System	Type of Fire Alarm Systems	
Building	Car Park	Area	Cubicle Extent	No. of Storey	Ventilation (as per *Cl.3.2.8*)			Auto	Manual
≤ 24m	≤ 24m	≤ 4000m^2	≤ 15000m^3	≤ 3-storey	NR	NR	NR[2]	NR[1]	NR
		> 4000m^2 and ≤ 5000m^2	≤ 15000m^3	≤ 3-storey	Comply	NR	NR[2]	R	NR
					Not comply	NR	R	NR	NR
		Cubical extent > 15000m^3 or Area > 5000m^2 or more than 3 storey			Comply	NR	NR[2]	R	NR
					Not comply	R	R	NR	NR
> 24m	Any	≤ 5000m^2	-	≤ 3-storey	NR	NR	R	NR	NR
		Area > 5000m^2 or more than 3 storey			Comply	NR	R	NR	NR
					Not comply	R	R	NR	NR

Note:

NR – Not required
R – Required
[1] Automatic fire alarm system shall be extended to the car park if the building is protected with automatic fire alarm system
[2] Sprinkler shall be extended to the car park if the building is protected with automatic fire sprinkler system

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
6.1.2a.(3)		01 Mar 2019	New		---
6.2.6	1 Sep 2021	1 Sep 2021	Clarification	Building under construction When a building in pursuance of Cl.6.2.1, is required to be equipped with rising mains, such rising mains shall be installed progressively as the building attains height during the course of construction. All outlets, landing valves and inlets, water tanks and pumps, and hydrants shall be properly installed so as to be readily operational in case of fire.	1 Sep 2021
6.2.8	1 Mar 2021	1 Sep 2021	Revised/Clarification	Hose reels a. (1) provided to every storey of every building regardless of building height. (2) cover the M&E plants/equipment. (3) Exemption (a) (b) commercial-cum-residential building or single storey standalone building and fulfilling all of the following conditions: (i) (ii) 3m from the external. (iii) materials. (iv) (v) (vi) (c) (i) (ii) Bin centres. (iii) (iv) not exceeding 200m2 and openings that constitute not less than 80% of the perimeter wall area (measured along the roof eaves).	1 Mar 2021
6.2.8a.(3)	3 Mar 2025	3 Sep 2025	Relaxation/Revised	6.2.8a.(3) Exemption (a) (b) (c) Other standalone buildings as follows: (i) (ii) (iii) (iv) (v) (vi) (vii) (viii) ...	3 Sep 2025
6.2.8a.(3)(b)(vi)		01 Mar 2019	New		---
6.2.8a.(c)(viii)	1 Sep 2024	1 Sep 2024	Relaxation	6.2.8a.(3)(c) Other standalone buildings as follows: (i) ... (ii) ... (iii) ... (iv) ... (v) ... (vi) ... (vii) ...	1 Mar 2024
6.2.8d.(3) and (4)		01 Mar 2019	New		---
6.2.8e.	2 Mar 2025	2 Mar 2025	Relaxation/Revised	Piping The use of copper or stainless-steel piping is permissible for the connection of the hose reel to the PUB mains.	2 Sep 2024
6.3.10		16 Jun 2016	Extracted from SCDF's circular		15 Dec 2015
6.3.10 (dated 1 Sep 2021)	1 Sep 2021	1 Mar 2022	Revised/ Clarification	Exemption of automatic fire alarm protection The following areas are exempted from automatic fire alarm protection in an automatic fire alarm building: a. areas which are covered with trellises, louvres or perforated panels having 50% or more evenly distributed effective free openings; and b. external open-sided linkways not exceeding 5m in width measured from eave to eave, provided these areas are not for commercial activities or storage.	1 Sep 2021
6.3.11		01 Mar 2019	New		---
6.3.1a(1)	10 May 2019	10 May 2019	Clarification	Every building or part of a building, except that of PG I or II (residential floors), having a total floor area of more than that specified in column (3) of Table 6.3A having regard to the purpose group of the building or part of the building, shall be installed with a fire alarm system, either of the automatic or manual type as indicated in column (4), which shall be an electrically supervised system complying with the requirements of the SS CP 10. The fire alarm system shall be connected to the SCDF's Operations Centre through an approved alarm monitoring company if required under Cl.6.3.7.	10 May 2019

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
6.3.1b		1 Nov 2016	Revised, extracted from SCDF's circular. Formerly Cl.6.3.1(b)(i) & (ii)		11 Aug 2016
6.3.1b(3)	10 May 2019	Immediate	Clarification	Connection of the fire alarm system to an approved alarm monitoring company stipulated under Cl.6.3.7 is not required if the number of non-residential floors is not more than one storey.	10 May 2019
6.3.1b. (dated 2 Dec 2019)	2 Dec 2019	1 June 2020	Revised	b. PG II mixed occupancy For PG II mixed occupancy buildings where an automatic sprinkler system and/or electrical fire alarm system is provided to the non-residential part of the building: (1) common areas of the non-residential floors and extended to the immediate two residential floors above the non-residential floor. (2) or 5dBA above the ambient noise level in all parts of such areas. (3) stipulated under Cl.6.3.8 is not required if the number of non-residential floors is not more than one storey.	2 Dec 2019
6.3.3d.(2)		01 Mar 2019	New		---
6.3.3e		01 Mar 2019	New		---
6.3.5b	10 May 2019	Immediate	Change in requirements	The fire alarm sounder shall have a sound that is readily distinguishable from any other alarm system.	10 May 2019
6.3.5b. (dated 15 Sep 2020)	15 Mar 2021	15 Mar 2021	Revised	b. Audio alarm The fire alarm sounder shall have a sound that is readily distinguishable from any other alarm systems. In places of entertainment or areas where sound and/or special effects lighting systems are installed, the sound systems shall be electronically interlocked with the fire alarm system to enable these systems to be automatically cut-off when the fire alarm system is activated.	15 Sep 2020
6.3.5c(1)(c)	1 March 2019	1 March 2019	Relocated and Revised	In dance clubs, gaming centres, places of entertainment or areas where sound and/or special effects lighting systems are installed, they shall be electronically synchronised with the fire alarm system to enable these systems to be automatically cut-off when the fire alarm system is activated.	
6.3.5c.	10 May 2019	Immediate	Change in requirements	(1) Provision (a) Visual alarms shall be provided for buildings protected by fire alarm systems, and shall not be used in place of audible alarms. (b) Visual alarms shall also be provided in places where persons can be isolated. This is to account for persons with severe hearing impairment, especially when they are not in their identified locations. Such isolated spaces includes full-height enclosed washroom spaces, car park floors, lift lobbies, etc.. (c) In dance clubs, gaming centres, places of entertainment or areas where sound and/or special effects lighting systems are installed, they shall be electronically synchronised with the fire alarm system to enable these systems to be automatically cut-off when the fire alarm system is activated. (2) Siting of visual alarms Visual alarms shall be located together with manual alarm call points. Where they are not readily visible from all accessible locations, additional visual alarms shall be provided. the height of the visual alarms shall be between 2m to 2.5m above finished floor level.	10 May 2019
6.3.5c. (dated 25 Aug 2023)	25 Aug 2023	25 Aug 2023	Revised/Clarifications	6.3.5c. Visual alarms (1) Visual alarms shall not be used in place of audible alarms and shall be provided: (a) for buildings protected by fire alarm systems (b) in places, such as full-height enclosed washroom spaces, car park floors, lift lobbies, etc. where persons with hearing impairment can be isolated, especially when they are not in their identified locations; and (c) in places of entertainment e.g. dance halls, gaming outlets, internet games cafes, arcades where users use headgear that affect hearing or areas where sound and/ or special effects lighting systems are installed. (2) Siting of visual alarms Visual alarms shall be located	25 Aug 2023
6.3.5c.(1)(b)		Immediate	Relocated from Appendix 20 (Cl.7.2) of Fire Code 2013		---
6.3.5c.(2) and (3)		Immediate	Relocated from Appendix 20 (Cl.7.2) of Fire Code 2013		---
6.3.6		1 Jun 2018	Extracted from SCDF's circular		16 Nov 2017

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
6.3.6 (dated 2 Mar 2020)	2 Mar 2020	2 Mar 2020	Clarification	Home Fire Alarm Device (HFAD) For individual residential units under PG I or II, HFAD shall be installed in accordance with all of the following requirements: a. HFAD shall possess the following features and comply with all the requirements stated below: (1) (a detector with multiple sensors built into the device) with smoke detection capability; (2) (3) (4) (5) (6) years) with low battery alert capability, or to be wired to household electrical supply; (7) 3786, UL 217); (8) (either wired or wirelessly) such that when one of the HFADs is triggered, all connected HFADs shall sound an alarm if they are installed on 2 or more storeys (see Diagram 6.3.6a.(8)); and	2 Mar 2020
6.3.9	1 Sep 2021	1 Sep 2021	Clarification	Sprinkler-protected building Where sprinkler system is required by this Code, provision of automatic thermal/smoke detectors in sprinkler-protected premises will be exempted except where such detectors are required to activate or operate the sprinkler or other systems.	1 Sep 2021
6.4.1	1 Sep 2021	1 Sep 2021	Clarification	Provision The following shall be provided with an automatic sprinkler system: a. Whenever compartmentation requirements under Chapter 3 of this Code cannot be complied with. b.	1 Sep 2021
6.4.1c.		01 Mar 2019	Extracted from SCDF's circular, revised		11 Aug 2016
6.4.1e.		01 Mar 2019	Revised, formerly Cl.6.4.1(e)(iii)		---
6.4.1f.(4)		16 Jun 2016	Extracted from SCDF's circular		15 Dec 2015
6.4.1f.(4) and (5)	1 Sep 2021	1 Mar 2022	Revised/ Clarification	Provision f. Exemption of sprinkler protection All of the following areas not located within PG VI or VIII buildings are exempted from sprinkler protection in a sprinkler-protected building: (1) Canopies/car porches (a) drop-off. (b) (c) separate the sprinkler-protected and non-sprinkler-protected areas. (2) External corridors shall not exceed 4m in width, and there shall be no commercial activities or storage within these areas. (3) External/open-sided linkways shall not exceed 5m in width, and there shall be no commercial activities or storage within these areas. (4) Areas which are covered with trellises, louvres or perforated panels, which have 50% or more evenly distributed effective free openings (applicable to all purpose groups).	1 Sep 2021
6.4.3c		01 Mar 2019	Revised, formerly Cl.6.4.3(b)		---
6.4.3d		01 Mar 2019	New		---
6.4.7.b(2)	2 Dec 2019	2 Dec 2019	Revised	Water supply (2) Inlets to storage tank The inlets to the storage tank shall be fitted with a non-modulating type of pilot float valve listed by the SCDF.	2 Dec 2019
6.4.8		Immediate	Relocated from Appendix () of Fire Code 2013		---

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
6.4.8 (dated 15 Sep 2020)	15 Sep 2020	15 Sep 2020	Clarification	Combined sprinkler and wet riser systems a. Combining sprinkler and wet riser systems is permitted for buildings of ordinary hazard category classification provided their designs comply with the provisions stipulated in SS CP 52 and SS 575 respectively. b. There is no necessity to cater for water storage for the sprinkler system's demand separately. c. Pump sets shall be designed for the simultaneous operation of both the sprinkler and wet riser systems. d. The combined systems' sprinkler riser and wet riser stacks shall not be interconnected by sprinkler system piping or a single riser that serves both systems.	15 Sep 2020
6.4.8.a	2 Dec 2019	Immediate	Clarifications	Combined sprinkler and wet riser systems a. Combining sprinkler and wet riser systems is permitted provided their design complies with the provisions stipulated in SS CP 52 and SS 575 respectively.	2 Dec 2019
6.6.3b.(1)(c)		01 Mar 2019	Revised, formerly Cl.6.6.2(b)		---
6.6.3b.(1)(d)	1 Mar 2023	1 Mar 2023	Relaxation	Emergency power supply a. Emergency ..... b. A standby .....for: (1) homing of lifts during an emergency for: (a) PG II ..... (b) mixed-use..... (c) PG III to ..... (d) all basement occupancies;	1 Sep 2022
6.6.3b.(2)		01 Mar 2019	New		---
6.6.4a.(5)		01 Mar 2019	New		---
6.6.4c.(1)	1 Mar 2023	1 Mar 2023	Relaxation		1 Sep 2022
6.6.4c.(1) (dated 25 Aug 2023)	1 Mar 2024	1 Mar 2024	Revised/Clarifications	6.6.4c. Accessibility and coverage (1) A fire lift shall be located such that the travel distance between the nearest edges of the lift landing door and exit staircase door is not more than 5m. In addition, the exit staircase shall be approached through a fire lift lobby at each storey. Exception : (a)	25 Aug 2023
6.6.4c.(1)(dated 1 Sep 2024)	1 Sep 2024	1 Sep 2024	Relaxation	6.6.4c. Accessibility and coverage (1) A fire lift shall be located such that the travel distance between the nearest edges of the lift landing door and exit staircase door is not more than 5m. In addition, the exit staircase shall be approached through a fire lift lobby at each storey. Exception: (a) For the final discharge of exit staircase at ground level for PG II buildings, the travel distance between the nearest edge of the fire lift landing door and exit staircase door can be extended to at most 10m. Where the travel distance between the nearest edge of the fire lift landing door and exit staircase door exceeds 5m, additional signage shall be displayed prominently at the fire lift lobby to indicate the location of exit staircase door. This exception is not applicable to PG II mixed occupancy buildings.	1 Mar 2024
6.6.4d.(2)		01 Mar 2019	New		---
6.6.5e.(2)		01 Mar 2019	New		---
6.6.6a.(2) and (3)		01 Mar 2019	New		---
6.6.6c.		Immediate (extracted portion) 01 Mar 2019 (revised portion)	Revised, formerly Cl.6.6.4(c) and Cl. 6.6.4(d)(i). Extracted from SCDF's circular		8 Nov 2012
6.6.6c.(3)	1 Sep 2022	1 Mar 2023	Relaxation	Nil	1 Mar 2022
6.6.6c.(dated 3 Mar 2025)	3 Mar 2025	3 Mar 2025	Clarification/ Revised	6.6.6c. For buildings which do not require standby generating plants, and for buildings with standby generating plants but without automatic fire alarm or sprinkler system (1) ..... (2) Smoke/ heat detectors shall be provided at all lift lobbies such that all lifts serving the same lobby shall be brought to the designated floor or alternate designated floor upon activation of the detectors. For buildings without a fire alarm system, the smoke/ heat detectors shall form part of the lift system and shall be connected to the lift control panel to home the lift under normal power upon activation.	3 Mar 2025
6.6.6e.(3)		01 Mar 2019	New		---
6.6.7c.(2)(a)	1 Sep 2021	1 Mar 2022	Revised/ Clarification	Landing emergency doors (2) The landing ..... (a) They shall form a clear opening of at least 760mm wide and 2m high. (b)	1 Sep 2021

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
6.6.7d.(2)	1 Mar 2023	1 Mar 2023	Revised/Clarifications	Provisions for lift rescue d. Car emergency doors (1) When car ..... (2) When car ..... (a) The horizontal distance between cars shall not exceed 750mm. (b) The dimension of ..... (c) Car emergency doors ... (d) Car emergency doors .... (e) Car emergency doors .... (f) A set of detachable bridging plate and handrail, painted in bright yellow, shall be provided and secured to each emergency door. The plate shall have an anti-slip surface and means shall be provided to prevent accidental dropping of the plate and handrail into the lift well during deployment. (g) The detachable bridging plate shall have a minimum loading capacity of 200kg and shall not weigh more than 10kg. The maximum loading capacity shall be clearly marked on the top- face of the plate. Means shall be provided to prevent the plate and handrail from slipping off when deployed. (h) Each car emergency door shall be provided with an electrical contact, the opening of which will render the lift inoperable. A safety feature to prevent the lift from operating when the bridging plate or the handrail is deployed shall also be provided.	1 Sep 2022
6.6.7d.(2)(b)	1 Sep 2021	1 Mar 2022	Revised/ Clarification	Car emergency doors (1) When car emergency ..... (2) When car emergency doors are provided, all of the following requirements shall be complied with (see Diagram 6.6.7d.(2)): (a) ..... (b) Car emergency doors shall measure at least 1.8m high and 350mm wide. (c)	1 Sep 2021
6.6.8	2 Sep 2024	2 Mar 2025	New/ Relaxation		2 Mar 2025
6.7		01 Mar 2019	New		---
6.7.1f .	10 May 2019	10 May 2019	Change in requirements	Total flooding fire extinguishing system (1) Manual release control (2) Abort switch (3) Breathing apparatus cabinet/enclosure	10 May 2019
6.7.1i.	10 May 2019	10 May 2019	Change in requirements	Electromechanical locking system (for exit and exit access door) Emergency door release	10 May 2019
6.8		01 Mar 2019	New		---
Table 6.4A	1 Mar 2023	1 Mar 2023	Revised/Clarifications	Existing Table 6.4A	1 Sep 2022

CLAUSE 7.1 AIR-CONDITIONING AND MECHANICAL VENTILATION SYSTEMS

7.1.1 General

Explanation and Illustrations

(No illustration)

The term “air conditioning” has been defined by the American Society of Heating, Refrigerating, and Air Conditioning Engineers as:

“Air conditioning is the process of treating air so as to control simultaneously its temperature, humidity, cleanliness and distribution to meet the requirements of the conditioned space”.

The use of air-conditioning and mechanical ventilation systems will invariably, except for self-contained split units, involve some use of pipe works and ducts for air distribution and removal.

The use of ducts present the inherent possibility of spreading fire, heat, gases and smoke throughout the building or the floors/areas served.

Where air-conditioning system is designed to operate during fire emergency, it is to be emphasized that the system shall comply with all the relevant requirements for the mechanical ventilation system in this Code.

Where an air-conditioning system is provided in lieu of a mechanical ventilation system for emergencies, all the requirements specified in this Code for mechanical ventilation systems shall apply to the air-conditioning system.

7.1.2 Construction of ductwork

Explanation and Illustrations

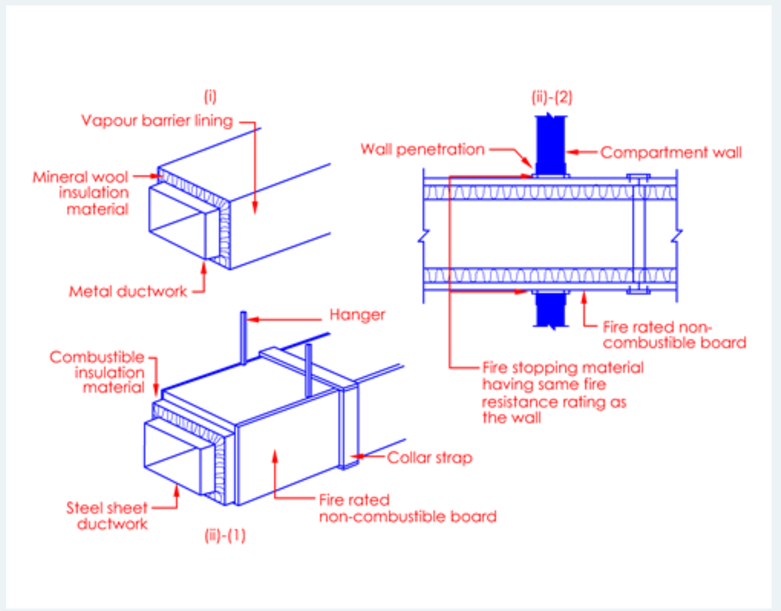


Figure 7.1.2

Insulation material/barrier lining and adhesives shall have minimum Class 1 flame spread rating. Where ceiling construction requires Class 0, covering and lining insulation material shall also be Class 0. Where combustible material is used for the insulation of the duct, it shall be kept at least 1000mm away from a fire damper in order to prevent premature closing of the damper arising from a fire from the combustible insulation material. For flexible joints and connections which are combustible, there is a need to limit the length of the joints and connection to max. 250mm and 4m respectively.

Ducts for air-conditioning and mechanical ventilation systems shall be constructed in compliance with all of the following requirements:

a. Materials

Air-conditioning or other ventilation ducts, including framing thereof, shall be constructed of steel, aluminium, glass fibre batt or mineral wool batt or other approved materials.

b. Support

Air-conditioning or other ventilation ducts shall be adequately supported.

c. Duct linings & coverings

Duct covering and lining shall be non-combustible. However, if it is necessary to use combustible material, it shall:

(1) when tested in accordance with methods specified in this Code, have a surface flame spread rating of not lower than Class 1, except in areas of a building where Class 0 flame spreading rating is required for the ceiling construction under this Code, a Class 0 rating for the covering and lining materials shall instead be required;

(2) when involved in fire, generate a minimum amount of smoke and toxic gases; and

(3) be at least 1m away from a fire damper.

d. Flexible joints and connections

(1) Flexible connections at the ends of ventilation ductwork connecting terminal units, extract units and ventilation grilles shall not exceed 4m.

(2) Flexible joints, which are normally provided to prevent and/or allow for thermal movements in the duct system, shall not exceed 250mm in length.

(3) Flexible joints shall be made of material classified as ‘not easily ignitable’ when tested under *BS 476: Part 5*.

e. Duct enclosure

Enclosure of ducts shall comply with the requirements in *Cl.3.8.9a.*.

Explanation and Illustrations

(No illustration)

A protected shaft used for the enclosure of services shall comply with the following:

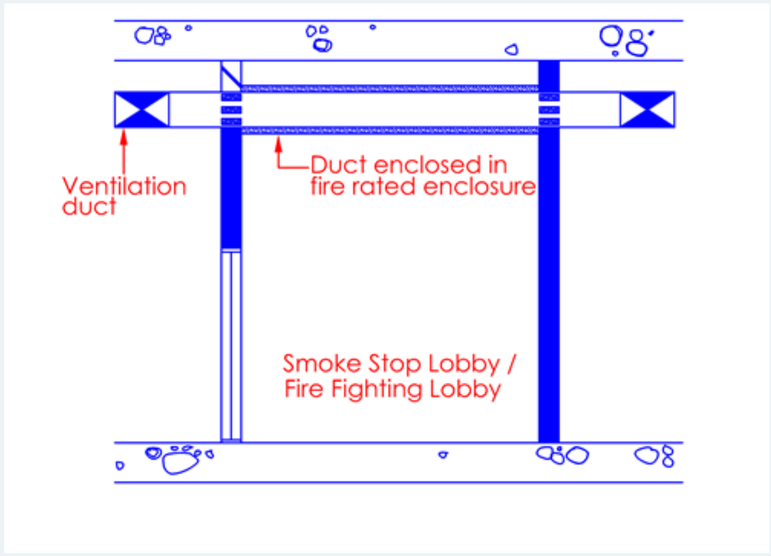
a. The protecting structure for protected shaft containing kitchen exhaust duct and mechanical ventilation ducts serving areas specified in *Cl.5.2.1g.(1)(a), (b), (c), (i)* and *Cl.5.2.1h.* which passes through one or more floors shall be masonry. Such shaft shall be completely compartmented from the rest of the shaft space containing other ducts or any other services installations.

b. For protected shaft containing ducts serving other areas which passes through two or more floors shall be constructed of fire-rated material.

f. Ductwork through smoke-free or fire lift lobbies

Ventilation ducts should not pass through smoke-free or fire lift lobbies. Where unavoidable, the part of the ventilation duct within the lobby shall be enclosed in masonry construction with fire resistance rating at least equal to that of the elements of structure. If other forms of fire resisting construction are used, a fire damper shall be fitted where the duct penetrates the lobby enclosure.

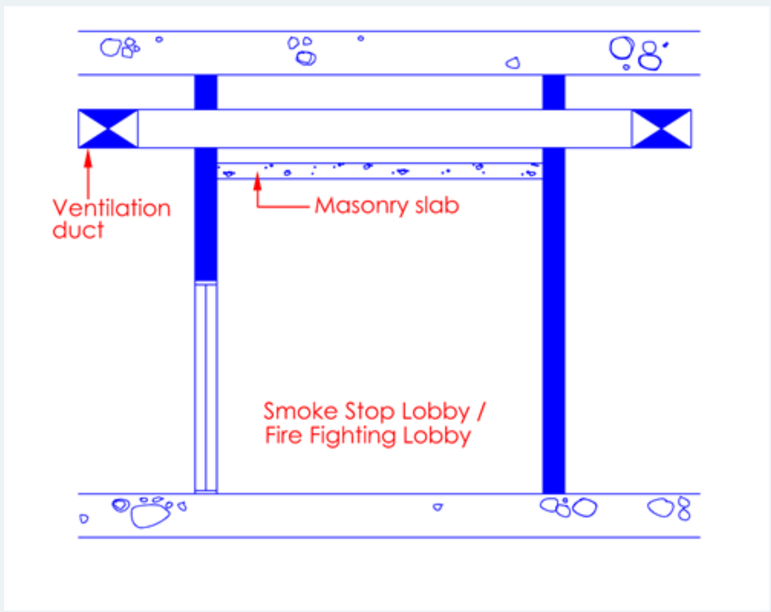
Explanation and Illustrations



Section

Figure 7.1.2f. – 1

In addition to providing fire-rated enclosure to the duct within the lobby, fire damper is fitted where the duct penetrates the lobby enclosure. Should a fire penetrates the fire damper, it will still be contained within the duct.



Section

Figure 7.1.2f. – 2

The omission of fire damper to the duct where it penetrates the lobby enclosure is acceptable if a masonry slab is constructed below the duct to act as compartment ceiling. The masonry slab over the lobby completes the compartmentation making the lobby a safe area.

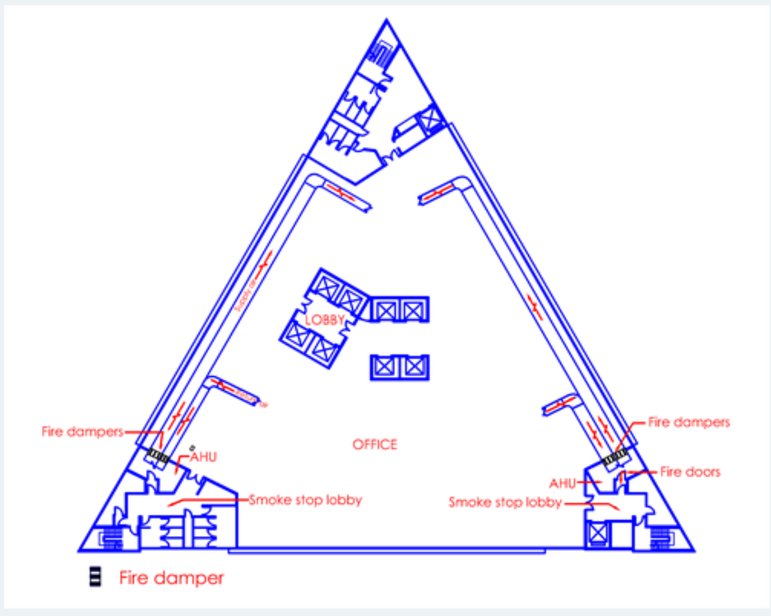


Figure 7.1.2f. – 3 : Routing of ventilation ducts directly from AHU room to office space

With proper pre-planning, ventilation ducts are routed directly from the AHU rooms to occupancy areas, thus avoiding the routing through the protected lobby.

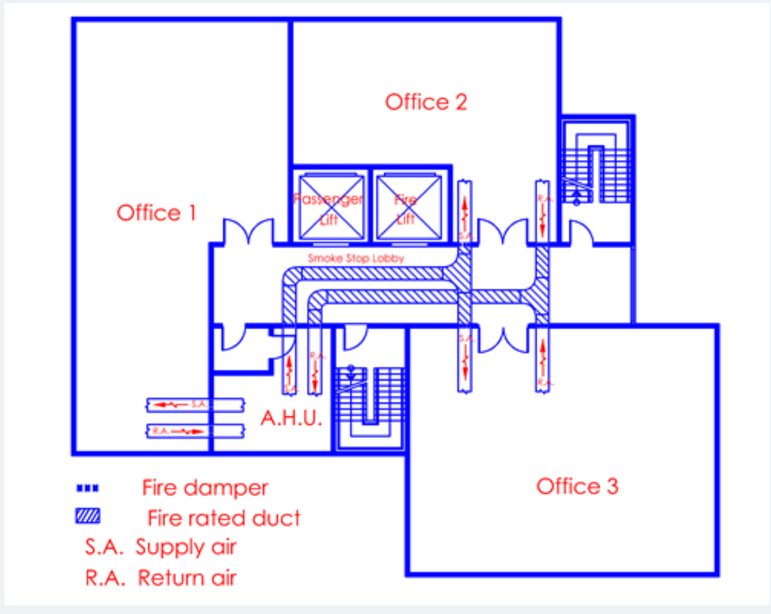


Figure 7.1.2f. – 4 : Routing of ventilation ducts along protected lobby

Ventilation ducts are routed along the smoke-stop lobby to serve office 2 & 3. Routing the ventilation ducts through the fire lift or smoke-stop lobbies should be avoided. “Unavoidable situations” where ventilation ducts were routed through the fire lift or smoke-stop lobbies referred to existing building where physical constraints existed making it difficult to route the ventilation duct through other spaces other than the lobby area.

g. Ductwork through separating walls

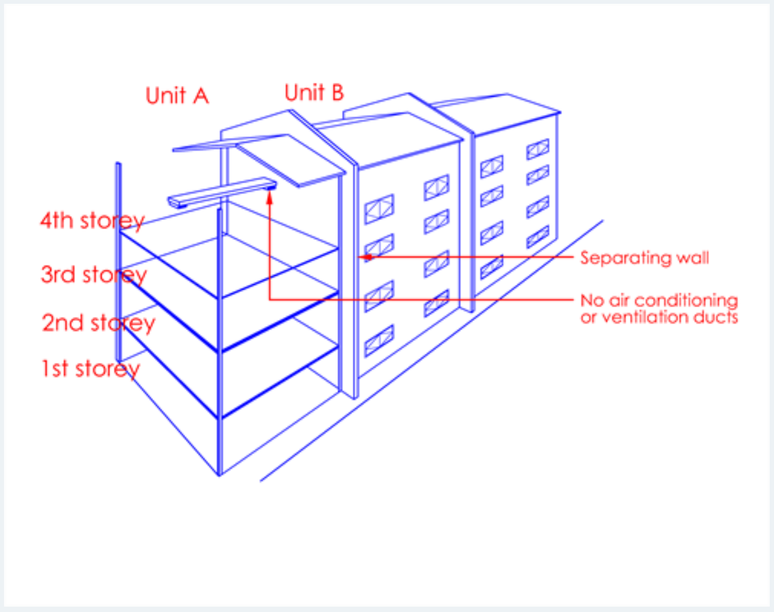
No air-conditioning or ventilation duct shall penetrate separating walls.

h. Fire-rated duct

(1) Where proprietary fire-rated materials are used to construct the fire-rated duct, the fire rating of the fire-rated duct shall have the same period of fire resistance as the wall or floor it penetrates.

(2) Proprietary fire-rated duct shall be tested to *BS 476 Part 24* or equivalent and its usage be approved by the SCDF.

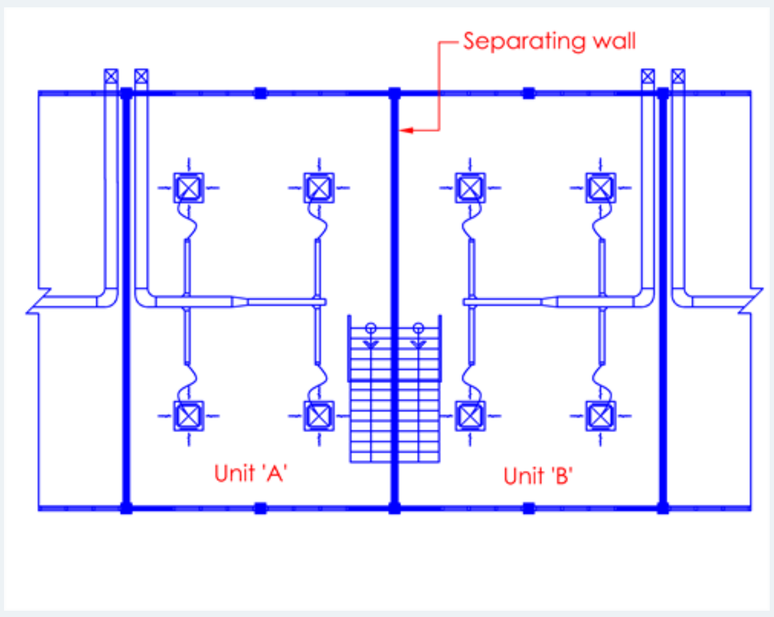
Explanation and Illustrations



Axonometric section

Figure 7.1.2g. - 1

A separating wall is a division wall that separate adjoining buildings of different ownership. Ducts are prohibited to penetrate separating wall to prevent fire spread from one building to another.



2nd storey floor plan

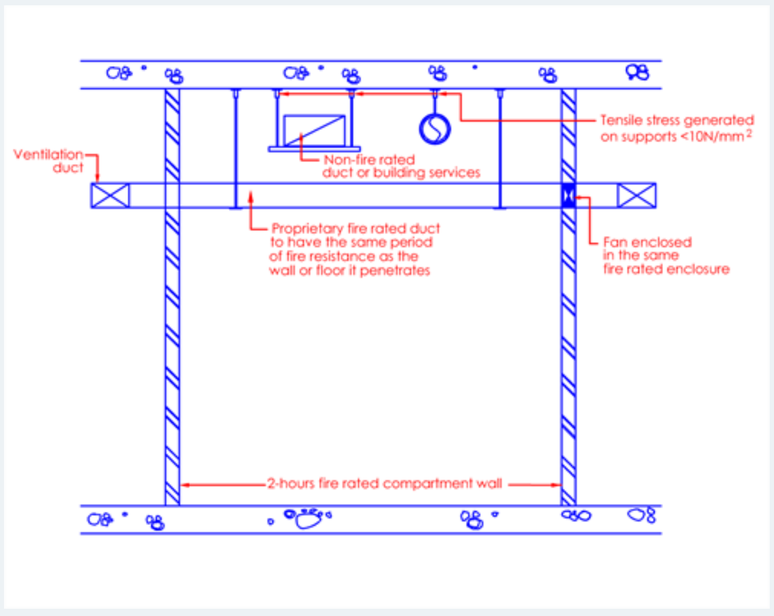
Figure 7.1.2g. - 2

In terrace shophouses, there should be no sharing of air-con ducts.

(3) Running of non-fire-rated duct and/ or other building services above the proprietary fire-rated duct should be avoided. When unavoidable due to physical constraints, the supports to such non-fire-rated duct and/ or other building services running above the proprietary fire-rated duct shall be strengthened, such that the tensile stress generated on the supports shall not exceed 10N/mm^2. The non-fire-rated duct and/ or building services shall also be adequately protected to prevent collapse in a fire which will otherwise affect the stability of the proprietary fire-rated duct below.

(4) Fans forming part of a fire-rated duct shall also be enclosed in the same fire-rated enclosure.

Explanation and Illustrations



Section

Figure 7.1.2h.(3)

i. Control panel

Rationale

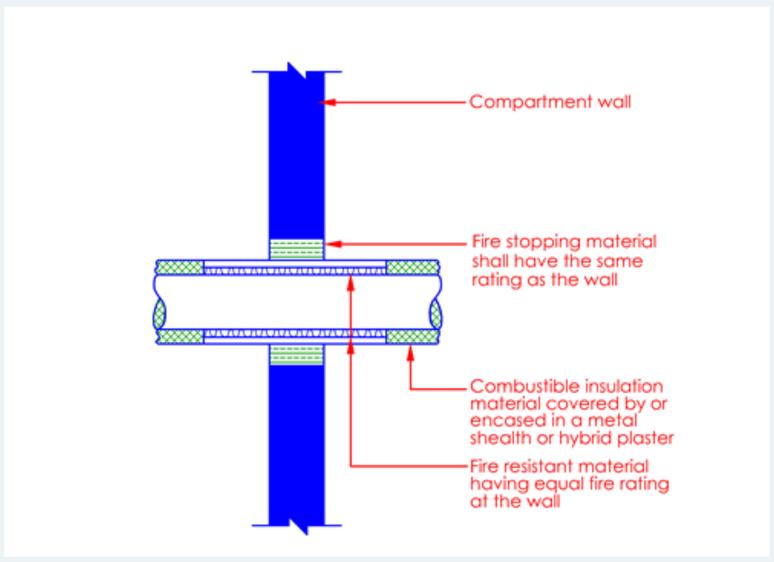
The control panel serving the fans of smoke control systems are crucial and should not be located within any smoke layer to ensure that the integrity of the smoke control system is not compromised in an fire emergency. The exhaust systems would not be operable in the event of failure of the control panels.

(1) The location and placement of control panels serving engineered smoke control and smoke purging systems shall be located within a common space such that the panels are clearly visible and readily accessible for operation and maintenance. Control panel shall be mounted at a height not less than 1.5m or not more than 1.8m from the finished floor level.

(2) For control panels serving smoke purging systems, it shall be located at least 1.5m away from fire hazards e.g. control panels for smoke purging system in carparks sited away from vehicle parking lots. Alternatively, the control panel shall be protected with at least 1-hr fire resisting rating enclosure.

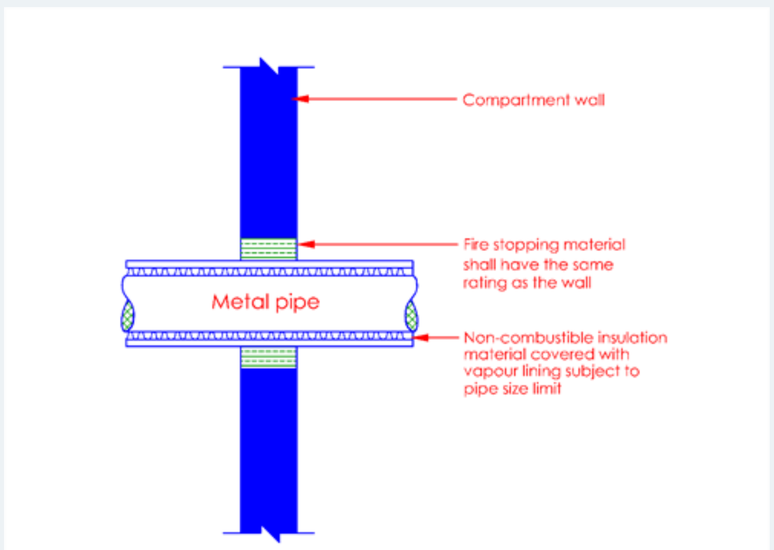
7.1.3 Pipework

Explanation and Illustrations



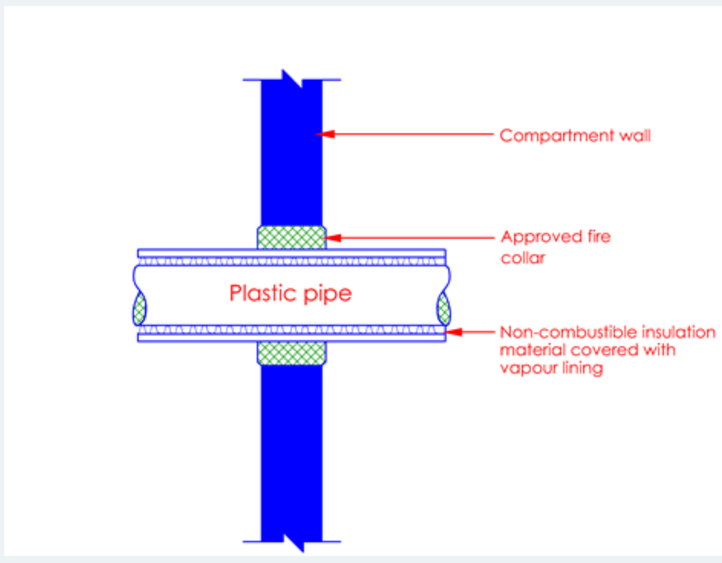
Section

Figure 7.1.3 – 1 : Metal pipes with combustible insulation



Section

Figure 7.1.3 – 2 : Metal pipes with non-combustible insulation



Section

Figure 7.1.3 – 3 : : Plastic pipes with non-combustible insulation

Minimum Class 1 for insulation material/barrier lining and adhesives. Where ceiling construction requires Class 0, insulation material shall also be class 0. However, the use of 10mm to 15mm max. pipe works for split unit system would be considered as acceptable.

The use of fire collar shall be appropriate for the diameter of the PVC/UPVC pipe and shall be duly secured to the surface of the wall or floor with steel anchor bolts.

Insulation for pipework associated with the air-conditioning and mechanical ventilation systems shall comply with the following requirements:

a. Flame spread rating

Insulation material for pipework, together with vapour barrier lining and adhesives shall, when tested in accordance with the methods specified in this Code, have a surface flame spread of not lower than Class 1. However, in areas of buildings where Class 0 flame spread is required for the ceiling construction under this Code, a Class 0 rating for the insulation material shall be required.

b. Plastic and foam rubber insulation

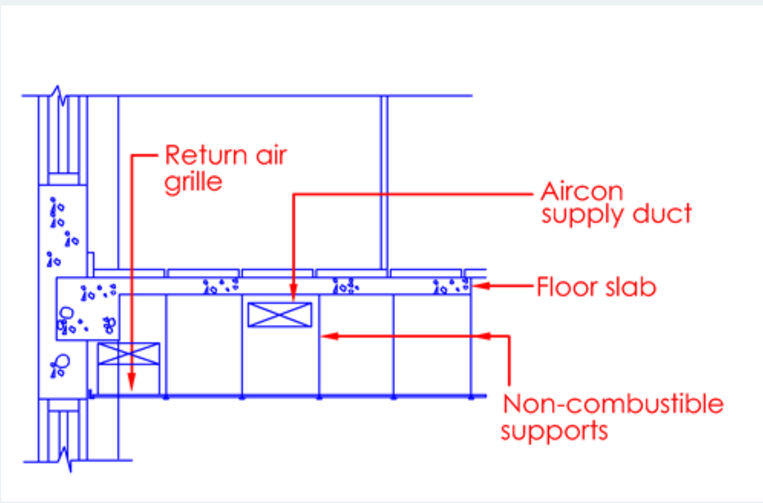
Notwithstanding the requirements of *Cl.7.1.3a.*, the use of plastic and foam rubber insulation materials of a lower classification is permitted if:

(1) it is of the self-extinguishing type; and

(2) the insulation is covered by or encased in a metal sheath or hybrid plaster or other non-combustible cladding material,

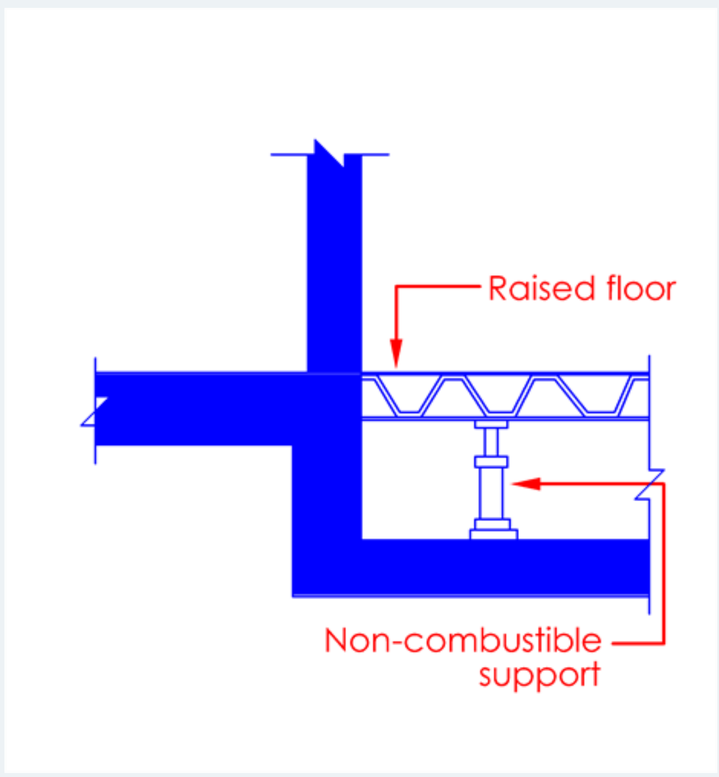
provided that any opening in the element of structure or other part of a building penetrated by the pipework shall be effectively fire-stopped by replacement of the insulation material at the junction of penetration with fire resistant material having equal fire resistance rating. A fire-rated proprietary pipework system can be used if it is tested in the manner acceptable to the SCDF.

Explanation and Illustrations



Section

Figure 7.1.4 – 1: Concealed ceiling space

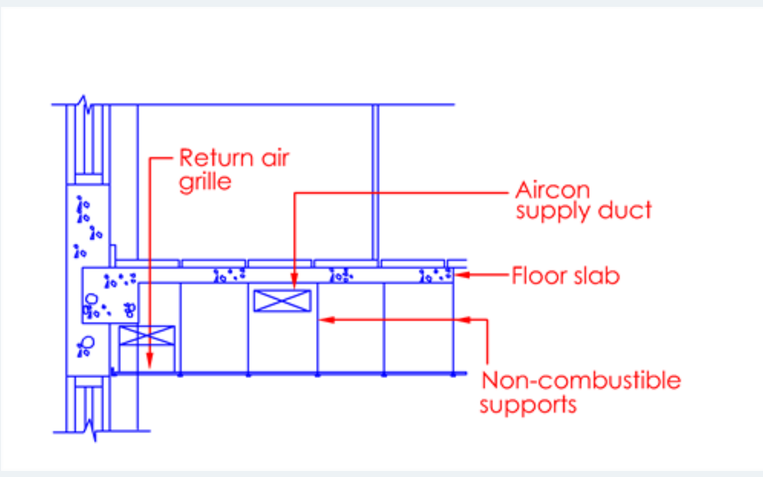


Section

Figure 7.1.4 - 2 : Concealed space below raised floor

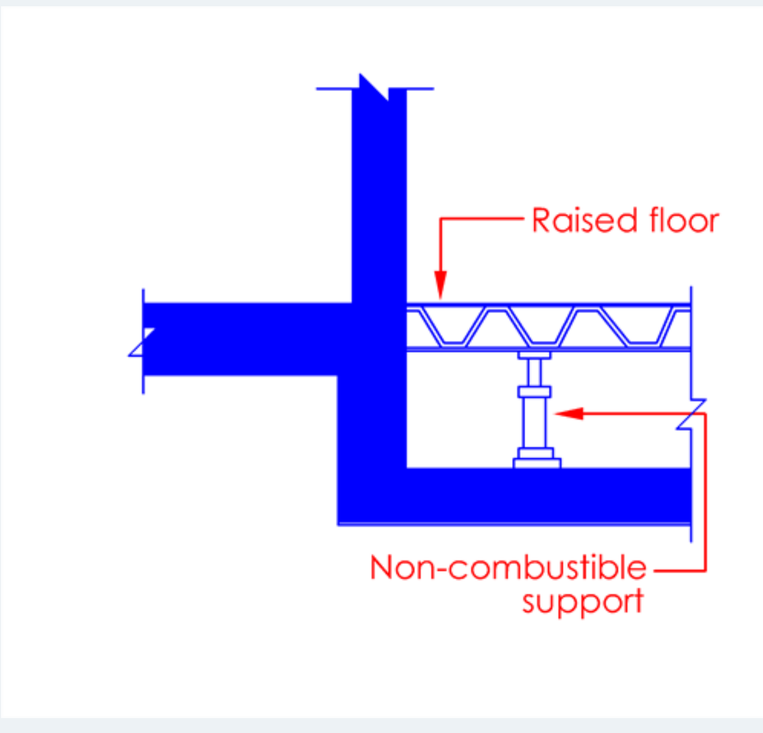
The main reasons for imposing additional fire safety requirements are that a fire occurring in the concealed space would be difficult to detect and that smoke and heat would quickly spread beyond the concealed space.

Sprinkler system is usually not provided in the concealed space, hence, all the supports for the raised floor or ceiling membrane shall be of non-combustible material. Ceiling plenum provides the means for transferring heat, smoke and fire, hence there should be a very strict control on the amount of combustible materials in it.



Section

Figure 7.1.4 - 3 : Return air in ceiling space

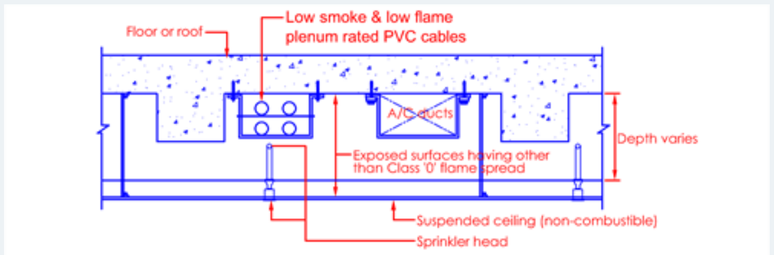


Section

Figure 7.1.4 - 4 : Return air plenum in concealed space below raised floor

A fire occurring in the concealed space would be difficult to detect. The smoke and heat could quickly spread beyond the origin of fire in the concealed space.

To restrict the unseen spread of smoke and heat in concealed spaces, additional fire safety requirements are imposed under *Cl.7.1.4a.* and *Cl.7.1.4b.*.



Section

Figure 7.1.4 - 5

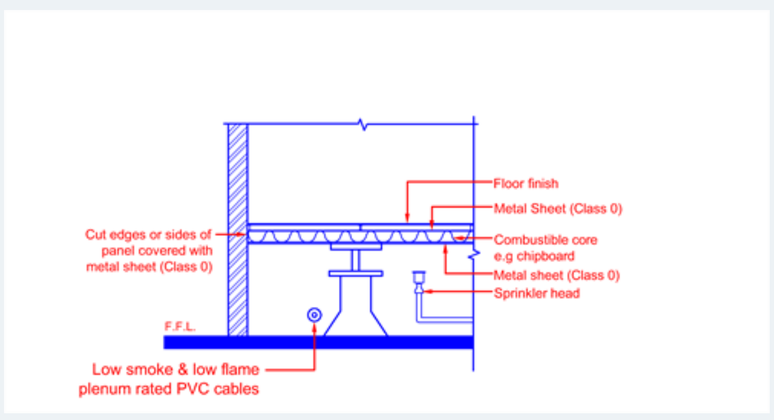


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Figure 7.1.4 - 6

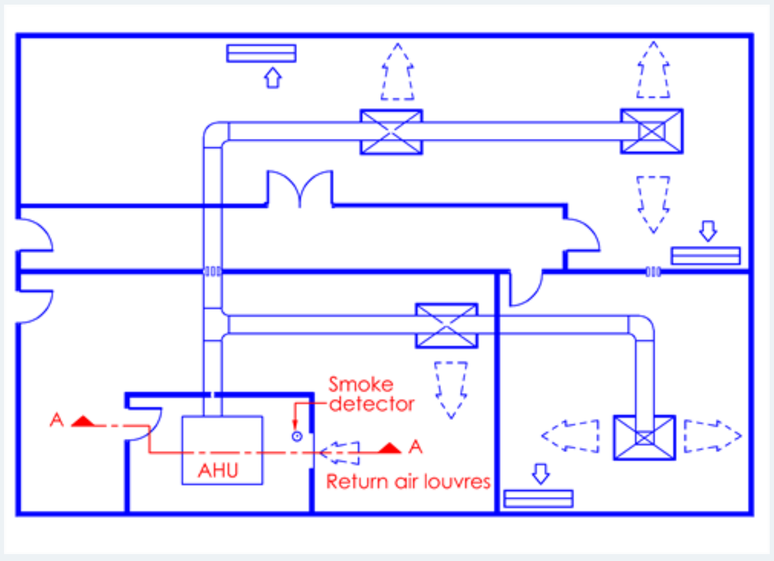
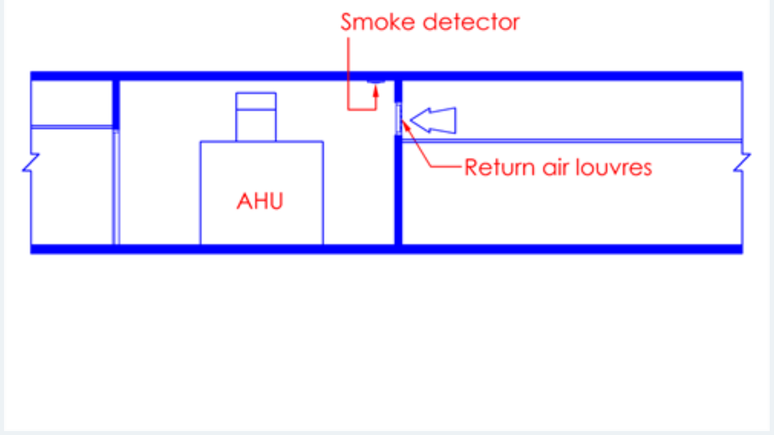


Figure 7.1.4 - 7



Section A-A

Figure 7.1.4 - 8

Low-flame and low-smoke plenum rated PVC cables conforming to NFPA 262 are permitted to be run exposed in plenum, provided that the plenum shall be protected by sprinkler system or gaseous total flooding system.

In the case of Fan Coil Unit (FCU) or Air Handling Unit (AHU) using plenum for air return and serving more than one rooms, it shall be provided with smoke detection at the return air plenum. This is to address smoke detection within the air plenum space.

A concealed space between the ceiling and floor above it, ceiling and roof, or raised floor and structural floor of a building can be used as a plenum provided:

a. The concealed space contains only:

(1) mineral insulated metal sheathed cable, aluminium sheathed cable, copper sheathed cable, rigid metal conduit, enclosed metal trunking, flexible metal conduit, liquid tight flexible metal conduit in lengths not more than 2m, or metal-cladded cables;

(2) electric equipment that is permitted within the concealed spaces of such structures, if the wiring materials, including fixtures, are suitable for the expected ambient temperature to which they will be subjected;

(3) other ventilation ducts complying with *Cl.7.1.2a.* to *d.*;

(4) communication cables for computers, television, telephone and inter-communication systems;

(5) fire protection installations; and

(6) pipes of non-combustible material conveying non-flammable liquids.

b. The supports for the ceiling membrane are of non-combustible material.

c. Exception

Low-smoke and low-flame plenum rated PVC cables conforming to *NFPA 262* can be run exposed in plenum, provided that:

(1) the plenum space is protected by a sprinkler system or gaseous total flooding system; and

(2) a FCU or AHU using a plenum for air return and serving more than one room, is installed with smoke detector(s) at the return air plenum space to shut down the FCU/ AHU upon detection of smoke.

7.1.5 Fire Dampers

Any fire damper shall have a fire resisting rating of not less than that required for the compartment wall or compartment floor through which the relevant section of the ventilation duct passes. Fire dampers shall be of the type approved by the SCDF and constructed in accordance with the requirements in *SS 333*.

a. Provision of fire dampers

Ventilation ducts which pass directly through a compartment wall or compartment floor shall comply with the following:

(1) where the ventilation duct does not form a protected shaft or is not contained within a protecting structure, the duct shall be fitted with a fire damper where it passes through the compartment wall or compartment floor; and

(2) where the ventilation duct forms a protected shaft or is contained within a protecting structure, the duct shall be fitted with fire dampers at the shaft inlets and outlets.

b. Installation of fire dampers

(1) Fire dampers shall be installed so that the casing completely penetrates through the compartment wall or floor, and the casing shall be retained, either:

(a) on both sides by means of flanges in such a manner that it can expand under fire conditions without distorting the blades in the closed position, or

(b) on the accessible side by means of one flange only, which can be fixed to the damper and to the wall through slotted holes to allow for expansion.

(2) Flanges shall be butted against the face of the compartment wall or floor and fixed to the damper casing.

(3) Ductwork connected to the damper shall be attached in such a manner as to ensure that the damper remains securely in position and is fully functional in the event of damage of ductwork.

(4) The clearance between the damper body and the sides of the penetration shall not be less than that of the tested prototype and be not greater than half the width of the angled section of the collar.

(5) The space between the damper body and the opening in the wall or floor shall be fire-stopped.

(6) Vertically positioned fire dampers shall be installed in such a manner that the direction of air flow assists in the closure of the damper.

(7) Connections to fire dampers

The distance between the plane through a closed fire damper and ducting, flexible connections, duct coverings, internal linings and the like, shall be

(a) not less than 1m when such parts are made of materials with fusing temperatures less than 1000oC;

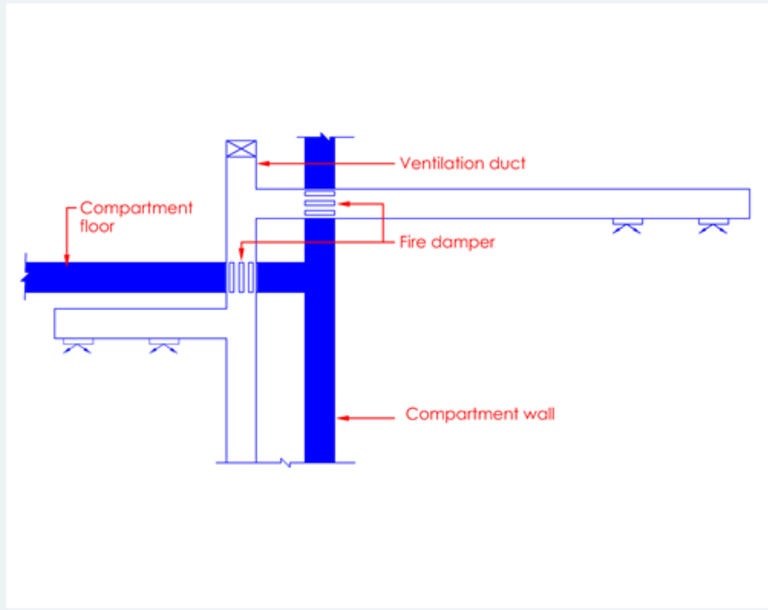
(b) not less than three times the diagonal or diameter of the damper; and

(c) not less than 2m when such parts are made of materials that are combustible, except for vapour barrier to provide thermal insulation.

(8) Fire damper inspection access doors

Each fire damper installation shall be provided with an inspection access door in the ventilation duct, either upstream or downstream, as appropriate. The access door dimension shall measure 450mm (length) X 450mm (width); for smaller ducts, the door width dimension can be reduced to the width or depth of the duct. Access doors shall be hinged and fitted with sash locks, and be constructed of minimum 1.25mm suitably braced sheet steel. Openings in ducts shall be stiffened by a sheet steel frame.

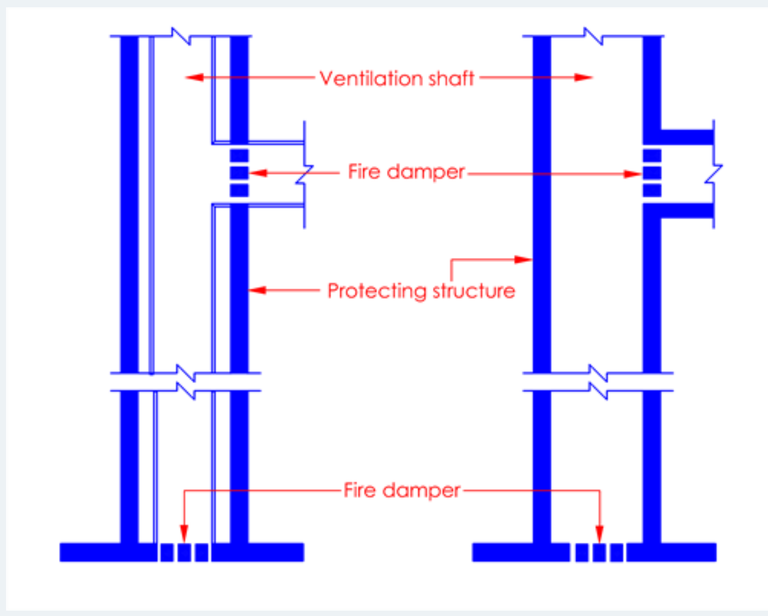
Explanation and Illustrations



Section

Figure 7.1.5a. – 1

Exposed ventilation duct is not fire-rated. Fire damper is provided where it passes through the compartment floor or wall to prevent fire spread from compartment to compartment via the duct.



Section

Figure 7.1.5a. – 2

To prevent fire spread from compartment to compartment via the duct, fire damper shall be provided at the inlets to the exhaust air shaft and outlets from supply air shaft.

The dampers shall be properly secured to the protecting structure or protected shaft to prevent any displacement. The method of installation shall follow the type tests shown in the test report issued by testing laboratory.

Fire dampers are provided to inlets of exhaust air shafts and outlets of supply air shaft

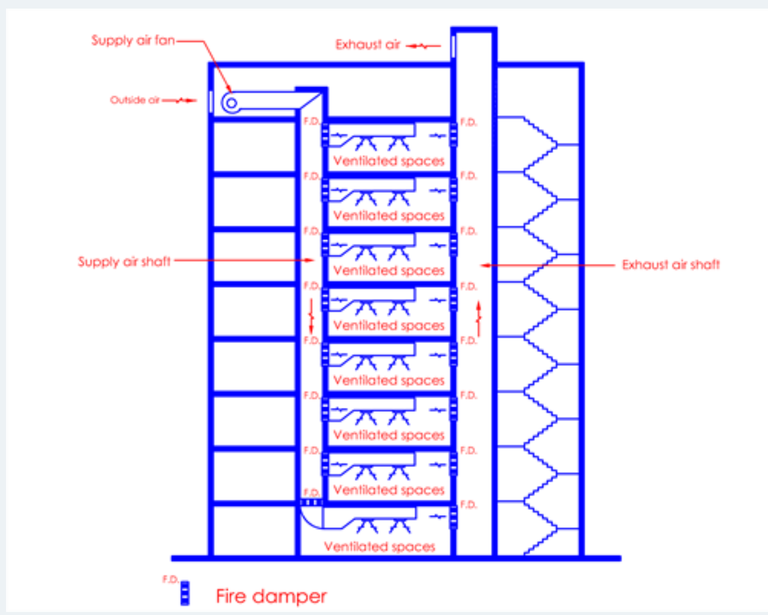


Figure 7.1.5a. – 3

c. Prohibition of fire dampers

Fire dampers shall not be fitted in any of the following locations:

(1) openings in walls of a smoke extract shaft, or a return air shaft which also serves as a smoke extract shaft, or

(2) openings in walls of a protected shaft when the openings have a kitchen exhaust duct passing through it, or

(3) opening in walls of a protected shaft when the openings have a fume hood exhaust duct passing through it, or

(4) anywhere in an air pressurising system, or

(5) in locations explicitly prohibited in this Code.

d. Standards

Where a fire damper is required by this Code to be installed in an air- conditioning and mechanical ventilation system, its type, details of installation, connection of accessories, inspection door, etc., shall be in accordance with *SS 333*.

Explanation and Illustrations

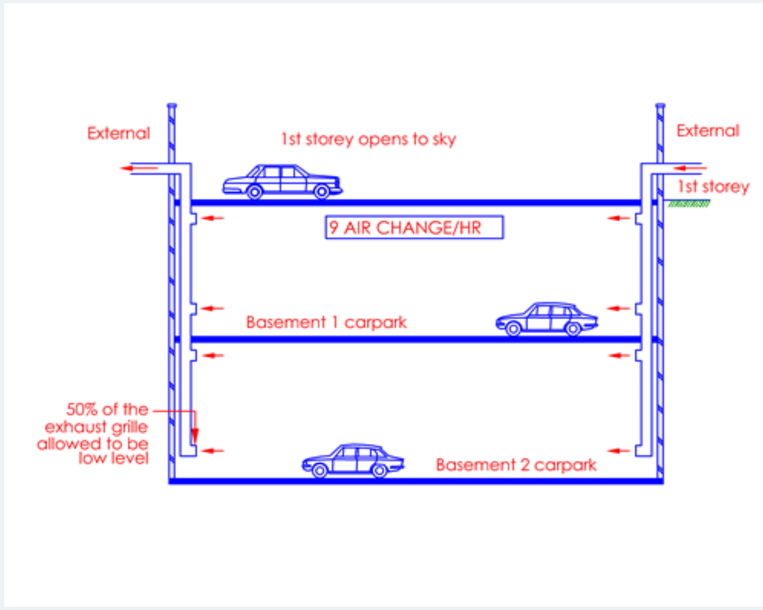


Figure 7.1.5c. : Car park smoke purging system

Fire dampers shall not be fitted in any of the supply air shaft or extract air shaft. The smoke purging system would fail as the fire dampers when in closed position would prevent movement of air within the shaft.

Fire dampers shall not be provided in the following locations:

a. openings in wall of a protected shaft serving kitchen exhaust;

b. anywhere in the supply duct work of air pressurising system to exit staircase; and

c. anywhere in the supply and exhaust ducts serving fire pump room, generator room, FCC and flammable store.

7.1.6 Fire resisting floor ceiling and roof ceiling

a. The space above a suspended ceiling which forms part of a fire-rated floor ceiling or roof ceiling construction shall not contain ducting, unless said ducting was incorporated in a prototype that qualified for the required fire resistance rating, in which case the ducting shall be identical to that incorporated in the tested prototype.

Explanation and Illustrations

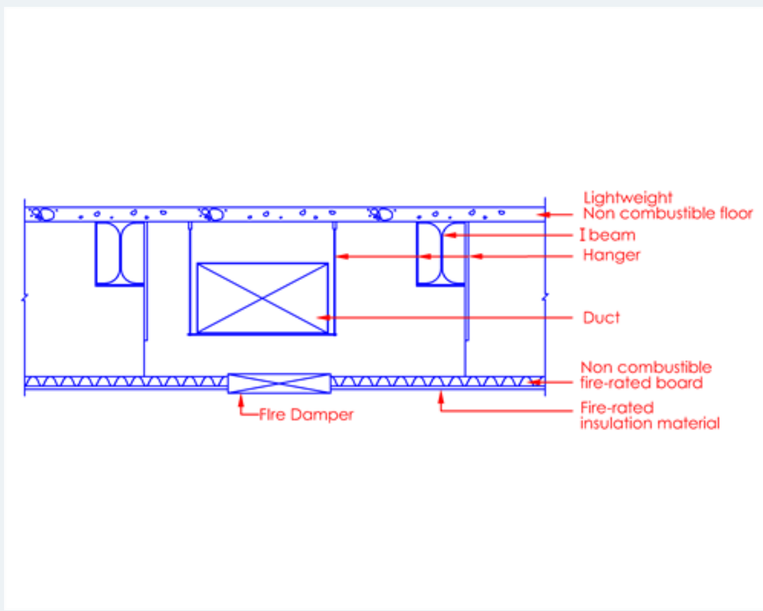


Figure 7.1.6a : Ducting above fire-rated ceiling or roof ceiling construction

Mechanical ventilation ducts are not permitted to be located in the concealed space of fire-rated floor ceiling or roof ceiling assembly, unless such ducts are included in the prototype that was tested for the required fire resistance rating. The type of ducting within such ceiling or roof spaces as well as details of openings in such ceiling shall be identical to that incorporated in the tested prototype.

b. Openings in the ceiling, including openings to enable the ceiling to be used as a plenum, shall be protected by fire dampers identical to those used in the tested prototype. Such openings in the ceiling shall be so arranged that:

(1) no opening is greater in area than that in the corresponding prototype test panel;

(2) the aggregate area of the openings per unit ceiling area does not exceed that of the prototype test panel; and

(3) the proximity of any opening to any structural member is not less than that in the prototype test panel.

Explanation and Illustrations

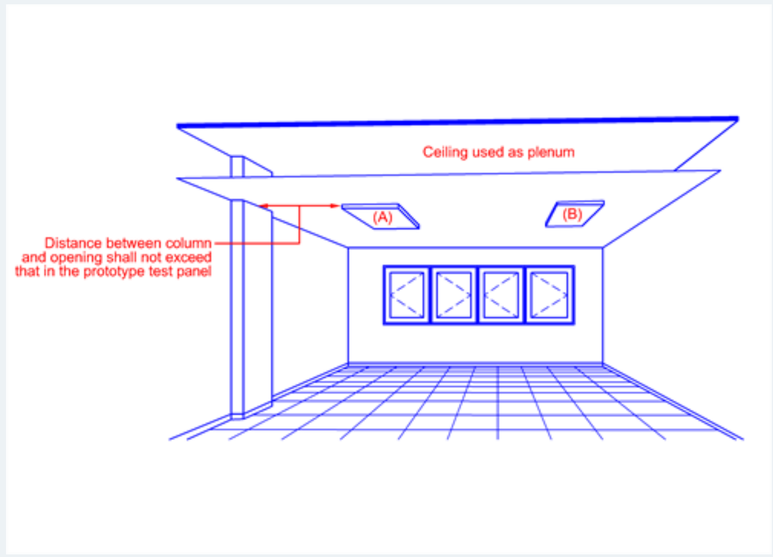


Figure 7.1.6b

1. Area of each opening (A & B) shall not be greater or larger than that in the prototype test panel.

2. Total area of openings (A & B) for ceiling to each compartment shall not be greater than that of the prototype test panel.

3. The opening (A & B) can be relocated within the ceiling area provided the proximity to structural member, e.g. column, beams and structural walls is not less than that in the prototype test panel.

7.1.7 Locations of intakes and return air openings/ exhaust air discharge outlet/ openings

a. Openings for the intakes of outdoor air to all air handling systems, mechanical ventilation systems, pressurisation systems of exit staircases and internal corridors, and smoke control systems shall be no less than 5m from any exhaust discharge openings.

b. All return air openings and outdoor air intakes shall be located and arranged such that sources of ignition, such as lighted matches and cigarette butts, which accidentally enter the openings and intakes cannot be deposited onto the filter media.

c. The exhaust air discharge outlets/ openings for ventilation system under this Code shall directly discharge to the external space.

7.1.8 Air handling unit (AHU) room

a. Air plenums

Air handling systems shall not use protected shafts of exits, smoke-free lobbies, including its concealed space for supply, exhaust or return air plenums.

b. Compartmentation

Rationale

Rooms having no usage other than housing air handling equipment or package units, and their associated electrical controls are typically not regarded as areas of high risk and therefore compartmentation is not required. However, fire dampers shall be provided within the air ducts of the air handling equipment where they penetrate through compartments to prevent fire spread.

(1) Where the air handling equipment serves more than one compartment, fire dampers shall be provided in air ducts at penetrations through the compartment walls and floors to comply with the requirements in Cl.7.1.5.

Explanation and Illustrations

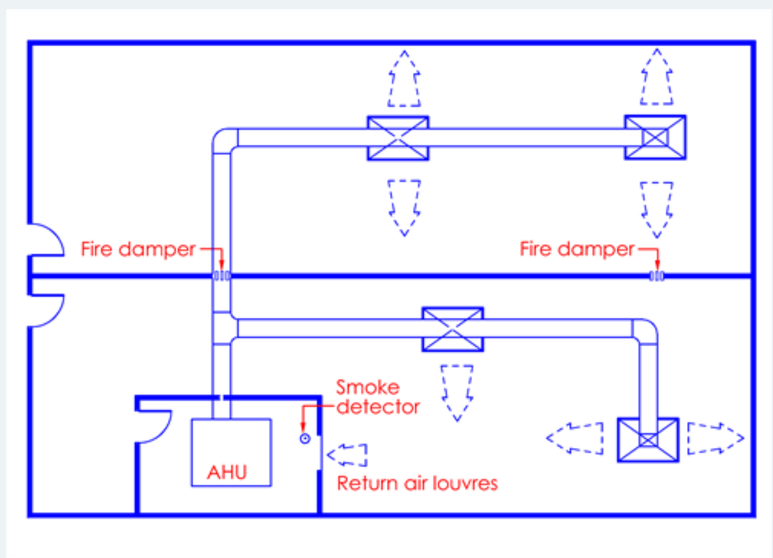


Figure 7.1.8b.(1)

Where the AHU serves more than one compartment, fire dampers shall be provided in air ducts at penetrations through the compartment walls and floors.

(2) Where AHU rooms are vertically stacked, each AHU room shall be separated by a compartment floor at every level.

c. Smoke detectors

(1) Smoke detectors of approved type shall be incorporated in the return air stream immediately adjacent to:

(a) AHUs serving more than one storey or compartment, or

(b) a single AHU in excess of 15000m³/h.

(2) The function of smoke detectors, where required by this Code, is to initiate action to shut down the AHU automatically when the smoke density in the return air system has become unacceptable for recycling.

d. Stop switch

Where the AHUs in a building are not centrally controlled, each AHU exceeding 8500m³/h shall be provided with a manual stop switch to facilitate quick shutting down of the fan in the case of fire. For ease of access, this switch shall be located on the wall next to the door opening of the air handling equipment room.

Explanation and Illustrations

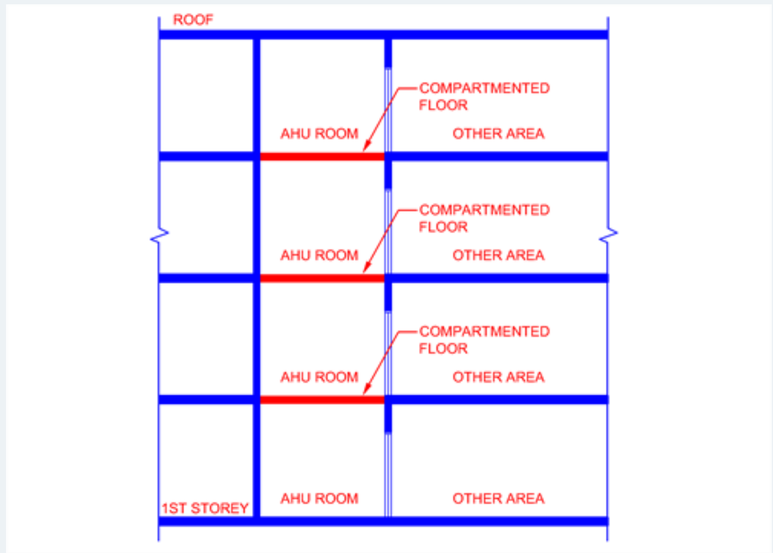


Figure 7.1.8b.(2)

1. Some practice of using fire-rated ceiling at the underside of the metal platform for vertically stacked AHU rooms which will likely deteriorate over time due to moisture or dampers, is no longer permitted.

2. Vertically stacked AHU rooms shall be separated by a compartment floor at every level.

7.1.9 Ventilation system for exits

a. Air plenums

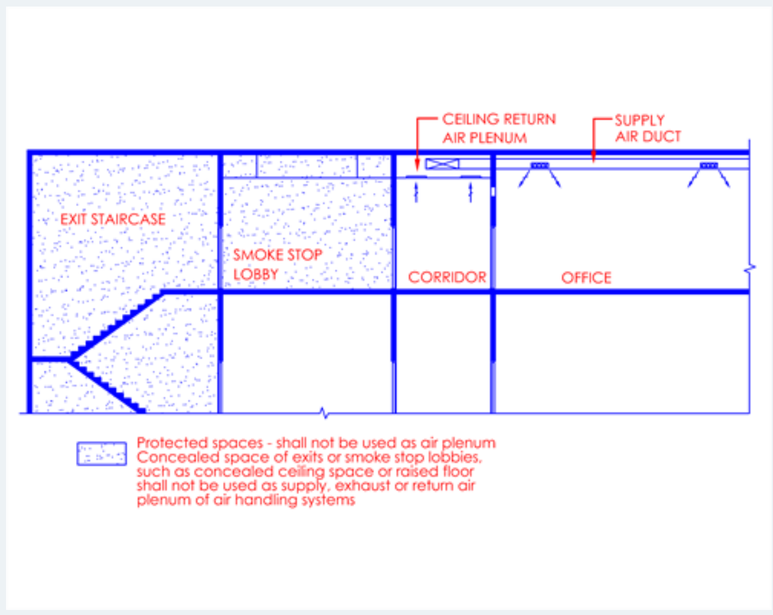
Protected shaft of exits, smoke-free lobbies, including their concealed spaces shall not be used for supply, exhaust or return air plenum of air handling systems.

b. Exit staircase and internal exit passageway

A mechanical ventilation system for each exit staircase and internal exit passageway, if provided, shall be an independent system of supply mode only exclusive to the particular staircase and internal exit passageway, and it shall comply with all of the following requirements:

(1) Supply air for the system shall be drawn directly from the external space, with intake point not less than 5m from any exhaust discharge openings.

Explanation and Illustrations



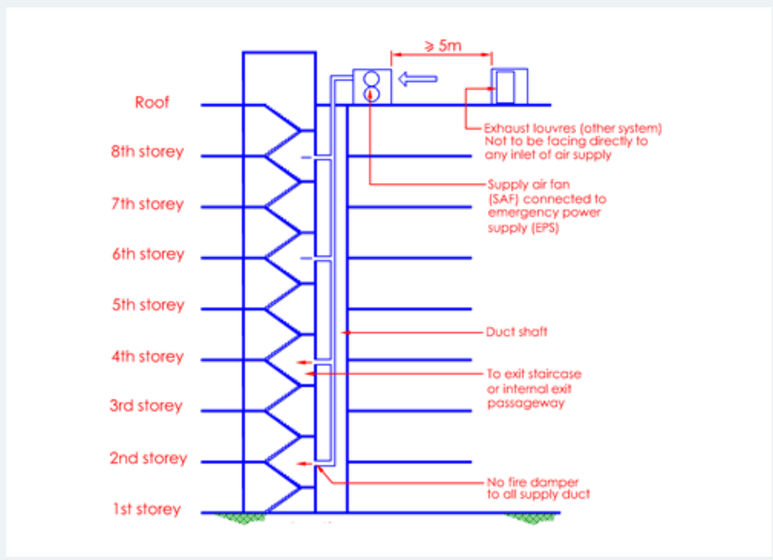
Section

Figure 7.1.9a.

The protection of these spaces as means of escape is important. They must not be used as air plenum by other systems.

(2) For exit staircase serving more than four storeys, supply air shall be conveyed via a vertical duct extending throughout the staircase height and discharging through outlets distributed at alternate floors.

Explanation and Illustrations



Section

Figure 7.1.9b.(2).: Mechanical ventilation to exit staircase and internal exit passageway

There is a need to separate supply air fan from the exhaust louvres by at least 5m measured from the edge of the exhaust louvres housing. This is to prevent the possibility of smoke being drawn into the supply air shaft. The exhaust louvres (outlet) shall not face directly to any inlet of air supply.

For maintaining uniformity of air distribution in the staircase it would be desirable to place the supply air outlet at every floor level, but should not be more than alternate floors. The supply air system to the staircase shall be an independent system as it is expected to operate during emergency to provide smoke free environment to serve occupants evacuating in the staircase.

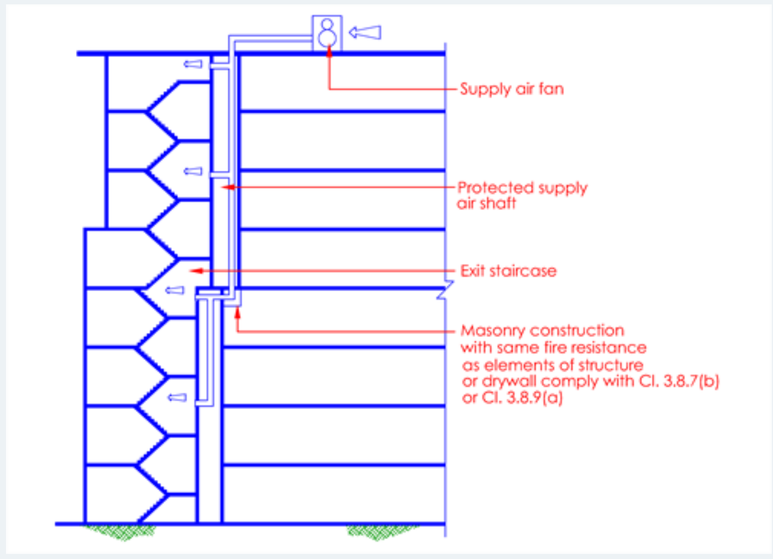
(3) Where the supply air duct serving the exit staircase has to penetrate the staircase enclosure, the portion of the duct where it traverses outside the staircase shall be enclosed in masonry construction or drywall complying with *Cl.3.8.7b.* of at least the same fire resistance as the elements of structure, and it shall not be fitted with fire dampers.

(4) The ventilation system shall be of supply mode only, and of not less than 4 air changes per hour.

(5) The mechanical ventilation system shall be automatically activated by the building fire alarm system. In addition, a remote manual start-stop switch shall be made available to firefighters at the FCC, or, where there is no FCC, at the fire alarm panel.

(6) Visual indication of the operational status of the mechanical ventilation system shall be provided.

Explanation and Illustrations



Section

Figure 7.1.9b(3).

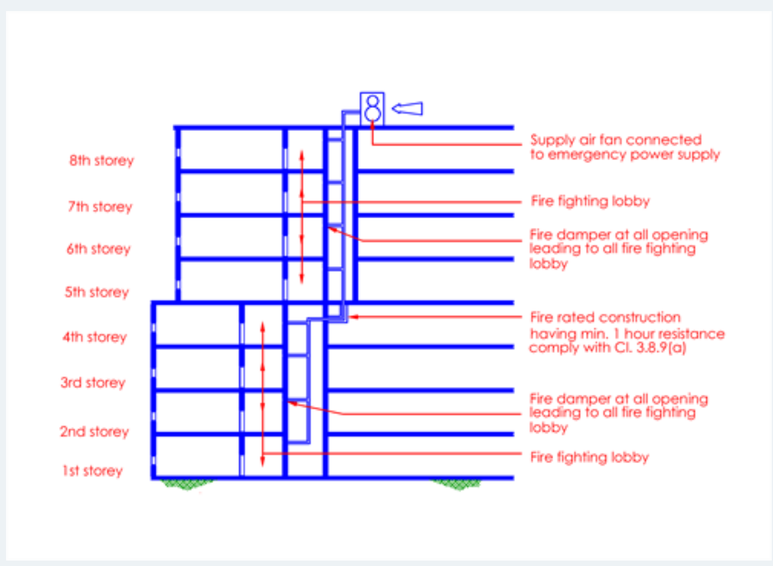
The supply air duct is considered as part of the exit staircase, as such that part of the duct which traverses outside shall be protected.

As exit staircase is the means of escape, protecting it with masonry or equivalent would ensure the durability of the shaft during a fire situation.

As far as possible, the supply air duct should be located within the protected shaft, unless it is unavoidable.

7.1.10 Ventilation system for smoke-free lobby and fire lift lobby

Explanation and Illustrations



Section

Figure 7.1.10 : Mechanical ventilation of smoke-stop/fire lift lobbies

The above figure shows that the supply air duct to the smoke-stop lobbies or fire fighting lobbies is provided with fire damper where it penetrates the compartment wall of the lobby. This is to ensure that the floor to floor compartmentation is maintained.

The portion of the duct which traverse outside the protected shaft is enclosed in fire rated construction e.g. fire-rated boards comply with *Cl.3.8.9a.* or *Cl.3.8.7b.*. The purposes of locating the manual start/stop switch with visual indication at the FCC, or at the main fire indicating board (FIB) where there is no FCC are:

(a) to allow firefighting personnel to shut down the supply air system temporarily in the event that smoke is being drawn into the lobby through the outdoor air intake; and

(b) to allow firefighting personnel to activate the supply air system should the fire alarm system fail to automatically activate the supply air system.

a. The ventilation system shall be of supply mode only of not less than 10 air changes per hour.

b. Supply air shall be drawn directly from the external space with intake point not less than 5m from any exhaust discharge or openings for natural ventilation.

c. Any part of the supply duct running outside the smoke-free or fire lift lobby which it serves shall either be enclosed or constructed to give a 1-hr fire resistance rating. The SCDF may, at its discretion, require a higher fire resistance rating if the duct passes through an area of high fire risk.

d. The mechanical ventilation system shall be automatically activated by the building fire alarm system. In addition, a remote manual start-stop switch shall be made available to firefighters at the FCC, or, where there is no FCC, at the main fire alarm panel.

e. Visual indication of the operational status of the mechanical ventilation system shall be provided.

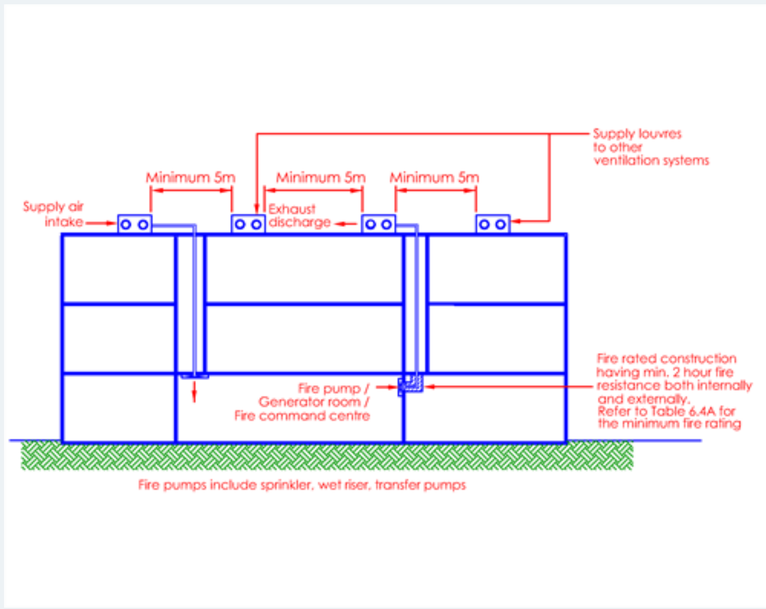
f. Where air conditioning is required for daily operations, this can be provided via supply and return air duct from the FCU/ AHU outside of the smoke-free/ fire lift lobby. Fire dampers shall be provided in the supply and return air ducts at penetrations through the compartment walls and/or floors. The ducts shall be fire-rated if it forms part of the other services passing through the smoke-free/ fire lift lobbies and/or the duct insulations are not of non-combustible type.

7.1.11 Ventilation system for fire pump room and generator room

Where mechanical ventilation is installed to provide a smoke-free environment for the room housing the fire pump or emergency generator, such systems shall be independent of each other and of any other system serving other parts of the building, and shall comply with all of the following requirements:

a. Supply air shall be drawn directly from the external space and its intake point shall not be less than 5m from any exhaust discharge openings. Exhaust discharge shall also be direct to the external space.

Explanation and Illustrations



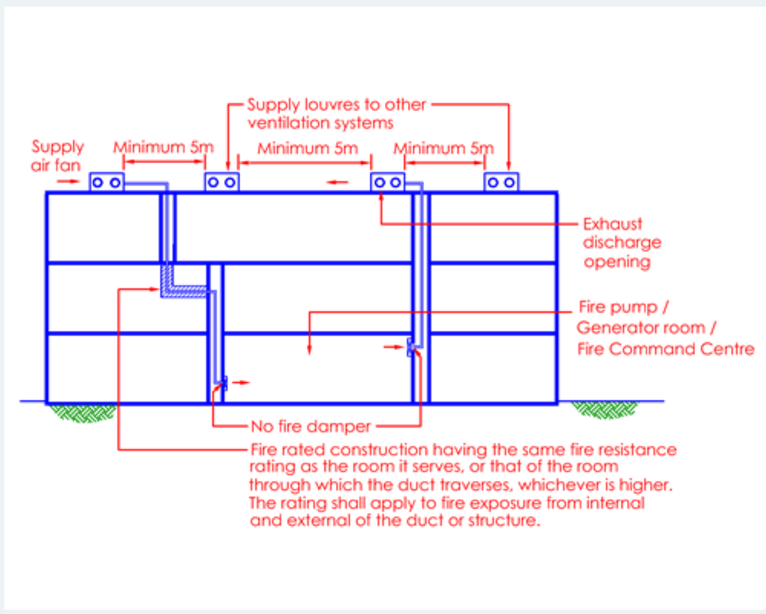
Section

Figure 7.1.11a

The 5m clearance between supply and exhaust units refers to the horizontal distance. This is to prevent the recycling of exhaust air back into the building.

b. Where the corresponding ducts run outside the room they shall either be enclosed in a structure or be constructed to give at least the same fire rating as the room which they serve, or that of the room through which they traverse, whichever is higher. The rating shall apply to fire exposure from both interior and exterior of the duct or structure. Where the duct risers are required to be enclosed in a protected shaft constructed of masonry or drywall complying with *Cl.3.8.7b.*, they shall be compartmented from the rest of the shaft space containing other ducts or service installations.

Explanation and Illustrations



Section

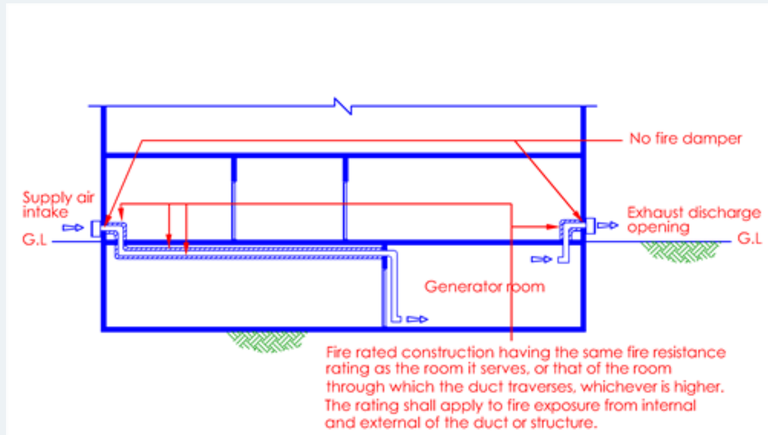
Figure 7.1.11b

The above figure shows that the ducts that run outside the protected shaft are enclosed in a structure or be constructed to give the necessary fire resistance rating. However, for the riser ducts which pass through one or more floors they are required to be enclosed in masonry shaft or drywall as required under *Cl.3.8.9a.*. This is to ensure that the riser ducts are properly protected within a shaft. The enclosure would ensure the integrity and stability of the riser ducts which pass floor to floor.

The provision of fire damper in the supply or exhaust duct is not allowed as the supply or exhaust system is required to function during emergency.

c. No fire damper shall be fitted in either supply or exhaust duct required under this clause.

Explanation and Illustrations



Section

Figure 7.1.11c. - 1

The concern is the stability of the riser ducts, if they pass through one or more floors

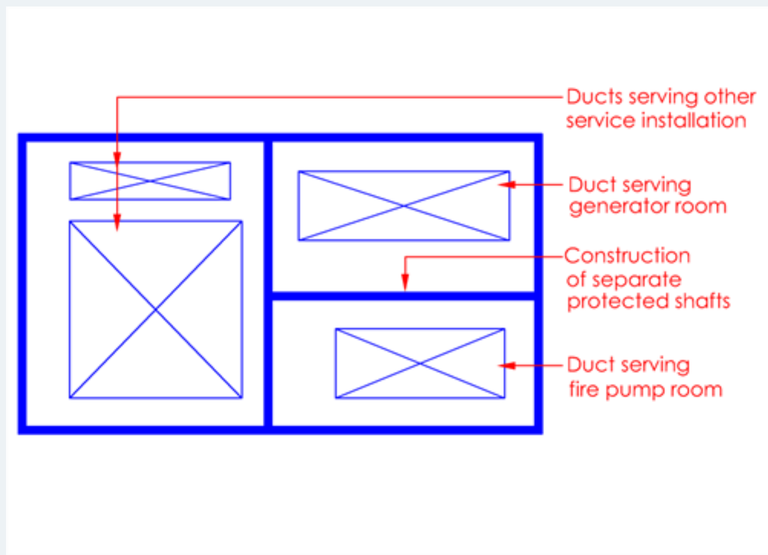


Figure 7.1.11c. - 2 : Protected shaft for ducts

As the mechanical ventilation system to generator room and fire pump room is independent of each other, the riser duct for each system shall be separately enclosed in a masonry or drywall shaft and compartmented from the rest of the shaft space containing other ducts or service installations.

Cl.3.8.9a. should also be referred to.

d. A duct serving areas other than rooms housing equipment stated in this clause shall not pass through such rooms.

Explanation and Illustrations

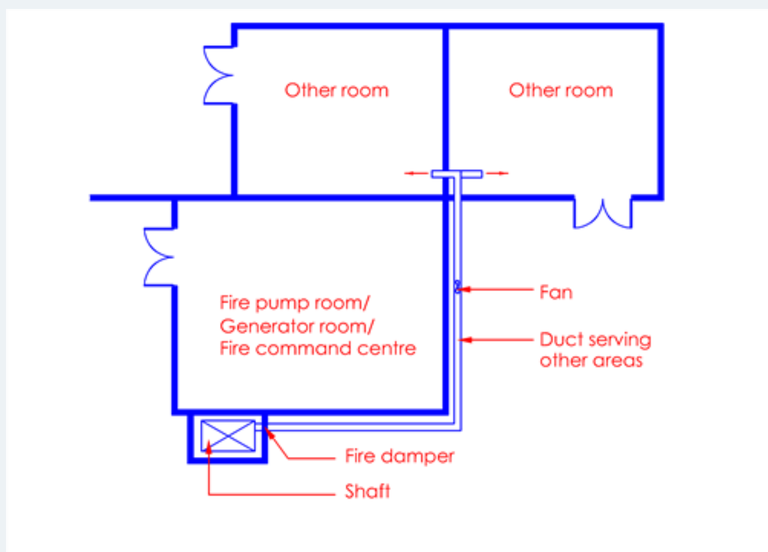


Figure 7.1.11d

Ducts serving other areas shall not pass through the fire pump room, generator room and FCC. The above figure shows that the ventilation duct is diverted from traversing the equipment room.

7.1.12 Ventilation system for Fire Command Centre (FCC)

The FCC can either be air-conditioned, naturally ventilated or mechanically ventilated. The air-conditioning or mechanical ventilation shall be independent of each other and any other system serving other parts of the building. Where air-conditioning or mechanical ventilation is provided, the fan coil unit or ventilation fan serving the FCC can be located within the FCC and shall also comply with all of the following requirements:

a. Supply air shall be drawn directly from the external space and its intake point shall not be less than 5m from any exhaust discharge openings. Exhaust discharge shall also be direct to the external space.

b. Where the corresponding ducts run outside the FCC, they shall either be enclosed in a structure or be constructed to give at least the same fire rating as the room which they serve or that of the room through which they traverse, whichever is higher. Where the duct risers are required to be enclosed in a protected shaft constructed of masonry or drywall complying with *Cl.3.8.7b.*, they shall be compartmented from the rest of the shaft space containing other ducts or service installations.

c. No fire damper shall be fitted in either supply or exhaust duct required under this Clause.

d. A duct serving areas other than the FCC shall not pass through the room.

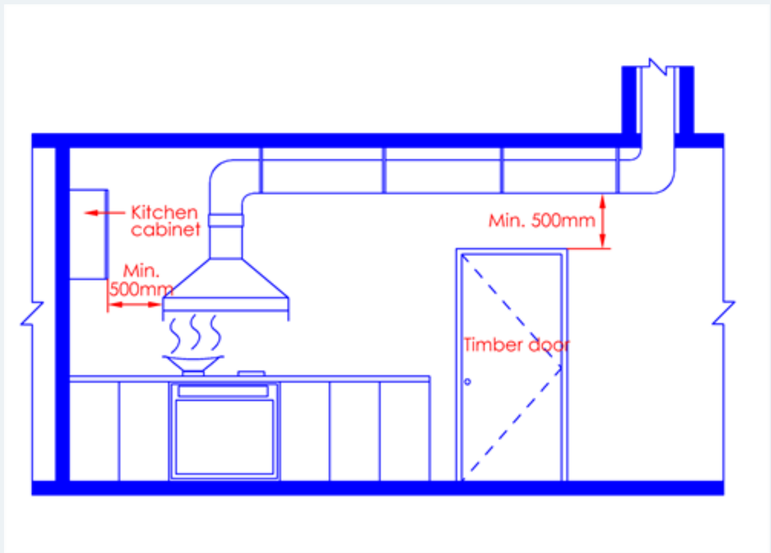
7.1.13 Exhaust system for kitchen

a. Provision

A mechanical exhaust system for the cooking area of a kitchen in a hotel, restaurant, coffee house or the like shall be independent of those serving other parts of the building. It shall also comply with all of the following requirements:

(1) The hood and ducts for the exhaust shall have a clearance of 500mm from unprotected combustible materials.

Explanation and Illustrations



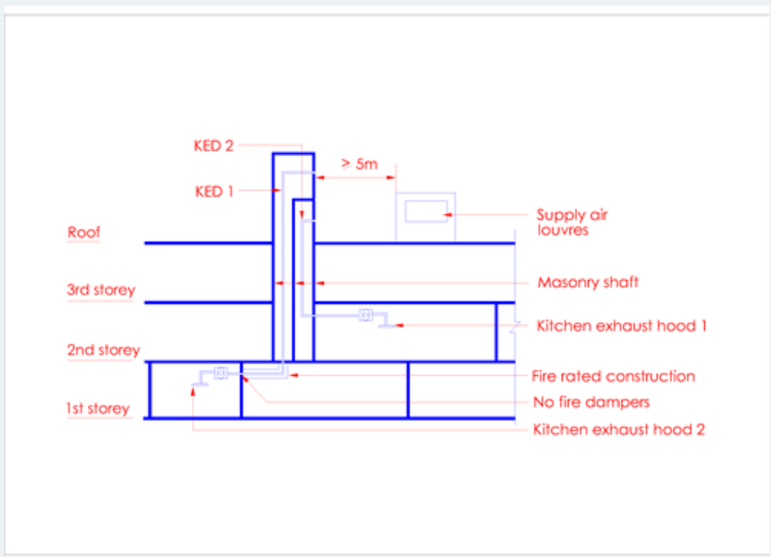
Section

Figure 7.1.13a(1).

The hood and duct should be separated from other combustible materials by a minimum horizontal clearance of 500mm to prevent ignition through heat radiation. Class F portable fire extinguishers shall be provided according to SS 578.

(2) The exhaust shall discharge directly to the external space and shall not be less than 5m from any air intake openings.

Explanation and Illustrations



Section

Figure 7.1.13a(2).: Kitchen exhaust duct

(3) The exhaust duct, where it runs outside the kitchen, shall either be enclosed in a structure or be constructed to give at least the same fire rating as the kitchen or that of the room through which it traverses, whichever is higher. The rating shall apply to fire exposure from both interior and exterior of the duct or structure. Where the duct riser is required to be enclosed in a protected shaft constructed of masonry or drywall complying with *Cl.3.8.7b.*, it shall be compartmented from the rest of the shaft space containing other ducts or services installations.

(4) No fire damper shall be fitted in kitchen exhaust ducts.

b. Sharing of kitchen exhaust system

Sharing of kitchen exhaust system for food and beverage outlets is allowed, provided all of the following conditions are complied with:

Explanation and Illustrations

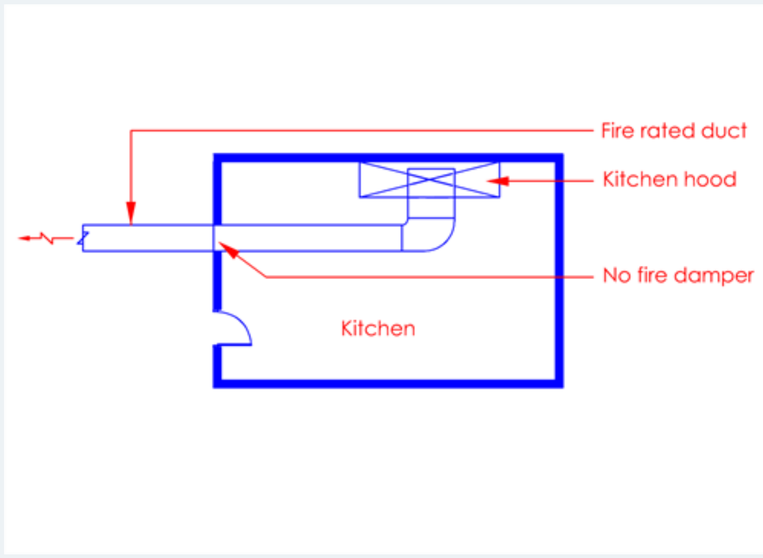


Figure 7.1.13a(3).- 1

Horizontal run of the exhaust duct outside the kitchen shall be fire-rated with minimum 1-hr fire resistance rating. The 1-hr fire resistance shall be applicable to the inside and outside of the duct.

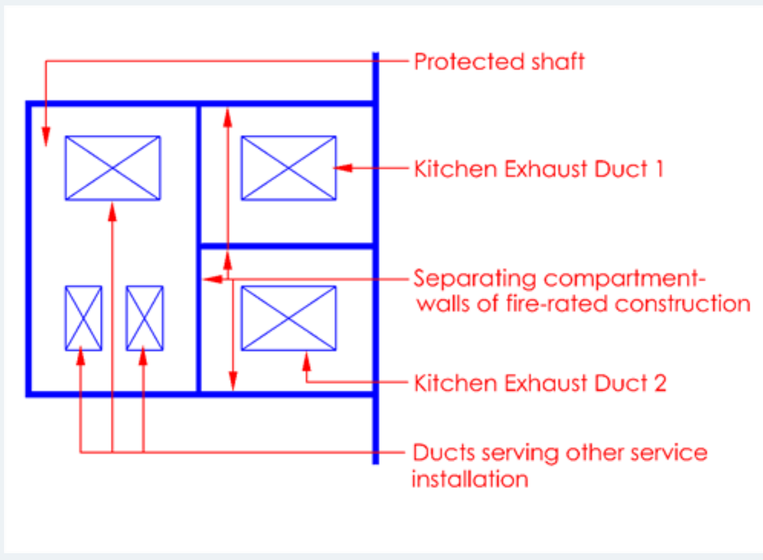


Figure 7.1.13a(3) - 2

The protecting structure for protected shaft containing kitchen exhaust duct that pass through one or more floors shall be of masonry construction or drywall.

To eliminate the risk of fire spreading from one compartment to another through burning grease within the duct system, a separate exhaust system is required for each hood located in separate compartments.

Fire dampers are not permitted within the duct system. The effectiveness of fire dampers is questionable as grease on the downstream side would likely ignite before the damper closed. The potential for false operation is also greater than normal and closure other than in a fire situation could have serious consequences. Further it is expected that the majority of kitchen hoods will have their own suppression thereby reducing the risk of fire spreading into the duct.

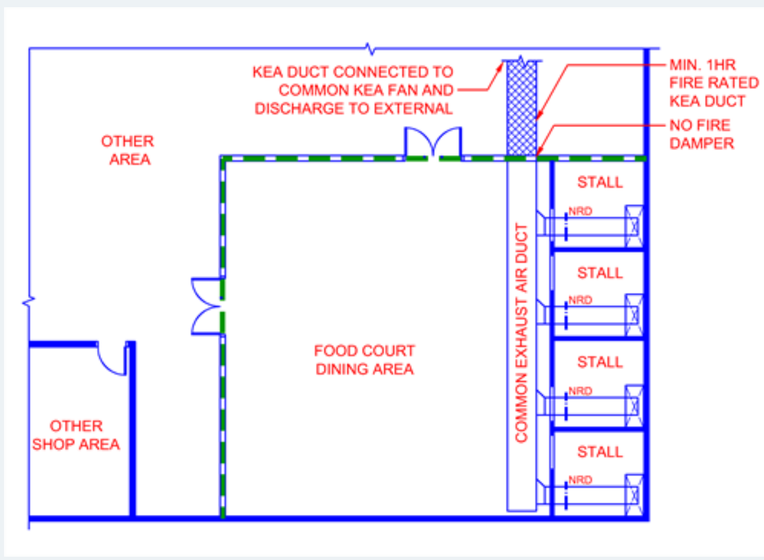
Continuation of the exhaust system during a fire involving the cooking equipment or in the compartment is not considered to aggravate the situation.

(1) For food courts

(a) The food court shall be under a single ownership/ operator.

(b) All kitchen exhaust ducts running outside the food court shall have 1-hr fire resistance rating, or shall not be less than that for the elements of structure, whichever is higher.

Explanation and Illustrations



NRD = Non-rated duct

Figure 7.1.13b.(1)

To share a kitchen exhaust system within a food court, it needs to be under a single ownership/operator. In addition, it is also required to make provision for maintenance and cleaning of the exhaust system, i.e. degreased & cleaned regularly.

All kitchen exhaust ducts running outside the food court shall have minimum 1-hr fire resistance rating or not less than that for the elements of structure, whichever is higher.

(2) For restaurants/small F&B outlets (e.g. snack bars, food kiosks, etc.)

Explanation and Illustrations

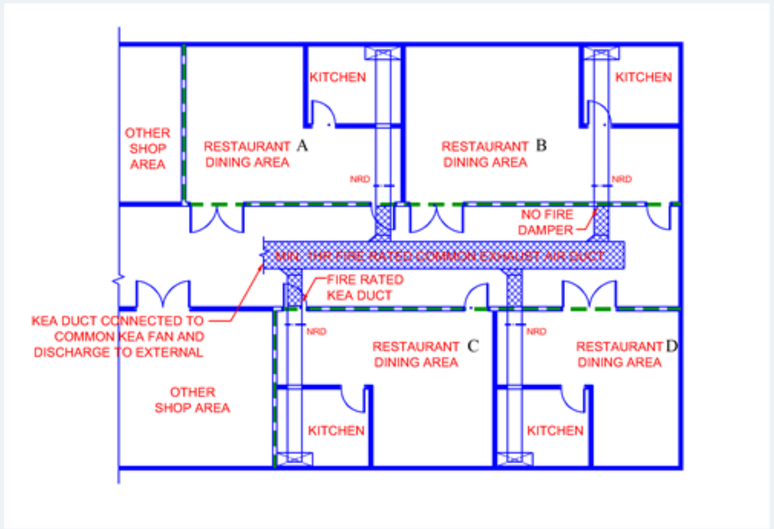


Figure 7.1.13b.(2)

To be precise, each restaurant shall be provided with its own kitchen exhaust duct. Where the restaurants are located close to each other, on the same floor, within a zone of not more than 2000m2 and have aggregate floor area of not more than 1000m², the sharing of kitchen exhaust duct is permitted.

Where the restaurants are located far from each other, then the relaxation of common kitchen exhaust duct shall not be applicable. In other words, each restaurant unit shall have its own kitchen exhaust duct.

(a) Restaurants and small F&B outlets that are sharing the same kitchen exhaust system shall be located on the same storey and within the aggregate zone area not exceeding 2000m^2. The maximum length of the aggregate zone covering from the first to the last restaurant/F&B outlet shall not exceed 50m.

(b) The aggregate floor area of the restaurants and F&B outlets shall not exceed 1000m^2.

(c) Common ducts shall be provided with a common exhaust fan.

(d) The building shall be protected by an automatic fire sprinkler system.

(e) The exhaust hood shall be fitted with a wet chemical fire extinguishing system.

(f) The fire rating of the common kitchen exhaust duct running outside the restaurants shall have 1-hr fire resistance rating, or shall not be less than that for the elements of structure, whichever is higher.

(Note: Kitchen exhaust ducts include both horizontal and vertical ducts.)

Note

Wet chemical fire extinguishing systems for exhaust hood(s) shall be of approved type based on international standards such as NFPA 17A. QPs are also reminded to ensure that the premise owners/ operators are aware of the stipulated maintenance regime in the standards.

c. Kitchen exhaust duct (KED)

(1) A KED running outside a building shall not be located within 3m of any unprotected openings. This separation distance can be reduced to 1.5m if the unprotected opening is on the same plane as the duct. (See *Diagram 7.1.13c.(1) - 1* and *2*)

(2) Where the distances mentioned above cannot be achieved, a fire resistant construction having at least ½-hr fire resistance shall be placed between the duct and the unprotected opening. (See *Diagram 7.1.13c.(2)*)

(3) A non-fire-rated KED shall not be located above an LPG storage cabinet, unless they are separated from LPG cylinders by a minimum of 2-hr fire-rated masonry construction above and beside the cylinders. (See *Diagram 7.1.13c.(3)*)

(4) The KED shall be located at least 3m from any unprotected LPG cylinders. Non-fire-rated KED shall be located at least 600mm from the vapouriser or any liquid-phase LPG pipeline. (See *Diagram 7.1.13c.(4)*)

(5) Access panels for KED

KED shall be provided with openings via access panels to facilitate inspection and maintenance, which shall comply with the following:

(a) Access panels shall be provided to allow the interior of the duct to be viewed without the assistance of tools, to facilitate thorough cleaning. The access panels shall not be obstructed by suspended ceilings, cable routes, pipes or other installations.

Explanation and Illustrations

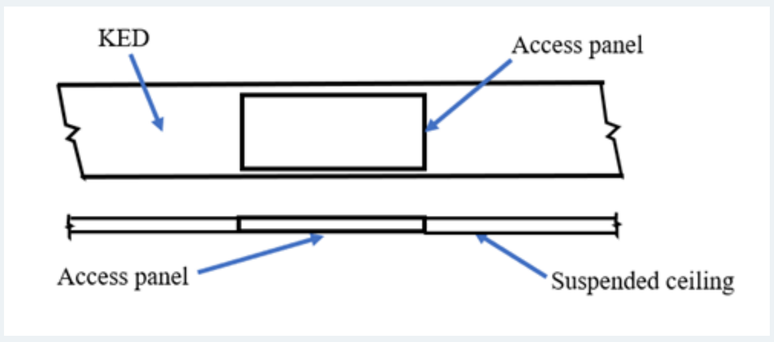


Figure 7.1.13c.(5)(a)

If suspended ceiling is provided, an access panel in the ceiling is required to enable access to the KED.

(b) Access panels shall be located at the sides of the duct.

Explanation and Illustrations

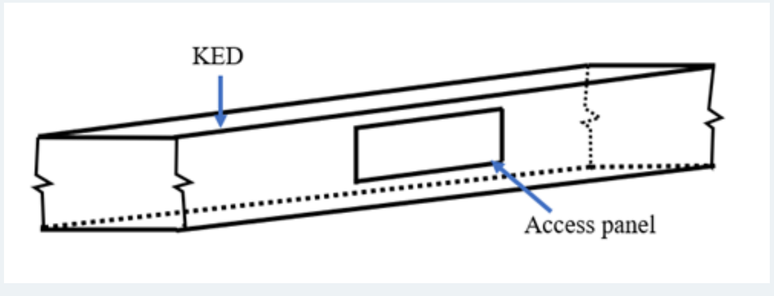


Figure 7.1.13c.(5)(b)

Access panels for KEDs shall be located at the sides, rather than the top surface.

(c) Access panels are not required at the duct entry, duct discharge, or sections of the duct which are fire-rated or protected with fire-rated enclosure. Excluding these exempted areas, access panels shall be provided at the following locations:

(i) at changes of ducting direction;

(ii) if fire extinguishing systems are provided, to facilitate installation and servicing of the fire extinguishing systems;

(iii) within 900mm of each side of exhaust fan assemblies;

(iv) at least 40mm from all outside edges of the duct or welded seams; and

(v) in addition to compliance with subclause (i) to (iv), access panels shall be located at maximum 3m intervals for horizontal ducting, and at the top and bottom of sections of vertical ducting which runs solely at the building exterior.

(d) Access panels shall be conspicuously marked with the following wording: ACCESS PANEL – DO NOT OBSTRUCT. The lettering shall be at least 25mm in height, in a colour contrasting with the background.

Explanation and Illustrations

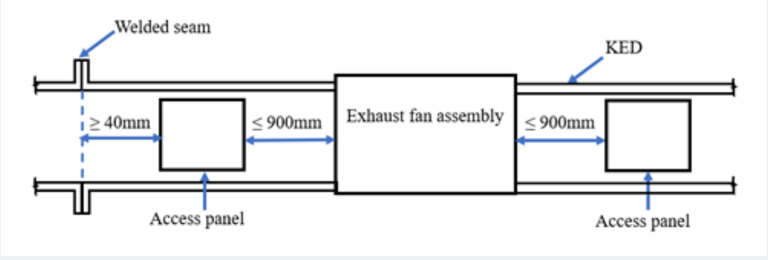


Figure 7.1.13c.(5)(c)(iii)

Access panels to be provided at before and after the exhaust fan assembly.

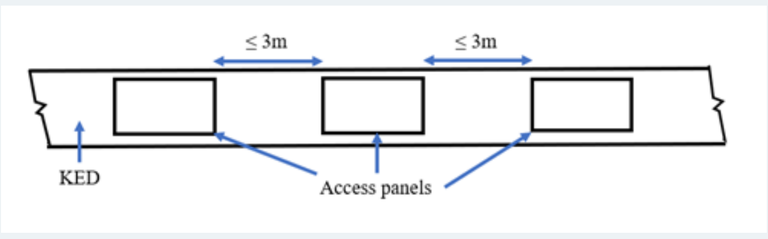


Figure 7.1.13c.(5)(c)(iv)

Access panels to be provided at maximum 3m intervals, measured from the edge of the access panels.

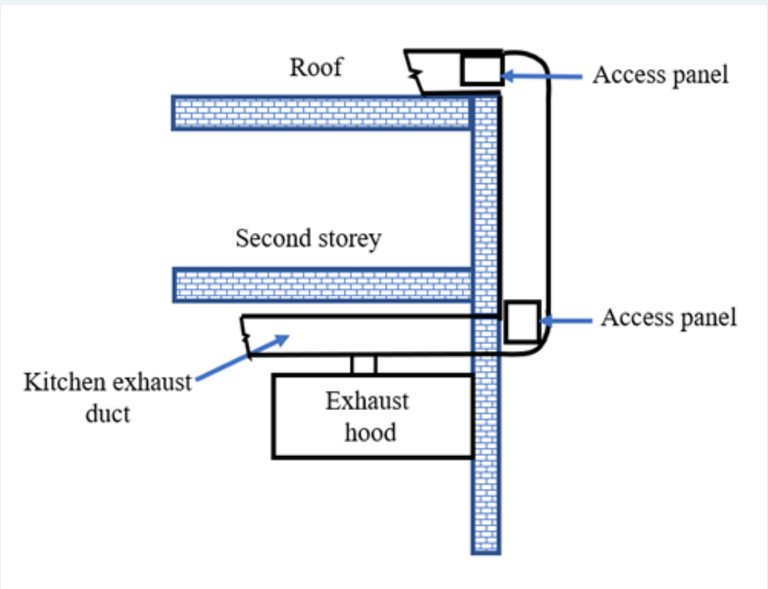


Figure 7.1.13c.(5)(c)(v)

Access panels to be provided at top and bottom of sections of vertical ducting which runs solely at building exterior.

d. Maintenance

All kitchen exhaust systems shall be properly maintained in accordance with the following:

(1) The entire (interior and exterior) exhaust duct and kitchen hood shall be degreased and cleaned at least once every 12 months.

(2) The work shall be carried out by a specialist and the records of cleaning and degreasing shall be kept by the owner/ operator for verification. This requirement shall be included in the Fire Safety Instruction Manual.

Note

Building owners, MCSTs and eating outlet operators shall ensure that the entire (interior and exterior) kitchen exhaust duct and kitchen hood shall be degreased and cleaned at least once every 12 months. The work shall be carried out by a specialist and the records of cleaning and degreasing shall be kept by the owner/MCST/operator for verification by the authority having jurisdiction.

7.1.14 Ventilation system for rooms involving use of flammable and explosive substances

a. Dedicated system

Mechanical ventilation systems, where required for rooms which involve the use of flammable and explosive substances, shall be independent from those serving other parts of the building. They shall comply with all of the following requirements:

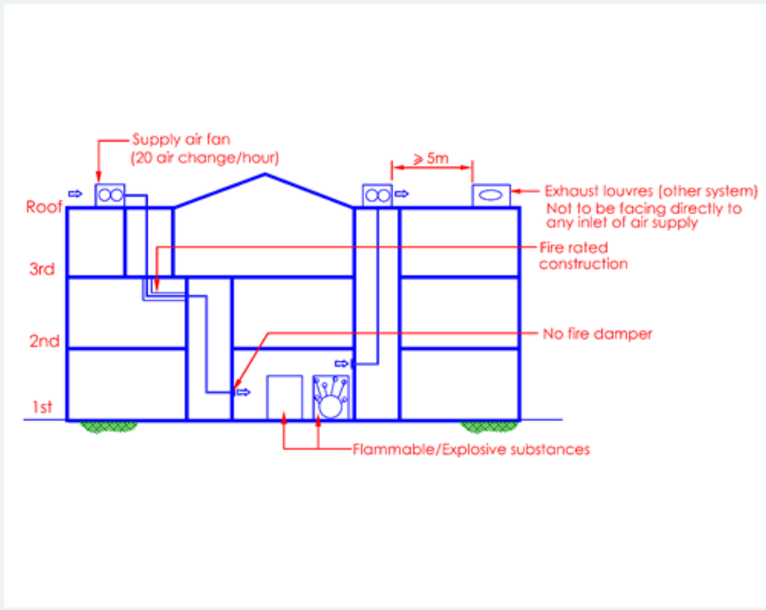
(1) Ventilation system shall consist of exhaust and supply parts with a rate of 20 air changes per hour or any other rates acceptable to the SCDF. The exhaust shall direct to the external space and shall not be less than 5m from any air intake openings.

(2) Where such ducts run outside the room they shall either be enclosed in a structure or be constructed to give at least the same fire rating as the room which they serve or that of the room through which they traverse, whichever is higher. The rating shall apply to fire exposure from both interior and exterior of the duct or structure. Where the duct risers are required to be enclosed in a protected shaft constructed of masonry or drywall complying with *Cl.3.8.7b.*, they shall be compartmented from the rest of the shaft space containing other ducts or service installations.

(3) No fire damper shall be fitted in either a supply or exhaust duct required under this Clause.

(4) Ducts serving other areas shall not pass through rooms involving use of flammable and explosive substances.

Explanation and Illustrations



Section

Figure 7.1.14a - 1

The exhaust system (without fire damper) is required to operate efficiently to remove any gaseous or flammable vapour from the room.

a. Where the flammable vapour being removed is heavier than air:

(1) At least one air outlet shall be located at a point near a wall, and no higher than 300mm from the floor; and

(2) At least one air inlet shall be located near the opposite wall, no lower than 300mm from the ceiling.

b. Where the flammable vapour being removed is lighter than air:

(1) At least one air inlet shall be located at a point near a wall, and no higher than 300mm from the floor; and

(2) At least one air outlet shall be located near the opposite wall, no lower than 300mm from the ceiling.

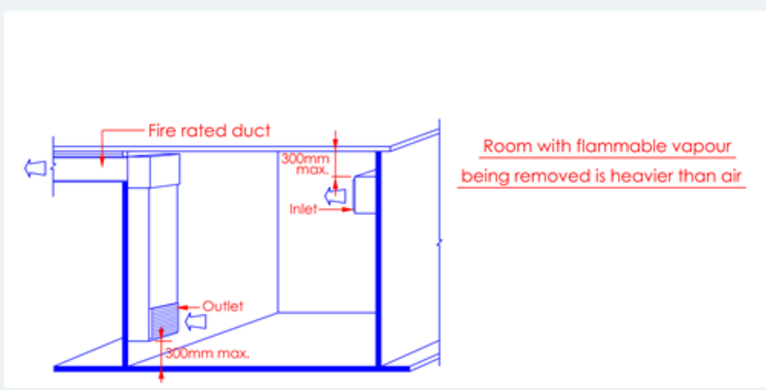


Figure 7.1.14a - 2

The flammable vapour which is heavier than the air will be discharged via the exhaust system (without damper) as shown above. Do refer to relevant SS for full compliance.

b. Sharing of supply air duct

A common fire-rated supply air duct can serve various compartments within the same floor level or other floor levels, provided:

(1) the compartments are sprinkler-protected;

(2) the compartments are of the same purpose group;

(3) the duct is fitted with a fire damper where it passes through the wall or floor of each fire compartment; and

(4) a dedicated exhaust duct is provided for individual fire compartments and shall be maintained in operation (with the minimum flow rate) even it is under fire mode situation to prevent smoke entering into other fire compartments.

7.1.15 Ventilation system for rooms housing batteries

Rooms housing batteries shall comply with the following requirements:

a. The batteries shall be of either vented or sealed type.

b. The room ventilation system shall be designed to limit the maximum concentration of Hydrogen (H2) gas to 1% of the total volume of the room during the worst case event of simultaneous "boost" charging of the batteries. The inlets and outlets of the ventilation system shall be properly located so that there is no stagnant area in the room.

c. Adequate hydrogen gas detectors shall be provided inside the room to monitor the hydrogen concentration and to activate the fan, if necessary, to ensure that the hydrogen concentration level at any part of the room does not exceed 1% of the total volume of the room. Display panels showing the readings of the detectors shall be located at the entrance to the room. At the same time, an alarm signal shall be sent to a manned station such as security control room, guard house or FCC.

Rationale

The revision is in line with NFPA to limit the maximum concentration of hydrogen to 1% of the total volume of the room. The ventilation rate for the room shall be computed in accordance with BS EN IEC 62485 or 6 air changes, whichever is higher.

d. The design of the battery room ventilation shall be in accordance with *BS EN IEC 62485-2* & *BS EN IEC 62485-3*.

e. For mechanically ventilated battery rooms, the ventilation requirement shall be based on *Cl.7.1.15d*, or 6 air changes per hour, whichever is higher.

f. No fire damper shall be provided in the essential ventilation system and ducts passing through other compartments shall have 2-hr fire resistance rating.

g. Essential fans and associated electrical controls shall be backed up with a secondary source of power supply.

Rationale

The revision is in line with NFPA to limit the maximum concentration of hydrogen to 1% of the total volume of the room. The ventilation rate for the room shall be computed in accordance with BS EN IEC 62485 or 6 air changes, whichever is higher.

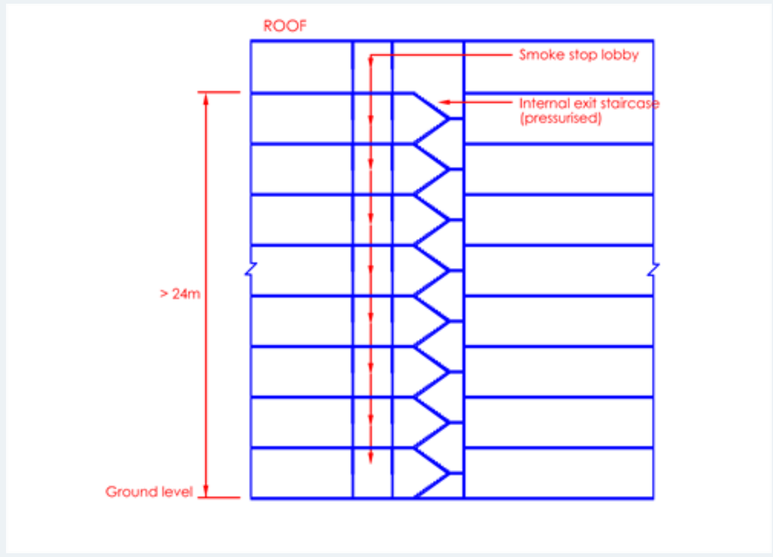
CLAUSE 7.2 PRESSURISATION FOR EXIT STAIRCASES

7.2.1 Provision

a. Internal exit staircase

In any building of which the habitable height exceeds 24m, any internal exit staircases without adequate provision for natural ventilation shall be pressurised to comply with the requirements in this Code. Where the upper part of the staircase is naturally ventilated, its lower part can be provided with mechanical ventilation or pressurisation, whichever is appropriate, in accordance with *Cl.2.3.3d.(9)*.

Explanation and Illustrations



Section

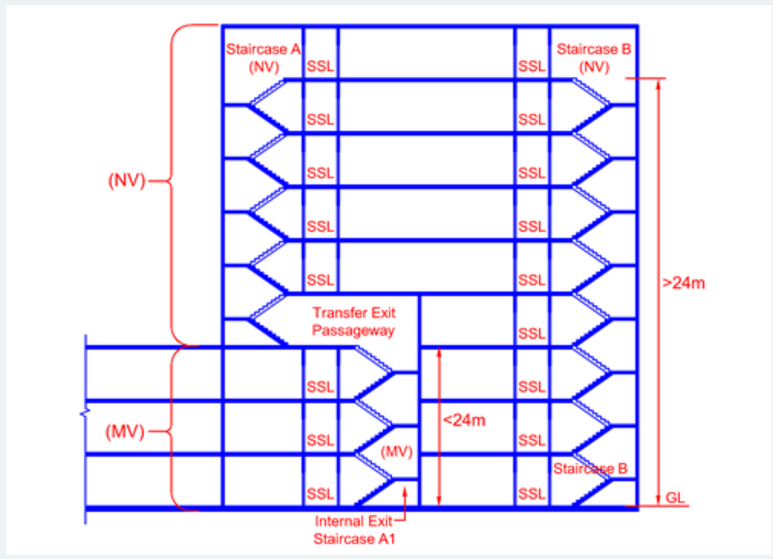
Figure 7.2.1a. - 1

The above clause specifies that all internal staircases without provision for natural ventilation of building having more than 24m in habitable height, shall be provided with pressurisation notwithstanding that smoke-stop lobby is provided. Smoke-stop lobby, if mechanically ventilated, is to be provided with supply air of at least 10 air changes per hour during fire mode. There shall be no exhaust duct extracting air out from the smoke stop lobby.

The need of a dedicated pressurisation system (two fans are recommended, capacity of each fan shall be provided for 50% equipment) for each exit staircase is to prevent failure of one system affecting all exits. Air supply to the exit staircase must be obtained from outside the building to minimise the risk of contamination from smoke resulting from a fire in the building.

Ductwork associated with the discharge of air throughout the staircase may be located within the staircase itself, otherwise it must be protected in a masonry or fire rated shaft.

To achieve the required air flow velocity on any storey, air supplied by the system should be evenly distributed throughout the height of the staircase by ductwork with outlets located not more than two storeys apart. Relief air grilles (pressure relief dampers) could be used for pressure control thereby minimising periods of excessive force to open doors of the staircases. Variable speed fans with pressure relief damper can be accepted as alternative arrangement.



Section

Figure 7.2.1a. - 2

Internal exit staircase without adequate ventilation at lower part can be mechanically ventilated provided the lower part shall not exceed 24m in habitable height. Where the lower part exceed 24m, the internal exit staircase shall be pressurised.

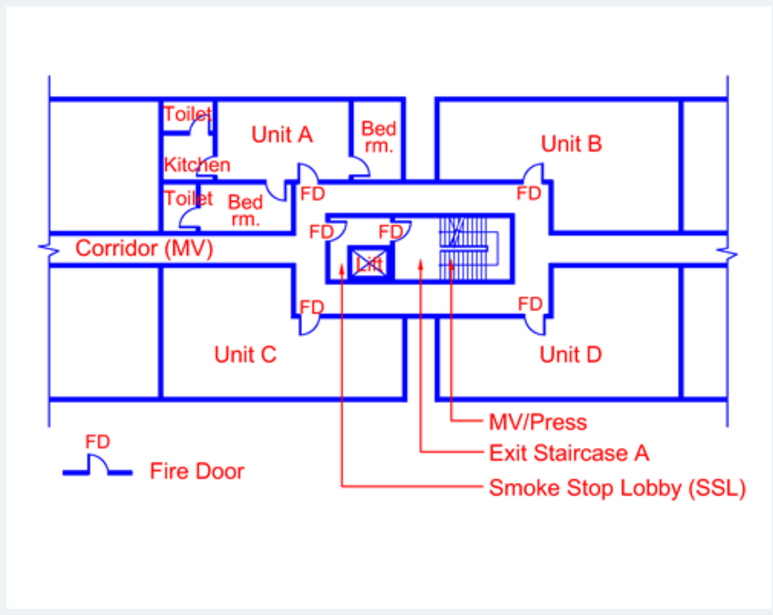


Figure 7.2.1a. - 3

Exit staircase (A) is pressurised as it is located within the floor space where natural ventilation cannot be provided. Exit staircase, which is designed without provision for natural ventilation, is pressurised. Smoke-stop lobby is also required to be provided to staircase A.

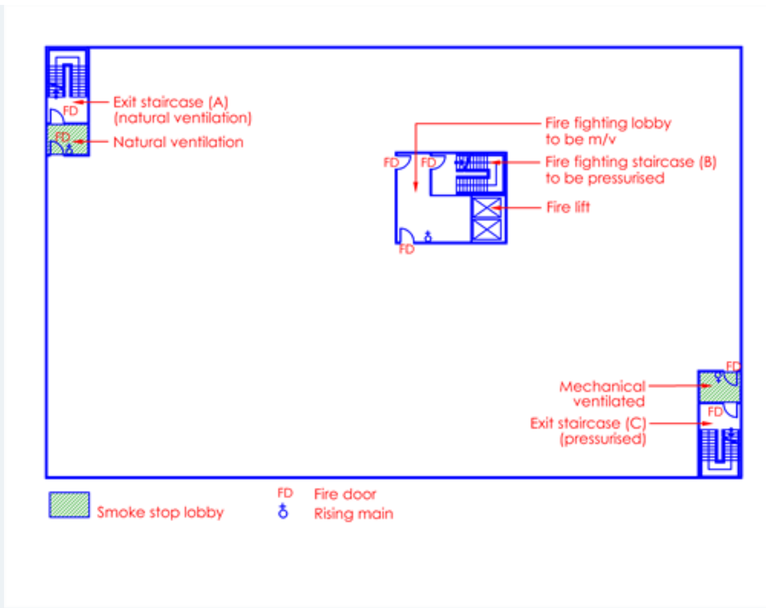
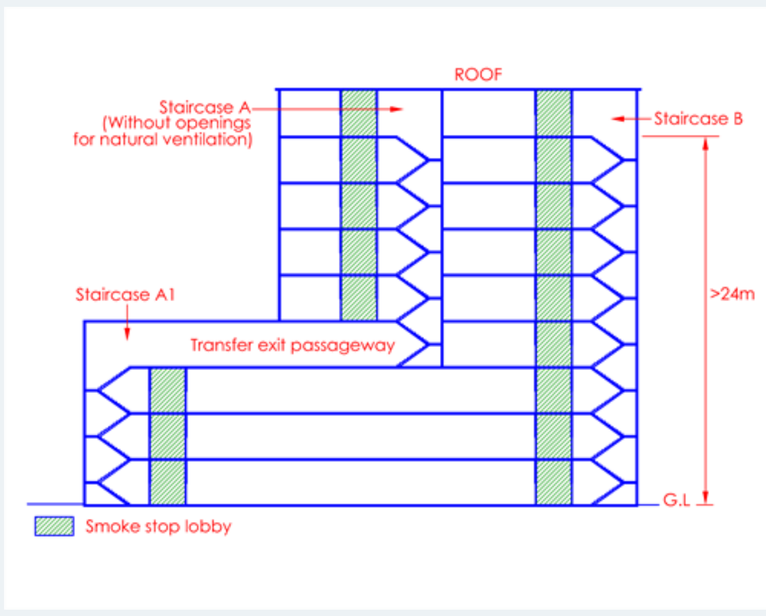


Figure 7.2.1a. - 4

Exit staircase (B) is pressurised as it is located within the floor space where natural ventilation can not be provided. Exit staircase (C), which is designed without provision for natural ventilation, is pressurised.

Notwithstanding clause *2.2.13(c)*, smoke-stop lobby is required to be provided to all internal staircases, without provision for natural ventilation, serving building exceeding the habitable height of 24m.



Section

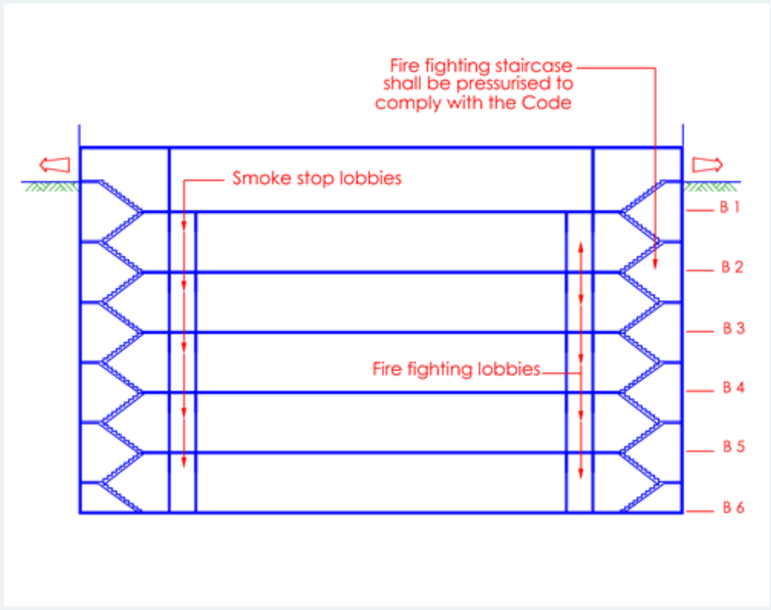
Figure 7.2.1a. - 5

Staircase A and transfer staircase A1 are considered as one single staircase sharing a common protected shaft. As staircase A is an internal staircase without openings for natural ventilation, exceeding a habitable height of 24m, it is required to be provided with MV and pressurisation. Since, staircase A1 is acting as a transfer staircase, it shall likewise be MV and pressurised notwithstanding the fact it can be naturally ventilated through external openings. The transfer exit passageway which connects staircases A and A1 should also be MV and pressurised. It is not acceptable to have partial pressurisation to staircase A by introducing a door across the transfer passageway, such that staircase A1 is separated for the provision of natural ventilation. The reason is that by providing a door across the transfer passageway, it would impede the movement of occupants moving towards staircase A1. In this way, the evacuation process within the whole shaft of staircase A would be slowed down.

b. Basement

In a building comprising more than four basement storeys, exit staircases connected to a fire lift lobby in basement storeys shall be pressurised to comply with the requirements in this Code.

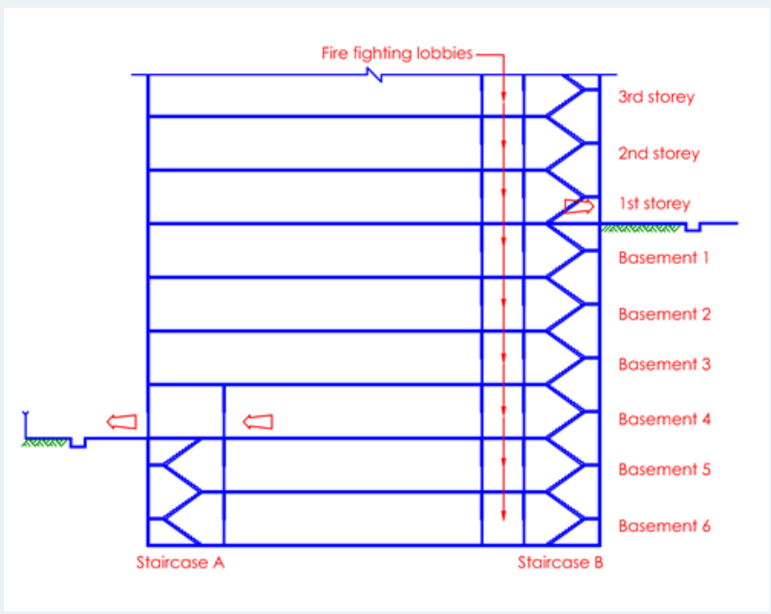
Explanation and Illustrations



Section

Figure 7.2.1b. – 1

In a building comprising more than 4 basement storeys, the exit staircase adjacent to the fire lift lobby shall be pressurised.



Section

Figure 7.2.1b. – 2

Owing to difference in ground levels, staircase B which is serving more than 4 basements shall be located adjacent to a fire lift lobby at each storey.

c. PG II occupancy

Where PG II building is provided with a mechanical ventilation system or pressurisation system for its staircase storey shelter, an automatic smoke detection system complying with SS 645 shall be installed. The smoke detector shall be located at the entrance of each exit staircase at every storey, including the non-residential floors. Activation of any smoke detector shall initiate the operation of the mechanical ventilation system or pressurisation system.

Explanation and Illustrations

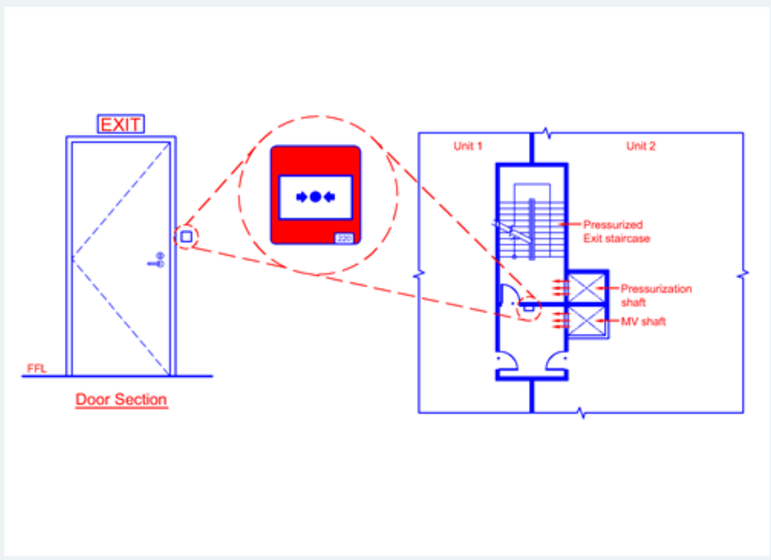


Figure 7.2.1c.

Note:

a. Pure residential buildings are not required to be provided with manual fire alarm or automatic fire alarm system.

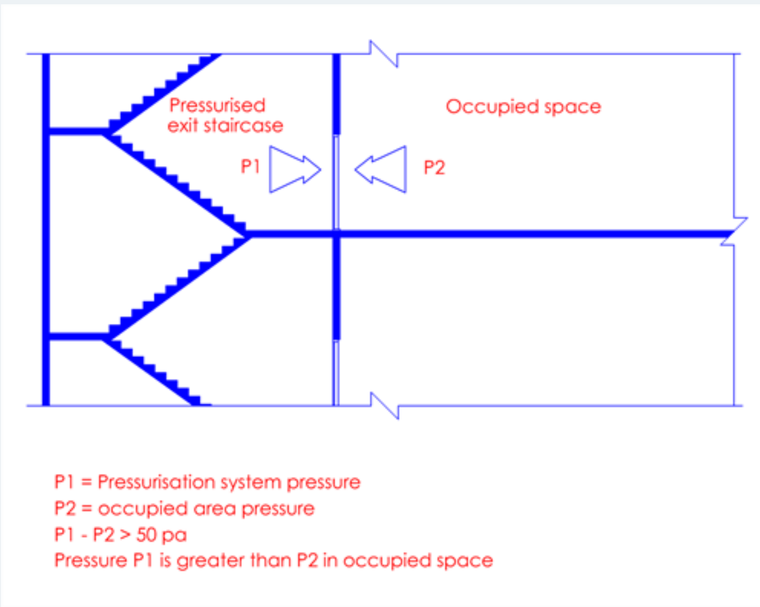
b. Where the stairs are not naturally ventilated and provided with mechanical ventilation or pressurisation system, there shall be a means to activate the mentioned system.

c. The manual call point provided at every entrance of exit staircase shall initiate the operation of mechanical ventilation or pressurisation system.

7.2.2 Pressurisation level

a. When in operation, the pressurisation system shall maintain a pressure differential of not less than 50 Pa between the pressurised exit staircase and the occupied area when all doors are closed.

Explanation and Illustrations

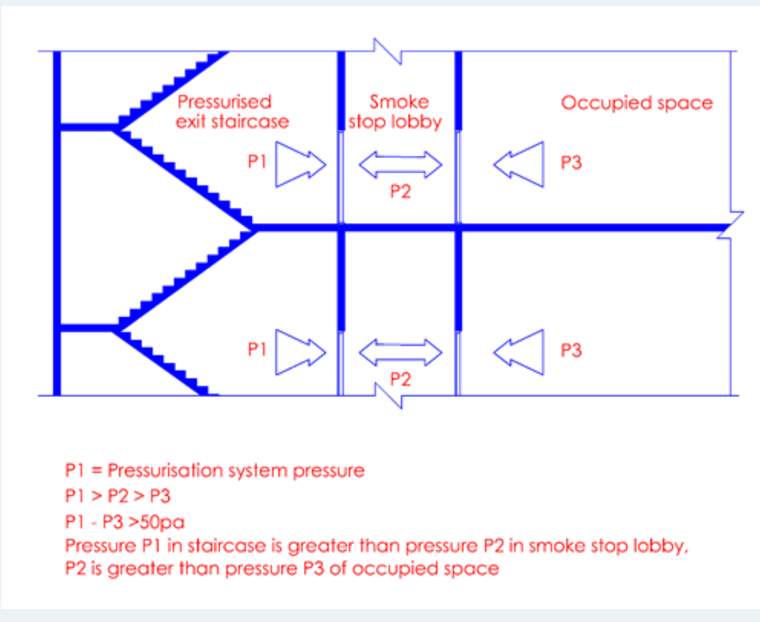


Section

Figure 7.2.2a. : Pressure differential between pressurised exit staircase and occupied space

b. Where a smoke-free lobby is also pressurised, the pressure at the exit staircase shall always be higher.

Explanation and Illustrations



Section

Figure 7.2.2b. : Pressure gradient

Where the smoke-stop lobby is pressurised, the pressure gradient shall be such that the pressure at the exit staircase is always higher.

c. The force required to open any door against the combined resistance of the pressurising air and the automatic door closing mechanism shall not exceed 110N at the door handle.

Explanation and Illustrations

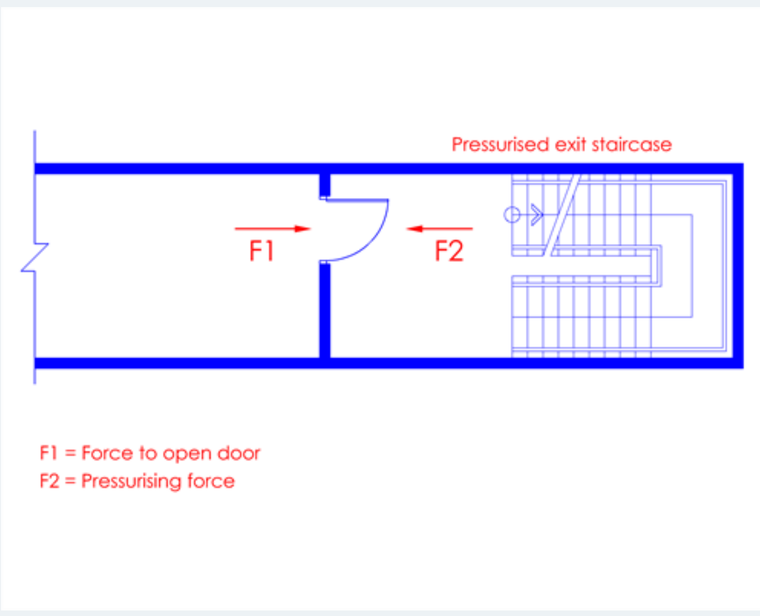


Figure 7.2.2c.: Maximum force required to open door

Measurement of the force required to open a stair door can be simply carried out by using a force-measuring in the push or pull mode e.g. a spring balance. The maximum force permitted to open a door in accordance with this Code is 110N. This equates to a force of 11.2kg.

Lever operated latch sets are probably the easiest to measure. Simply hook the spring balance over the lever handle and depress same to unlatch the door, whilst taking care not to exert any push/pull force in doing so. To take a reading, slowly and steadily pull the spring balance and read the scale as the door just starts to open

7.2.3 Egress velocity

Explanation and Illustrations

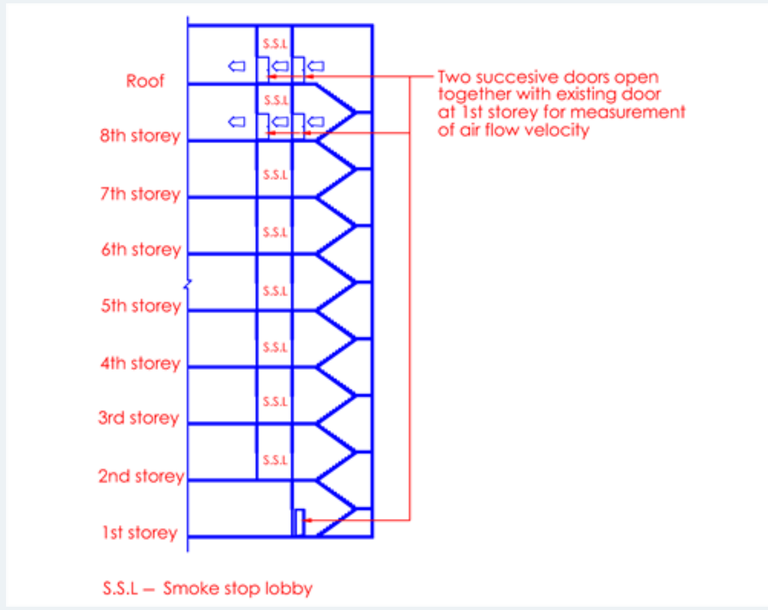


Figure 7.2.3 - 1

Air flow velocity of at least 1.0 m/s through open doors is required to prevent smoke from entering into the pressurised staircase.

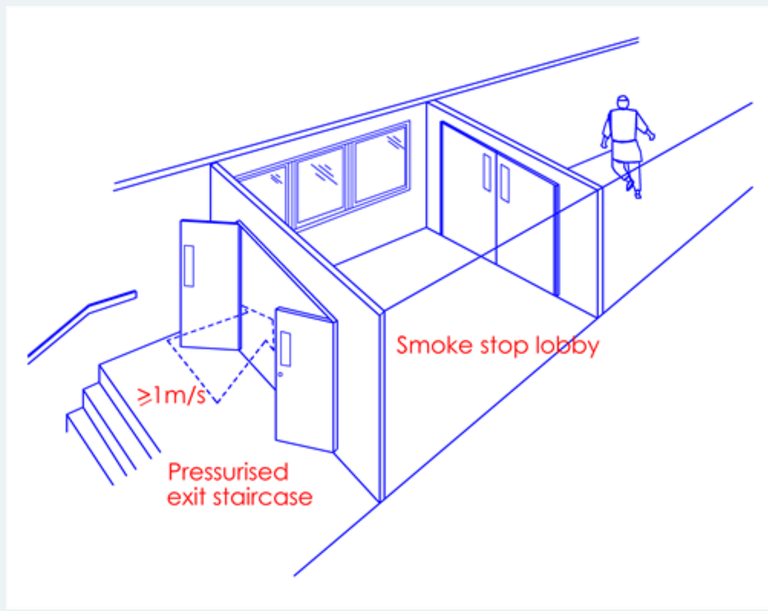


Figure 7.2.3 - 2

The air flow velocity measurement through an open door of a pressurised staircase is taken from the entrance of any of two successive doors held open together with its exiting door at the 1st storey. The resulting value of its airflow velocity through the open door shall not be less than 1m/s.

Tests conducted by the Commonwealth Scientific and Industrial Research Organization (CSIRO) have demonstrated that air flows in excess of 0.8m/s through a door will minimise the spread of smoke against the direction of flow. A minimum air flow rate of 1m/s has therefore been adopted. This air flow must be maintained across the doorway providing egress from the fire-affected storey into the staircase during a fire. Initially, building occupants from both the fire floor and the floor above the fire floor will evacuate the building and, depending on the fire situation, this may be simultaneous operation.

The requirement for two floor doors and the 1st storey door (opening into the exterior) to be open the same time has two applications:

(i) When the fire fighters arrive and use the staircase for fire fighting operations, hose connection to the landing valves located on a floor would be carried out. Initially hose will be run from the floor below up the staircase and onto the fire floor hence a minimum opening of two doors is involved.

(ii) All required exit staircases must be usable at the same time as either fire fighters or evacuating occupants will be using any of them to exit at the 1st storey door to the street or external safe open area. Thus the final exit door would remain in the open position at all times.

a. When in operation, the pressurisation system shall maintain an airflow of sufficient velocity through open doors to prevent smoke from entering into the pressurised area.

b. The flow velocity shall be attained when a combination of two doors from any two successive storeys and the main discharge door are fully open.

c. The velocity averaged over the full area of each door opening shall not be less than 1.0 m/s.

7.2.4 Leakages

Explanation and Illustrations

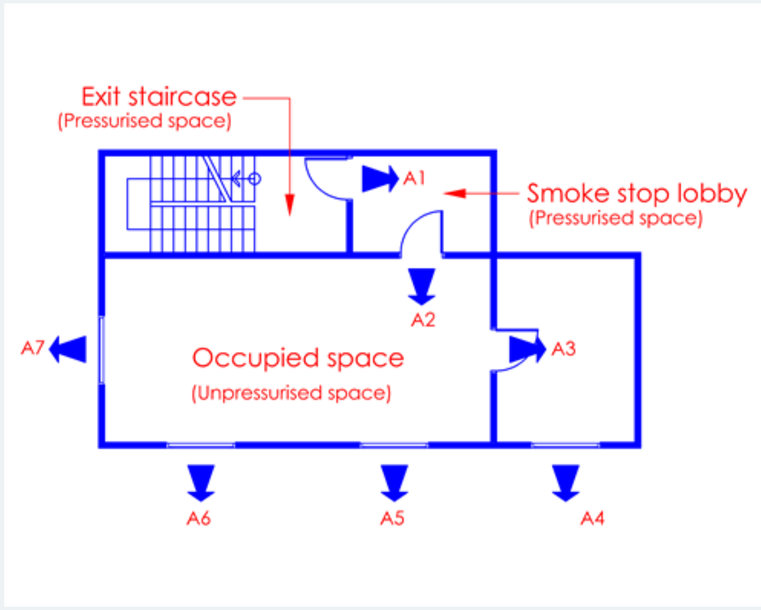


Figure 7.2.4

Pressurised air could leak through areas such as gaps around doors, windows, other ventilation openings and other places where air will escape.

In the above figure, pressurised air from the exit staircase leaks into the smoke-stop lobby (A1) and occupancy areas (A2 & A3).

To avoid a pressure built-up in the occupancy area, adequate measures shall be taken to allow air leakage, e.g. through windows A4 to A7. A pressure build-up would create difficulty in opening the doors to the occupancy area.

The following are possible ways in which the escape of pressurising air can be achieved:

(a) by window leakage, or

(b) by specially provided vents at the building periphery, or

(c) by the provision of vertical shaft, or

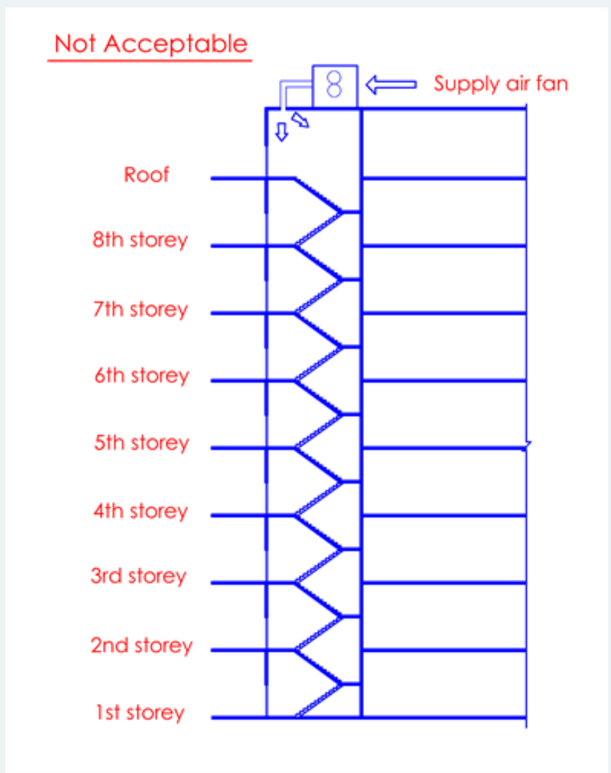
(d) by mechanically operated extraction.

a. The rate of supply of pressurised air to the pressurised areas shall be sufficient to make up for loss through leakages into the unpressurised surroundings.

b. Adequate relief of leaked air out of the occupied area shall be provided to avoid a pressure build-up in this area. The relief can be in the form of perimeter leakages or purpose built extraction systems.

7.2.5 Distribution of pressurising air

Explanation and Illustrations



Section

Figure 7.2.5

The above installation is not acceptable as over pressurisation would occur at the upper portion of the staircase. Supply air to the staircase should be well distributed by a vertical supply duct, preferably serving all the levels of the staircase.

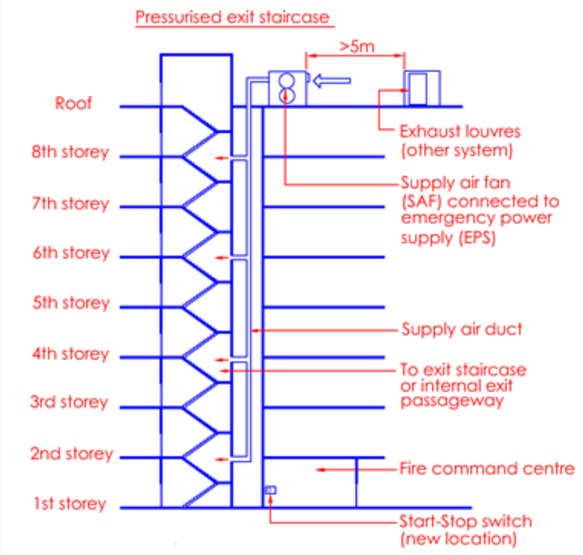
An example of an arrangement showing good distribution of supply air can be seen in *Figure 7.2.6*.

a. The number and distribution of injection points for supply of pressurising air to the exit staircase should ensure an even pressure profile complying with Cl.7.2.2.

b. The arrangement of the injection points and the control of the pressurisation system shall be such that when the opening of doors or other factors cause significant variations in pressure difference, the condition in Cl.7.2.2 shall be restored as soon as practicable.

7.2.6 Pressurisation equipment and controls

Explanation and Illustrations



Section

Figure 7.2.6

The “start-stop” switch is required to be provided in the FCC, or at the main fire alarm panel where there is no FCC. The rationale is to provide the firefighters greater ease and better control in operating the supply air fan to the staircase.

This arrangement facilitate the supply air fan to be shut from the designated remote “start-stop' location. The supply air fan can then be restarted anytime when required.

a. All the equipment and the relevant controls associated with the pressurisation system shall be designed and installed to ensure satisfactory operation in the event of a fire.

b. Supply air for the pressurisation system shall be drawn directly from the external space and its intake shall not be less than 5m from any exhaust discharge openings.

c. The pressurisation system shall be automatically activated by the building fire alarm system. In addition, a remote manual start-stop switch shall be made available to firefighters at the FCC, or at the fire alarm panel where there is no FCC. Visual indication of the operation status of the pressurisation system shall be provided.

CLAUSE 7.3 PRESSURISATION OF INTERNAL CORRIDORS IN HOTELS

7.3.1 Pressure differences

Explanation and Illustrations

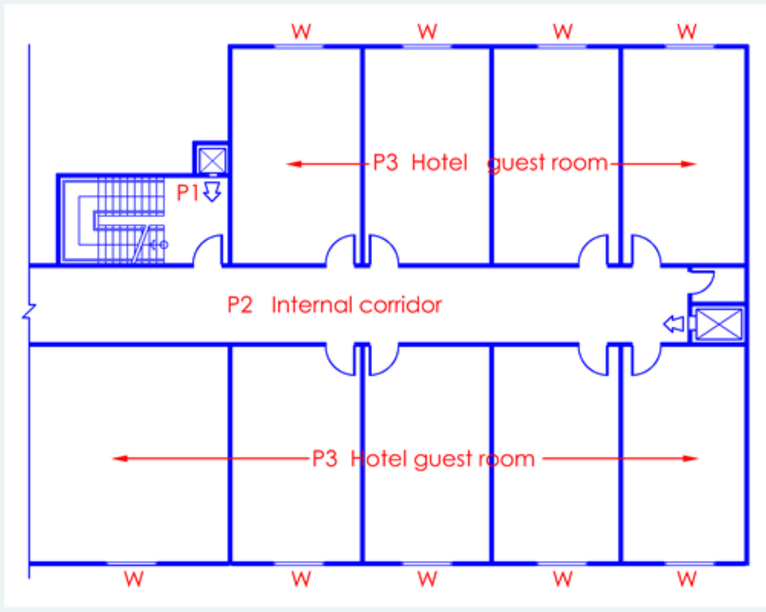
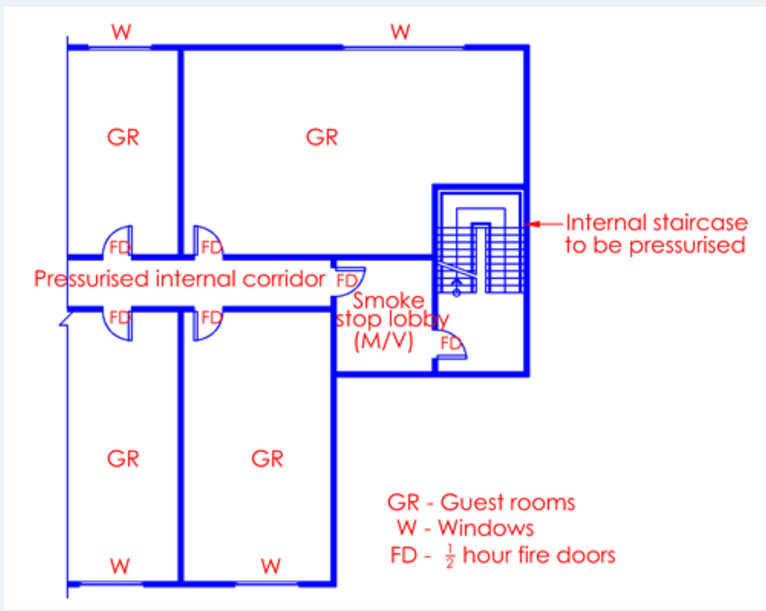


Figure 7.3.1 - 1

Provision of pressurisation to the internal corridor would help to check the migration of smoke from any of the guest rooms. The pressure gradient shall be such that :P1>P2>P3

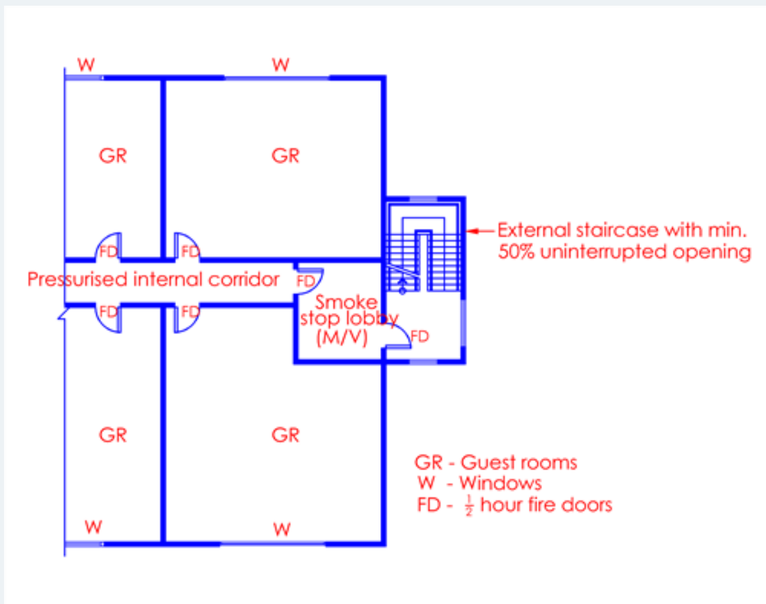


Acceptable

More than 4 storeys

Figure 7.3.1 - 2 : Internal staircase with MV smoke-stop lobby

The above figure illustrates a mechanical ventilated smoke stop lobby and an internal staircase to be pressurised accordingly. The pressure gradient shall be such that the pressure at the exit staircase shall always be higher.

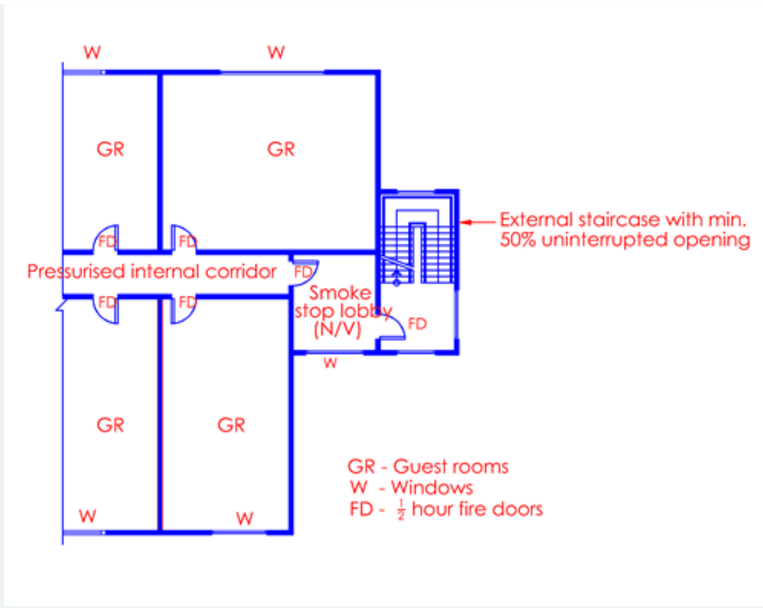


Acceptable

More than 4 storeys

Figure 7.3.1 - 3 : External staircase with MV smoke-stop lobby

The smoke-stop lobby shall be provided with mechanical ventilation and the staircase shall be treated as an external staircase. The external staircase shall be provided with uninterrupted permanent openings having minimum 50% of the staircase plan area (louvre is not allowed).

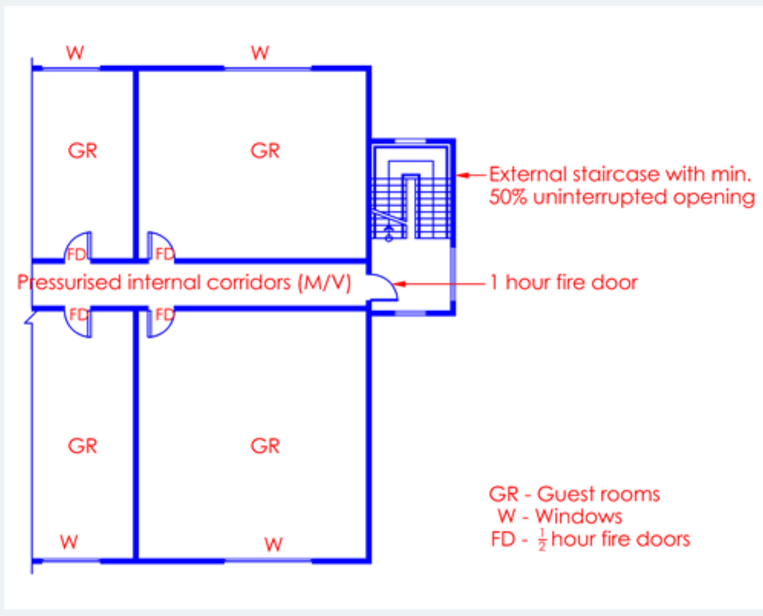


Acceptable

More than 4 storeys

Figure 7.3.1 - 4 : External staircase with NV smoke-stop lobby

The above figure illustrates a naturally ventilated smoke-stop lobby and external staircase. The smoke-stop lobby shall be provided with minimum 15% external openings. The external staircase shall be provided with uninterrupted permanent openings having minimum 50% of the staircase plan area (louvre is not allowed).

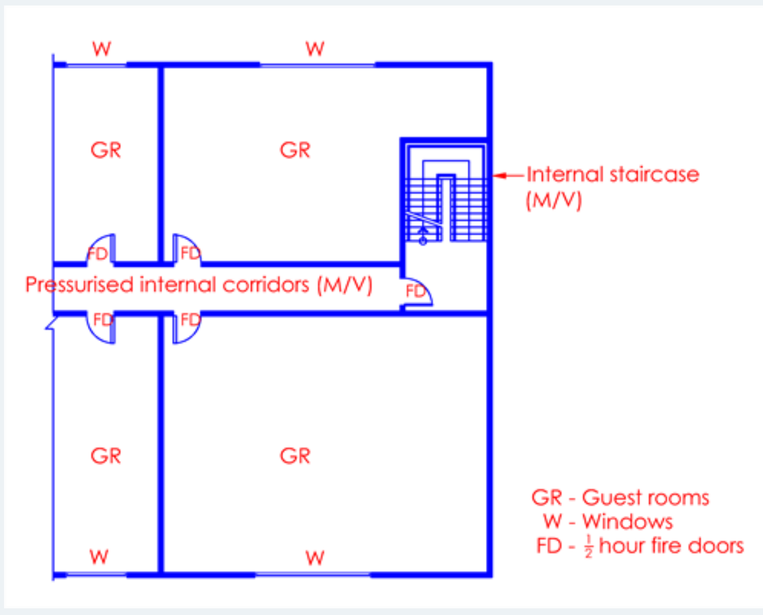


Not more than 4 storeys

Acceptable

Figure 7.3.1 - 5 : External staircase without smoke-stop lobby

The internal corridor leading to the exit should be via a minimum 1-hr fire resistance door. The external staircase shall be provided with uninterrupted permanent openings having 50% of the staircase plan area (louvre is not allowed).

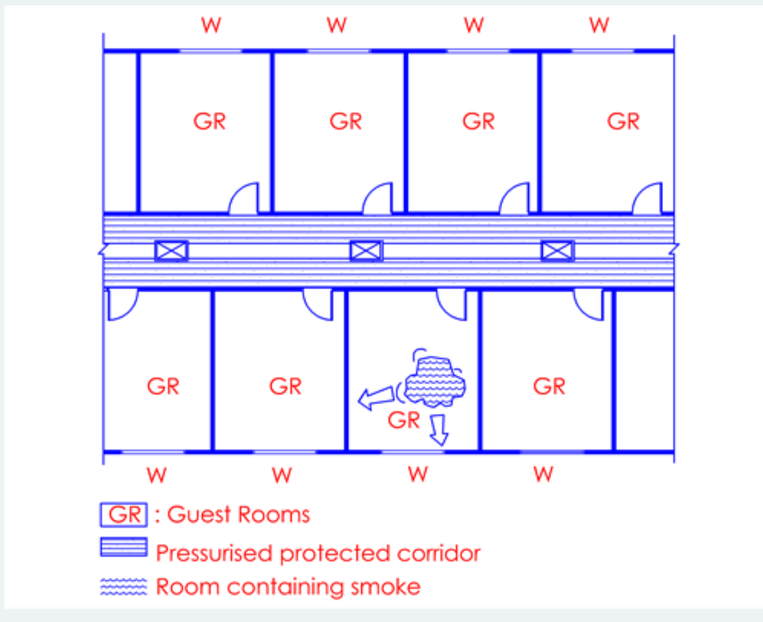


Not more than 4 storeys

Acceptable

Figure 7.3.1 - 6 : Internal staircase without smoke-stop lobby

In the above figure, the provision of smoke-stop lobby is not required by virtue of its height under Cl.2.2.13. The staircase is an internal staircase, as such it shall be pressurised to have a higher pressure differential than the internal corridor.



Not more than 4 storeys

Figure 7.3.1 - 7 : Pressurisation system for hotel

The above figure shows a simple pressurisation system suitable for small hotels. It consists of fans, which are connected to smoke sensitive device so that they operate in fire emergency. The corridor shall be provided with pressurisation to maintain a positive pressure. The power and capacity of the fan is calculated after evaluation of air leakage factors, so that an adequate pressure differential can be developed between the corridor and the guest rooms.

For effective pressurisation, there must be sufficient leakage through the external envelope of the building so that the pressure in the fire room will not reach the same pressure level with the pressure in the protected corridor.

a. Where internal corridors in hotels are required to be pressurised in compliance with *Cl.9.7.2a.(3)*, the pressure within such corridors shall be higher than that in the guest rooms by 12.5 Pa. Corridor pressurisation shall be activated for the floor on fire and two floors above.

b. The pressure within the smoke-free lobby/ fire lift lobby serving these internal corridors shall be higher than that of the internal corridors by 12.5 Pa. The pressurisation fans serving the smoke-free lobby/ fire lift lobby shall activate on all floors during a fire.

c. Pressure within the internal exit staircases shall comply with *Cl.7.2.2a.*.

CLAUSE 7.4 SMOKE CONTROL SYSTEM

7.4.1 Provision

a. An engineered smoke control system as specified in Cl.7.4.5 shall be provided where:

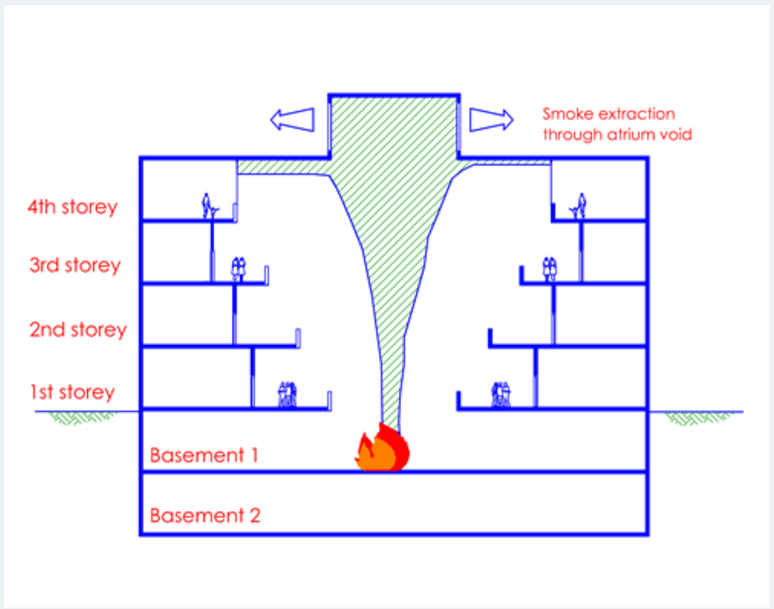
(1) the requirements for compartmentation specified in Cl.3.2.1, *Cl.3.2.4a.* and *Cl.3.2.4b.* are relaxed under the conditions in Cl.3.2.6 for Atrium spaces in a building, or

Note

The QPs are required to consult SCDF to seek consent before making any plan submission. The consent that is given by SCDF to allow the use of engineered smoke control system in the proposal shall only relate to the relaxation on the compliance with the above requirements under Cl.3.2.1 and Cl.3.2.4a. and b. of the Fire Code.

(2) the total floor area of any compartment in a building or part of a building exceeds 5000m², or

Explanation and Illustrations



Section

Figure 7.4.1a(1) & (2) : Atrium smoke control system

Before the use of engineered smoke control system is allowed in any proposal, the SCDF shall be satisfied that the compartment height of atrium is connecting more than 3 storeys below the habitable height of 24m;

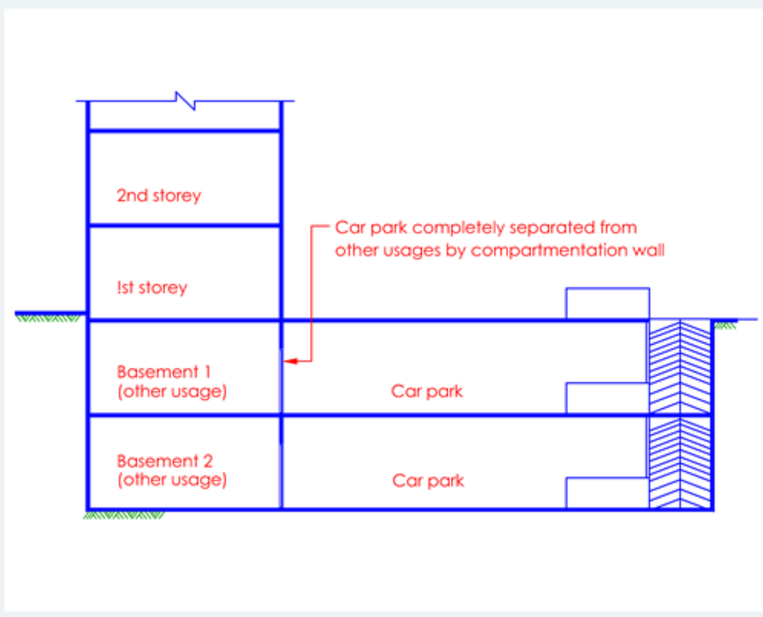
Where more than 3 storeys are interconnected and the size and volume is relaxed with provision of atrium smoke control system, only the first basement is allowed to form part of the upper storey.

A smoke control system shall be provided to any compartment in a building or part of a building which has a total floor area greater than 5000m². Smoke from any fire in such compartment would easily find its way into escape routes leading to exits or exit staircases. The activation of the smoke control system would ensure that the smoke layer would not be lower than 1.8m from floor level to allow occupants to find their ways to the exits or exit staircases.

(3) the total aggregate floor area of all basement storeys exceeds 2000m², except in any of the following situations:

(a) Where the basement or a portion of the basement is used as a car park, the car park shall comply with the requirements of smoke purging system in accordance with Cl.7.4.3, provided it is compartmented from the rest of the basement.

Explanation and Illustrations



Section

Figure 7.4.1a(3)(a)

If the total floor area of basements 1 & 2 (other usage + car park) >2000m², engineered smoke control is required to be provided in the basement storeys; except the car parking areas in basement 1 & 2 which need to be provided with smoke purging system under Cl.7.4.3.

(b) Where a plant/ equipment room with floor area not exceeding 250m² is compartmented from rest of the basement, two doors remotely located from each other for better reach in firefighting operations shall be provided. The provision of a single door opening for this room is permitted provided the most remote part of the room is less than 8m from the door, and the equipment found inside this room, does not obstruct the throw of a water jet from a firefighting hose.

Explanation and Illustrations

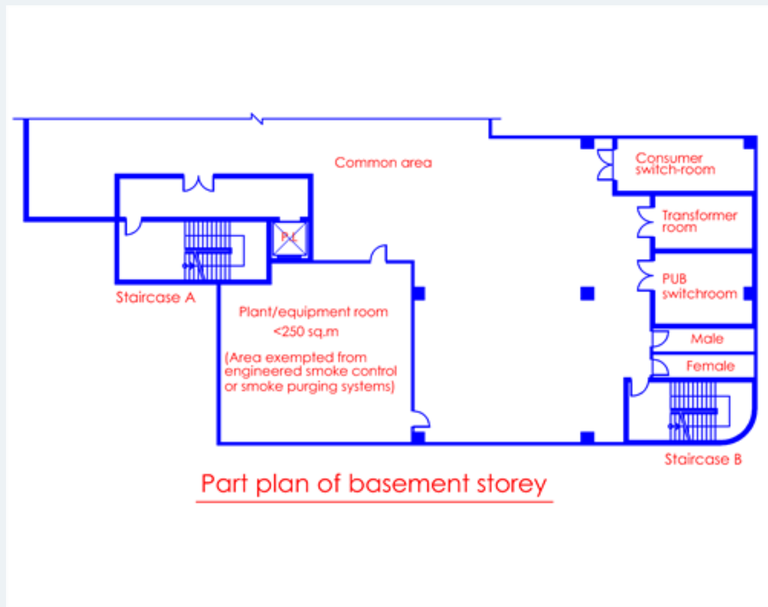


Figure 7.4.1a(3)(b)

Where the plant/equipment room is not greater than 250m², firefighters can fight a fire in that room from its doorway.

(c) Where a plant/ equipment room with floor area not exceeding 2000m², is provided with smoke vent in accordance with Cl.7.4.2 or smoke purging system in accordance with *Cl.7.4.3.*

Explanation and Illustrations

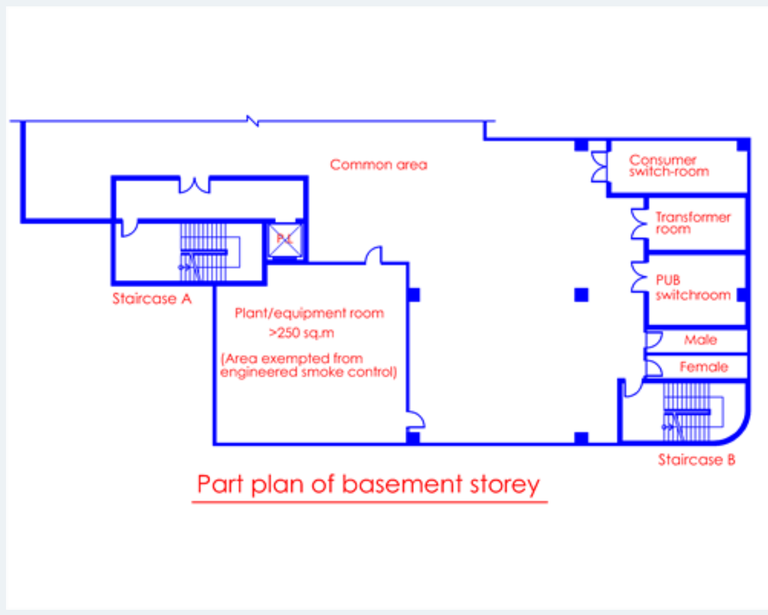


Figure 7.4.1a(3)(c)

Where floor area of the plant/equipment room is in excess of 250m², but not exceeding 2000m², provision of smoke vents in accordance to Cl.7.4.2 or smoke purging system in accordance with Cl.7.4.3 would be acceptable.

Cl.7.4.1a.(3)(c) is meant to grant relaxation over the general requirement as service rooms are usually of low occupancy load. Common areas outside the plant rooms/service rooms shall be provided with engineered smoke control system.

(d) Where a compartmented service area comprising storerooms or workshops (restricted to staff only) is provided with smoke vent in accordance with Cl.7.4.2, or smoke purging system in accordance with *Cl.7.4.3.*

Explanation and Illustrations

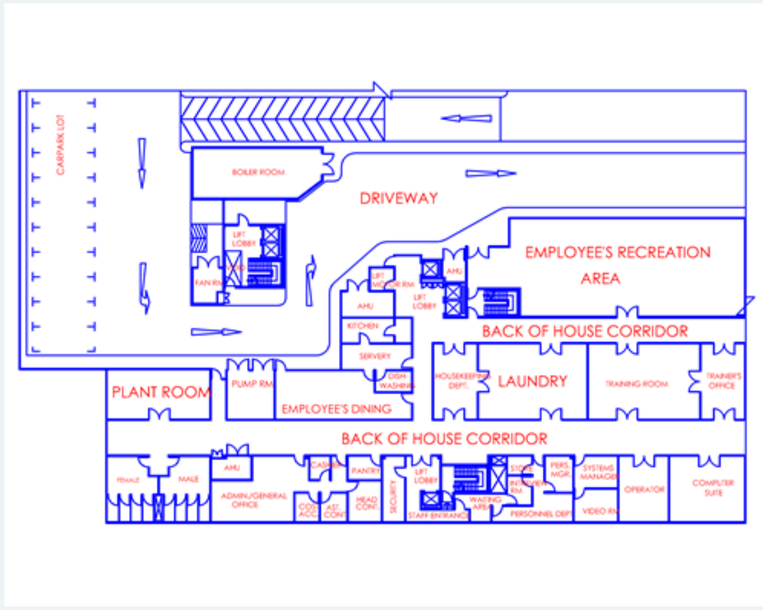


Figure 7.4.1a(3)(d) - 1

The above clause is mainly applicable to hotel building. Service areas such as laundries, stores and workshops that are restricted to staff only shall be compartmented. The total area of these compartments shall not exceed 2000m² (per storey basis). Each compartment shall be provided with smoke venting or smoke purging system.

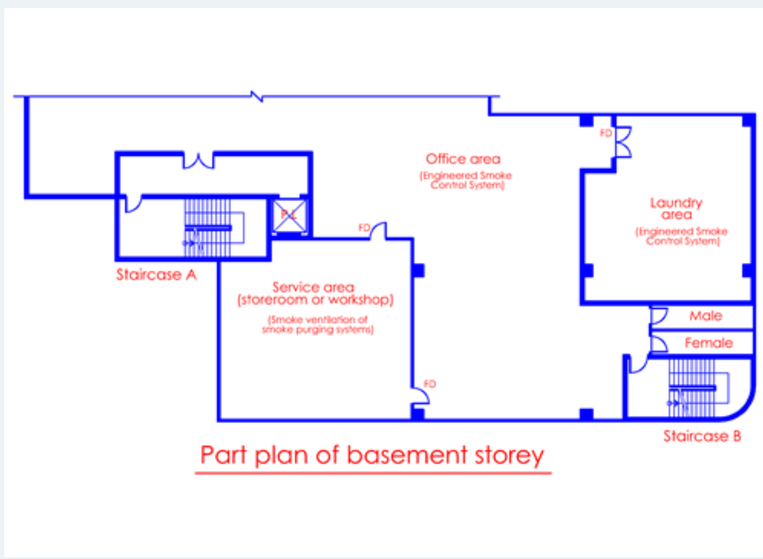


Figure 7.4.1a(3)(d) - 2

a. Service areas in basement storey used as laundry area are areas that are normally occupied.

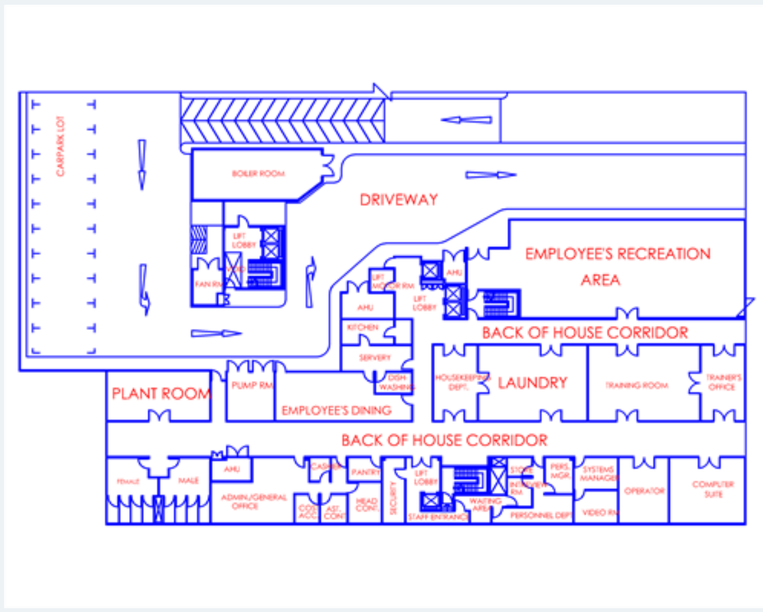
b. Hence, smoke dilution of at least 9 air charges may not suffice.

c. Adequate level of visibility and smoke dispersal shall be maintained for these areas to facilitate escape.

d. Engineered smoke control system shall be provided.

(e) Where the basement of a residential development is used as a car park, one office intended for ancillary use is permitted in the car park. The office shall be provided with smoke purging system in accordance with Cl.7.4.3 and compartmented from the rest of the basement. The office floor area shall not exceed 40m².

Explanation and Illustrations



b. A smoke vent in accordance with Cl.7.4.2 shall be provided if the total aggregate floor area of all basement storeys does not exceed 2000m², except for PG I buildings . In lieu of smoke vents, a smoke purging system or an engineered smoke control system is permissible for car parks or other occupancies respectively.

Explanation and Illustrations

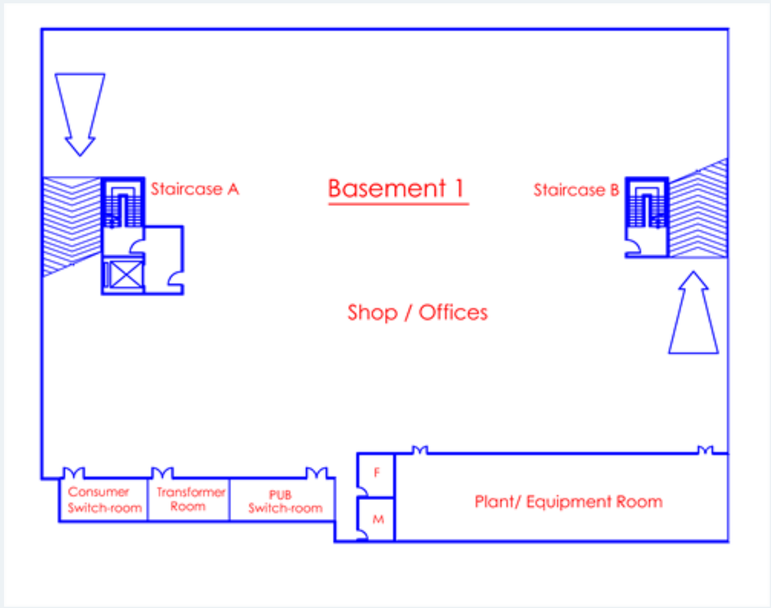


Figure 7.4.1b. – 1

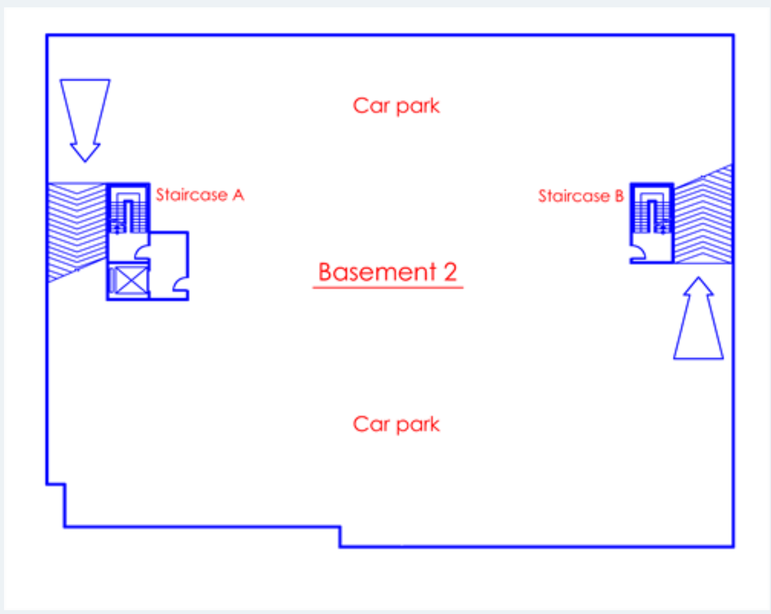


Figure 7.4.1b. – 2

Total aggregate floor area of basement storeys = Area of car park + staircases + services area (telecommunication room, transformer room etc.) + plant/equipment room of basement 1 + area of whole basement 2.

If total aggregate area< 2000m² (see Cl.7.4.2). If total aggregate area>2000m² (engineered smoke control system or smoke purging is required), See also Cl.7.4.3 and *Cl.7.4.1a.(3)(b)* & *(c)*

7.4.2 Smoke vent

Explanation and Illustrations

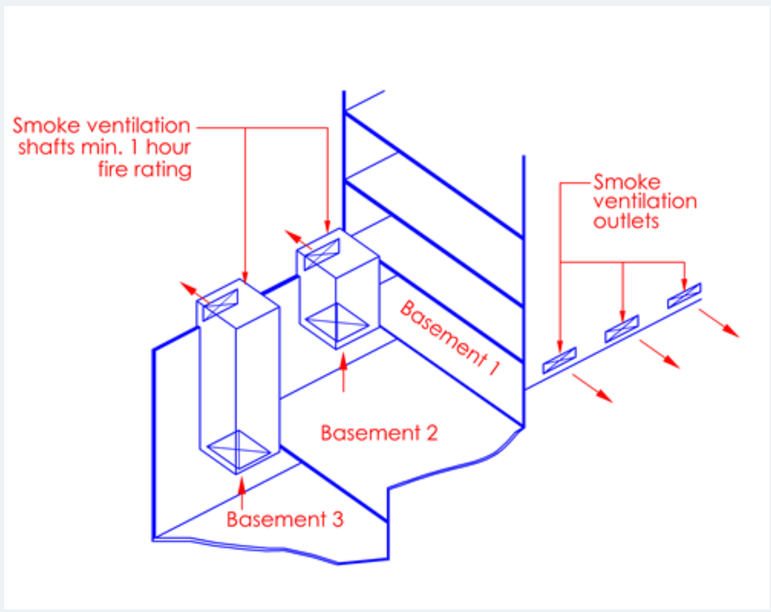


Figure 7.4.2 : Smoke vents for basement occupancies

a. Smoke ventilation shafts where extending through storeys above, shall be enclosed with imperforate walls having minimum 1-hr fire resistance.

b. Separate smoke ventilation shafts and outlets shall be provided for each basement storey.

c. Smoke venting outlets shall be so arranged that a through draught can be created.

d. Outlets covered by stalled boards, or approved type pavement lights shall be readily openable/breakable.

e. The positions of all smoke vent outlets and the basement level or areas they serve shall be suitably indicated on the external face of the building adjacent to such outlets.

Smoke vents shall be adequately distributed along the perimeter of the space served, and its outlets shall be easily accessible during firefighting and rescue operations. Smoke vents shall comply with the following requirements:

a. the number and their sizes shall be such that the aggregate effective vent openings shall not be less than 2.5% of the floor area served;

b. the vent outlets, if covered under normal conditions, shall be openable in case of fire;

c. the position of all vent outlets and the areas they serve shall be suitably indicated adjacent to such outlets;

d. where ducts are required to connect the vent to outlets, the ducts shall either be enclosed in structure or be constructed to give at least 1-hr fire resistance rating; and

e. separate ducts and vent outlets shall be provided for each storey.

7.4.3 Smoke purging system

Smoke purging system, where permitted under this Code in buildings, shall conform to all of the following requirements:

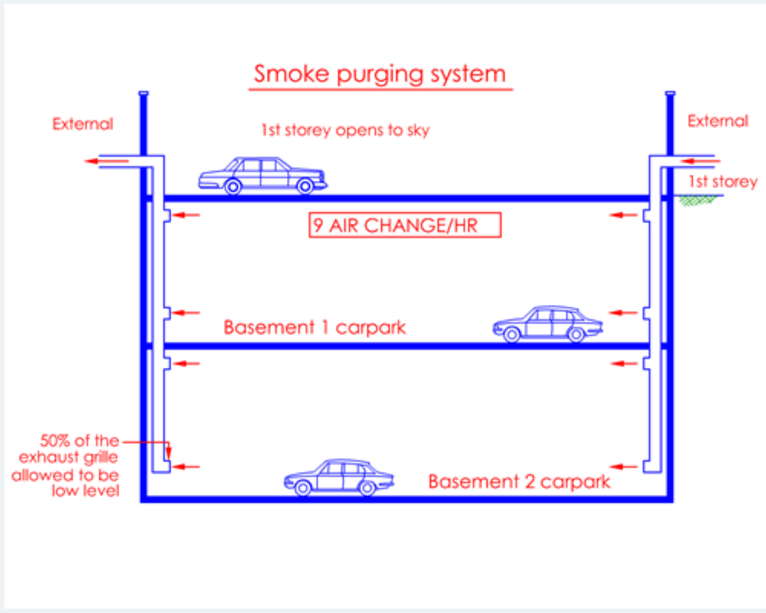
a. The smoke purging system shall be independent of any other system serving other parts of the building.

b. The purging system's purge rate shall be at least 9 air changes per hour.

c. The purging system shall be activated automatically by the building fire alarm system. In addition, a remote manual start-stop switch shall be located at the FCC, or at main fire alarm panel on first storey (where there is no FCC in the building). Visual indication of the operation status of the smoke purging system shall also be provided with this remote control.

d. Supply air shall be drawn directly from the external space and its intake shall not be less than 5m from any exhaust discharge openings. Outlets for the supply air shall be adequately distributed over the area served.

Explanation and Illustrations



Section

Figure 7.4.3a.-d. : Smoke purging system with ducted supply air intake

The reasons for locating the remote manual start/stop switch in the FCC or main fire alarm panel on 1st storey (where FCC is not available) are:

a. to allow firefighting personnel to shut down the supply air system temporarily in the event that smoke is being drawn into the lobby through the outdoor air intake; and

b. to allow firefighting personnel to activate the supply sir system should the fire alarm system fail to automatically activate the supply air system.

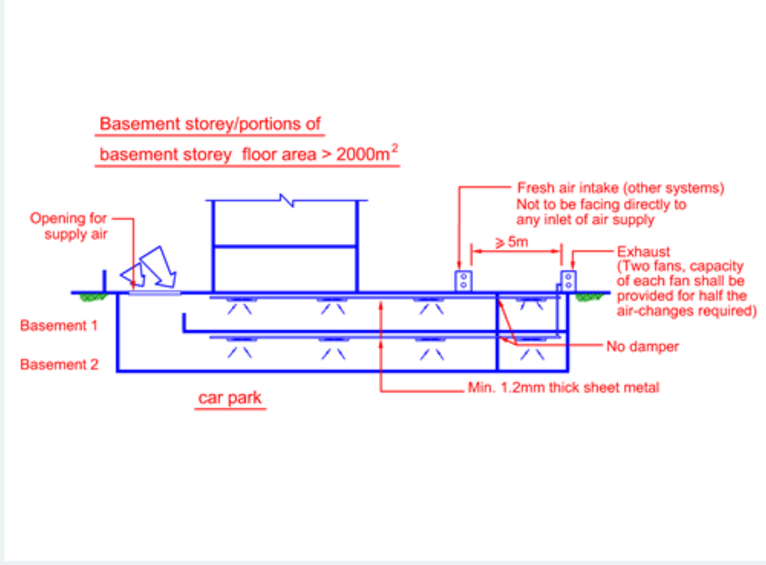
e. Where there is natural ventilation for the area served based upon evenly distributed openings equal to not less than 2.5% of the floor area of a given storey, such natural ventilation can be considered a satisfactory substitute for the supply part of the smoke purging system.

f. Replacement air shall be provided and if it is supplied by a separate mechanical system, such a system shall be connected to a secondary power supply.

g. Exhaust ducts shall be fabricated from heavy gauge steel of at least 1.2mm thickness.

h. The exhaust fan shall be capable of operating effectively at 250°C for 2 hours and be connected to a secondary power supply.

Explanation and Illustrations



Section

Figure 7.4.3e.-h. : Smoke purging system with natural opening for supply air intake

Exhaust fans shall be rated at minimum 250°C. Supply air part of the smoke purging system is provided via opening to the external air. The openings provided for supply air shall not be less than 2.5% of the floor area of each basement storey. Ramp openings, voids over car parking areas are considered acceptable openings for fresh air supply.

Where a smoke purging system consists of a supply and exhaust , both of which shall be designed such that each can operate in two sections.

The capacity of each section shall be sufficient to provide half the air changes required. Each section of the smoke purging system shall so constructed that in the event of failure of one section (exhaust part or supply part), the other section shall continue to operate. This can prevent failure of the system caused by failure of one single fan.

The exhaust and supply parts shall be electrically interlocked so that failure of any section of the exhaust part shall automatically shut down the corresponding section of the supply part, which can prevent total failure of the smoke purging system caused by the failure of one single fan.

In the event that any exhaust fan fails to run or is shut down for maintenance, the corresponding supply fan should not run so as to prevent fresh air from being pumped into the basement. The interlocking arrangement will not apply if smoke purging system consists of only the exhaust part. However, the exhaust system shall also be designed into two section as per the above.

7.4.4 Ductless jet fan system

a. General

This system can be used in lieu of a smoke purging system for conventional car parks where passenger cars/light weight vehicles are parked alongside each other with common driveways. It is not intended for mechanised car park systems or other forms of car parking systems.

b. Provision of sprinkler system

(1) The basement car park shall be sprinkler-protected in accordance with the *SS CP 52*.

(2) The arrangement of the sprinkler heads and the jet fans shall be such that, upon the operation of the jet fans, the effect on the spray pattern of the sprinklers is minimised.

c. Zoning of car park

(1) All car park spaces shall be divided into smoke control zones with each zone not larger than 2000m^2 (excluding plant rooms and circulation spaces) for the purpose of smoke containment and quicker location of fire. A commissioning test will be carried out using hot smoke to demonstrate that smoke can be contained within each zone and channelled to the extract fans.

(2) Each smoke control zone shall have its own jet fan system (fresh air fans, exhaust air fans and jet fans) to purge smoke from the affected zone. The ducts shall be fabricated from heavy steel gauge steel of 1.2mm thickness. Alternatively, sharing of the fresh air and exhaust air fans is permitted provided the fans, wiring and control panel are protected with at least 1-hr fire resistance rating. The exhaust fan system shall also be designed to run in at least two parts, such that the total exhaust capacity does not fall below 100% of the required rate of extract for the zones affected in the event of failure of any one part. This requirement is also applicable for mechanised supply fan system, if it is used.

d. Jet fan system

(1) The jet fan system shall be activated by the sprinkler system serving the basement car park level and any other areas located within the same level. The activation of the jet fan system shall be confined to the smoke control zone on fire and all its adjacent zones. A firefighter cut-off and activation (override) switch shall be provided at the FCC. As an alternative form of fan activation, the use of smoke detectors to activate the jet fan system is allowed, provided:

(a) the detectors are positioned at the effective mid-range of the jet fan profile;

(b) in-duct smoke detector is located at the start point of the exhaust duct; and

(c) jet fan system shall only operate upon activation of two smoke detectors. This is to minimise false alarms.

(2) The jet fan system shall be provided with a secondary source of power supply through automatic operation of an emergency generator in case of failure of the primary power supply source.

(3) The jet fans shall be distributed at a spacing of 2/3of the tested effective range of each jet fan. The tested effective range of the jet fan shall be taken as the distance up to the point at 0.2m/s of the air-velocity distribution profile.

(4) The minimum headroom for the installation of the jet fan system is 3m.

(5) The interaction of the various components of the jet fan system shall be as follows:

(a) Each group of exhaust fans for each smoke control zone shall be interlocked with its corresponding groups of jet fans for that zone.

(b) If the group of exhaust fans stops/ fails in any smoke control zone, the corresponding group of jet fans in that zone shall stop. But if any of the exhaust fans is still in operation in a particular smoke control zone, all the jet fans in that zone shall continue to operate.

(c) The exhaust fan shall continue to run even if any corresponding group of jet fans fails.

(d) The other groups of jet fans shall continue to run even if any one group of jet fans fails.

(e) If the fire alarm signal is isolated, the exhaust fans and jet fans shall continue to run at high speed. If the fans are manually restarted, both the exhaust fans and jet fans shall continue to run at high speed until they are set to low speed at the field control panel.

(6) The jet fan system shall be independent of any systems serving other parts of the building.

(7) The jet fan system design shall be such that the bulk air velocity induced by the jet fans is sufficient to stop the advance of the ceiling jet within 5m from the fire location in the direction opposite to the induced bulk air flow.

(8) The smoke control sub-panel in each smoke control zone is to be connected to the main smoke control panel, such that any isolation of jet fan system at a particular zone is automatically displayed at the main smoke control panel.

(9) The car park main smoke control panel at the FCC/ Guard house and remote local panel for the supply and exhaust fans shall indicate, by means of indicator lights, whether the fans are on low or high speed. The panels are also required to have the individual group of jet fans indication lights interlocked with the main exhaust fans in the respective smoke control zones.

(10) In the event of failure of the primary source of power supply and subsequent operation of the secondary power supply, the mode of operation of the jet fan system during the fire mode shall follow that prior to the failure of the primary power supply. For example, if the operation of jet fan system in a particular smoke control zone is switched off by the firefighter during fire mode condition and the primary source of power fails, the subsequent operation of the secondary power supply shall be such that the jet fan system remains in the previous fire mode condition, i.e., non-operational mode for that smoke control zone, while the other smoke control zones resume operation.

(11) The jet fan system design shall take into consideration the presence of any down-stand beams and other obstructions that are of depths of more than 1/10 of the car park floor to ceiling height so as to account for any resistance to airflow.

(12) On activation of the jet fan system, the movement of smoke towards the extraction point(s) shall not adversely affect the means of escape and cause smoke to be blown into the lobby area or exit staircases.

(13) The operation of the jet fan system should be such that there are no stagnant areas where smoke can accumulate in the event of fire.

(14) The operation of the jet fan system shall not cause the volume of air movement to be greater than that volume extracted by the main exhaust fans.

(15) There shall be at least one viable approach route (i.e. where acceptance criteria for firefighters are in accordance with *Cl.7.4.4g.* and *Diagram 7.4.4e.(4)-2*) for the firefighters to any possible fire location up to a distance of 5m from that fire. As such, information as to the viable approach route shall be displayed at the main fire alarm panel. This can be achieved by arranging the sprinkler control zone to correspond with that of the smoke control zone. Upon detection of the fire within a particular smoke control zone/ sprinkler zone, reference can be made to the display showing the viable approach route for that particular smoke control zone.

e. Wiring arrangement of jet fans

(1) All jet fans shall be connected to the local jet fan control panel in groups of not more than three jet fans.

(2) Each group will be connected by fire-rated cabling.

(3) Each group of jet fans will be protected by a separate MCB (main circuit breaker), with power supply compliant with SS 638, to prevent the failure of all the jet fans at once due to tripping of the main RCB, e.g., due to overloading.

(4) The jet fans shall also be wired in a zigzag configuration and no two consecutive jet fans in a straight line are to be wired in the same group. In the event of failure of one group of jet fans, the next corresponding group will be able to drive the smoke towards the exhaust location to be extracted (see *Diagram 7.4.4e.(4) - 1 & 2*). Should one group of jet fans fail, all other groups shall still continue to run.

(5) The location of the local control panel for the operation of the jet fans within each zone shall be in a relatively safe area within the zone and be spaced as least 5m apart from the local control panels of adjacent zones. This is to minimise the risk of a fire affecting all the control panels if they be spaced closely together, and thus rendering the ineffectiveness of the jet fan system.

f. Provision of supply air

(1) Supply air to the car park can be provided via mechanised supply air fans or by permanent openings of at least 2.5% of the floor area. Whichever is used, the maximum inlet air speed shall be 2m/s to prevent recirculation of smoke.

(2) The air velocity within escape routes and ramps shall not exceed 5m/s to prevent escapees from being hindered by the air flow.

(3) The replacement air intakes shall face away from any smoke exhaust points and be sited at least 5m apart so as to prevent recirculation of smoke. If the supply and exhaust louvers are located on the same façade of the building, they shall also be sited at least 5m apart.

(4) The replacement air intake shall be located on the opposing end of the smoke exhaust points so that there is no opposing flow between the supply air and the smoke that is drawn towards the exhaust fan.

g. Exhaust fan design

(1) The car park shall be provided with at least 12 air changes per hour during a fire. A lower air change not less than 9 air changes can be permitted provided the acceptance criteria stipulated in the *Cl.7.4.4g.(1)(b)* can be achieved through fire modelling:

(a) Hot smoke test/ CFD fire modelling

The effectiveness of the jet fans system design shall be demonstrated using hot smoke test in accordance with *Cl.7.4.4j.*. The heat release rate of the fuel load for the hot smoke test shall be at least 1MW. The relevant PE or Fire Safety Engineer should decide on the fire location(s) that is (are) deemed most onerous with justification. In addition to the hot smoke test, Computational Fluid Dynamics (CFD) fire modelling will also be required in the following instances:

(i) If air change per hour is smaller than 12.

(ii) If there are general goods vehicle or coaches where design fire size exceeds 4 MW (i.e., car fire).

(iii) If replacement air is a combination of natural and mechanical means.

(iv) If spacing of jet fans is more than 2/3 of the tested effective range.

The CFD study is to be endorsed by a Fire Safety Engineer (FSE) to verify the conformance of the jet fans system with the acceptance criteria as stipulated in *Cl.7.4.4g.(1)(b)*. The FSE is also required to put up a fire engineering report. Some of the accepted fire modelling software includes FDS, Swift-AVL, Fluent and Pheonics.

(b) Acceptance criteria

(i) Not more than 1000m^2 of the car park space can be smoke-logged for at least 20 mins, regardless of whether the fire is located within the smoke control zone or across the zone boundaries (Note: After the 20 mins duration, smoke is expected to remain confined within the 1000m^2 area). Within this smoke-logged area, there shall be at least 1 viable route for the firefighters where the following conditions are satisfied:

* Smoke temperature shall not exceed 250°C at a height of 1.7m from floor level.

* Visibility shall not be less than 5m at a height of 1.7m from floor level.

These conditions shall commence at a distance of 5m from the fire location in the direction opposite to the induced bulk air flow induced by the jet fans. All other areas outside the smoke-logged area shall be kept substantially free from smoke i.e. smoke temperature not more than 60oC and visibility of at least 25m (*Diagrams 7.4.4e (4) - 1 & 2*).

(Note: If hot smoke test is performed, assessment is to be made on the operation of the jet fans system, movement of smoke towards the extraction points and smoke spread. The latter 2 aspects can be generally verified using the above visibility criterion. The temperature criterion need not be verified in view of the nature of the hot smoke test.)

(c) CFD fire modelling input parameters

(i) Fire Size

The design fire size shall be based on at least 4MW steady-state fire (i.e., car fire). For general goods vehicle, the design fire size shall be based on at least 10MW steady state fire (FSE is expected to provide justification for the bigger fire size other than the car fire).

(ii) Type of fire

The type of fire shall be flaming polyurethane.

(iii) Location of fire

Generally, the fire should be located furthest away from the exhaust points and in between zones. The relevant PE or Fire Safety Engineer should decide on the fire location(s) that is (are) deemed most onerous with justification.

(iv) Down-stand beams and other obstruction

The CFD model shall take into consideration the presence of any down-stand beams and other obstruction that are of depths of more than 1/10 of the car park floor to ceiling height so as to account for any resistance to airflow and turbulence.

(v) Jet fan velocity profile

Validation model of the velocity profile is to be carried out for a single jet fan. The data from the model shall be compared against physical test data.

As such, the jet fan shall be tested for velocity profile by an accredited testing laboratory for comparison with the simulated velocity profile. The test report is to be attached to the Fire Engineering Report. The equation to be used for the deviation between the CFD profile and actual test profile is as follows:

Equation : Deviation = [(A-B) / B] X 100%

Where :

A = distance/width/height from CFD profile
B = distance/width/height from actual test profile

The deviation of the distance, width and height of the actual profile from the simulated profile at the various air velocities should be within 10%.

(vi) Duration of fire simulation

The duration of the fire simulation shall be at least 20 mins.

(vii) Sprinkler activation

The model shall assume there is no sprinkler activation for the design fire size specified in *Cl.7.4.4g.(1)(c)(i)*.

(viii) Grid resolution

The grid size to be used in the fire model shall not be larger than 200mm X 200mm X 200mm in the smoke control zone where fire is located and its adjacent zones. Other than these zones, the grid size shall not be larger than 400mm X 400mm X 400mm. Alternatively, the relevant PE or FSE undertakes a grid resolution study to ascertain the appropriate grid size needed for the fire size and smoke flows modelled (e.g., outcome of study showing that additional resolution does not make much of a difference to the results).

(ix) Sensitivity study

A sensitivity study is to be carried out to show the impact of 1 group of jet fan failure nearest the fire on the overall effectiveness of the jet fans system. This study is applicable to both fire modelling and hot smoke test. Notwithstanding the failure of 1 group of jet fans, the acceptance criteria must still be maintained.

(2) The capacity of the exhaust fan and any associated ducting shall be calculated on the basis that the pressure in the car park close to the extract points is equal to the external atmospheric pressure.

(3) Each smoke control zone of the car park shall have its own exhaust fan system. The exhaust fan system in each zone shall be designed to run in at least two parts, such that the total exhaust capacity does not fall below 50% of the required rate of extract in the event of failure of any one part, and that a fault or failure of the exhaust fan system in one zone will not affect the operation of the exhaust fan system in the other zones. The above requirement is also applicable for mechanised supply fan systems, where used.

(Note: If there is sharing of the exhaust air fans, see *Cl.7.4.4c.(2)*)

(4) The smoke discharge points shall be located such that the smoke extracted from the smoke exhaust fans does not affect any occupied area or means of escape at the level where smoke is discharged.

h. Fire resistance of jet fan system

The jet fan system, such as the mechanised air supply fans, smoke exhaust fans, jet fans, duct works and wiring shall be capable of operating effectively at 250°C for 2 hours. The fans, ducts and wiring shall be tested in accordance with *EN 12101-3, BS 476: Part 24* and *SS 299*, respectively.

i. Operations and maintenance manual

An operations and maintenance manual shall be attached. The manual shall contain the roles and responsibilities of the building owner/ operator, the restrictions placed on the building, identification of the sub-systems, servicing and maintenance plan, fault identification, etc. The manual can also be used as a guide for future renovations and changes to the building.

j. Commissioning test

The Registered Inspector who carries out commissioning test of the jet fans system may make reference to *Table 2* of *BS 7346 - Part 7* as a guide. When hot smoke test is performed, the PE/ FSE shall use a test fire size of 1MW. Reference may be made to *AS 4391* on hot smoke test and PE is advised to make reference on how the test can be prepared and carried out in a proper manner.

7.4.5 Engineered smoke control system

a. Acceptable design guidance

The engineered smoke control system shall be in the form of a smoke ventilation system by natural or mechanical extraction designed in accordance with *BR 186, BR 258, BR 368* and other acceptable standards:

Explanation and Illustrations

(No illustration)

BR 186 and BR 258 and subsequent revisions / amendments have been adopted as acceptable design guides for engineering smoke control systems. Other acceptable standards such as NFPA 92A may be adopted, taking into consideration that the basic requirements of smoke control system in the Fire Code should be strictly complied with. In the case of differences in requirement between BR 186 / 258 and NFPA 92A, e.g. classification of fire size, the clear height of smoke layer base, the QPs should consult the SCDF to determine which requirement to adopt before building plan submission. Other acceptable standards referred to from time to time will be evaluated and QPs will be informed through SCDF's circulars.

b. Sprinkler system

Rationale

The main reason that sprinkler system must be provided is to control the fire size. The sprinkler head spacing in respect of both hazard and classification determines the size of a fire, in area and perimeter. The activation of sprinkler heads would, besides controlling the fire size, help to reduce the build-up of heat and toxic gases, which can lead to flashover and smoke explosions. Based on research, if the fire is not sprinkler controlled, the fire size would be unlimited and therefore, fire size could not be established.

A building provided with an engineered smoke control system shall be sprinkler-protected.

c. Fire size

(1) Non-industrial buildings

The capacity of the engineered smoke control system shall be calculated based on the incidence of a likely maximum fire size for a sprinkler controlled fire as recommended in the following table:

TABLE 7.4.5c.(1) : FIRE SIZE FOR NON- INDUSTRIAL BUILDINGS		
Occupancy (Sprinkler-protected)	**Fire Size**	
	Heat Output (MW)	**Perimeter of Fire (m)**
Shops	5	12
Shops (fast response sprinklers)	2.5	9
Offices	1	14
Hotel Guest Room	0.5	6
Hotel Public Areas	2.5	12
Assembly Occupancy with Fixed Seating	2.5	12

(2) Industrial buildings

The requirements for design fire size are applicable to sprinkler- protected industrial premises (factory and warehouse) without in-rack sprinklers and limited to the design of smoke control system based on Cl.7.4.

(a) Fire growth

The fire growth can be evaluated by the following generic fire growth curve (also referred to as 't2 fire'), that represents the general types of combustible material present within an enclosure:

$Q_{max} = \propto (t-ti)^2$ ---------- equation (1)
where:
Q_{max} = heat release rate (kW);
$\propto$ = fire growth parameter (kJ/s^3);
t = time (s);
t_i = time of ignition (s) (taken here as zero)

The fire growth parameter varies with the fire load density and the fire load configuration factor. However, for purpose of design, fire growth parameter can be generally defined as follows:

TABLE 7.4.5c.(2)(A) : FIRE GROWTH PARAMETER FOR INDUSTRIAL BUILDINGS		
Fire growth rate	**Fire growth parameter (kJ/s^3)**	**Time for Qg = 1MW (s)**
Slow	0.0029	600
Medium	0.012	300
Fast	0.047	150
Ultra fast	0.188	75
Note: The fire growth rate that is applicable through available literature or standard such as the SFPE Handbook shall be adopted. In the instance where the fire growth rate lies in between the range as stated above, the more conservative fire growth rate is to be used.		

(b) Design fire – sprinkler-protected

(i) The heat output of the design fire is assumed to increase according to equation (1) until sprinkler operation is deemed to occur at time t8. Following sprinkler operation, the heat output of the fire is considered to remain constant.

(ii) The capacity of the smoke control system shall be based on the fire size that is controlled by activation of 2nd ring of sprinklers.

(iii) The operation of the sprinkler system at ts and the corresponding fire size can be determined by hand calculations based on fire engineering principles or the use of fire engineering tools such as FPETool from National Institute of Standards and Technology (NIST). Whichever approach is used, the following design factors governing its calculation are as follows:

• Rate of fire growth
The type of fuel load and its configuration in the premises shall govern the rate of fire growth which can be represented using equation (1) and *Table 7.4.5c.(2)(a)*.

• Sprinkler response time index (RTI)
The RTI is the thermal sensitivity of the sprinkler and shall be based on the manufacturer's specification.
Example:
Standard response sprinkler – $105m^{0.5}s^{0.5}$;
Fast response sprinkler - $50m\ ^{0.5}s^{0.5}$;
ESFR - $26m^{0.5}s^{0.5}$

• Temperature rating of sprinkler
The operating temperature of the sprinklers shall be based on *SS CP 52* (e.g., 141°C or 68°C).

• Ambient temperature
Room temperature for air-conditioned spaces and non-air conditioned spaces can be taken as 25°C and 30°C, respectively.

• Ceiling height
The ceiling height shall be based on the height, measured from the finished floor level to the soffit of the ceiling/ roof.

• Spacing of sprinkler above fire
Sprinkler spacing shall be based on *SS CP 52* (e.g. 3m by 3m or 4m x 3m).

Note: The application of FPETool from NIST or any other software in determining the activation time of the sprinkler system and the corresponding fire size has its limitations. Some of the software programs are based on Alpert's correlations where a number of fundamental assumptions are made such as flat smooth ceilings, unconfined smoke flow, axisymmetric plumes (not near walls or corners), location of detector close to the ceiling, etc. Such assumptions shall thus be taken into consideration when using this tool.

(iv) The capacity of the smoke control system shall also take into consideration the possibility of forklift or general goods vehicle on fire along the internal ramps/driveways. For design purposes, the design fire size shall be taken as follows:

TABLE 7.4.5c.(2)(b)(iv) : VEHICLE DESIGN FIRE SIZE	
Type of vehicle	**Design fire size**
Forklift or car	4MW
General goods vehicle	10MW

(c) Determination of perimeter of fire

(i) Fire perimeter for forklift/car and goods vehicle

The fire perimeter is used to determine the mass flow rate of smoke. For forklift or general goods vehicle, the perimeter of fire shall be taken as follows:

TABLE 7.4.5c.(2)(C)(I) : FIRE PERIMETER SIZE	
Type of vehicle	**Perimeter of fire**
Forklift or car	5m x 2m
General goods vehicle	9m x 2.5m

(ii) Fire perimeter other than for forklift/car and general goods vehicle

Other than for forklift/car and general goods vehicle, the following equation is used to calculate the fire perimeter for a square fire of equal sides:

$P = 4(Q_c/Q_r)^{0.5}$ ---------- equation (2)
where:
P = fire perimeter (m);
Q_c = convective heat output = $0.7Q_{max}$ (kW);
Q_r = heat release rate per unit area (kW/m^2), see *Table 7.4.5c.(2)(c)(ii)*

Where elongated storage configurations such as racking or shelving are used, the fire perimeter is determined using the following equation:

$P = 2[Q_c/(Q_r \times d)]$ ---------- equation (3)
where:
Q_c = convective heat output = $0.7Q_{max}$ (kW);
Q_r = heat release rate per unit area (kW/m^2), see *Table 7.4.5c.(2)(c)(ii)*
d = depth of rack (m)

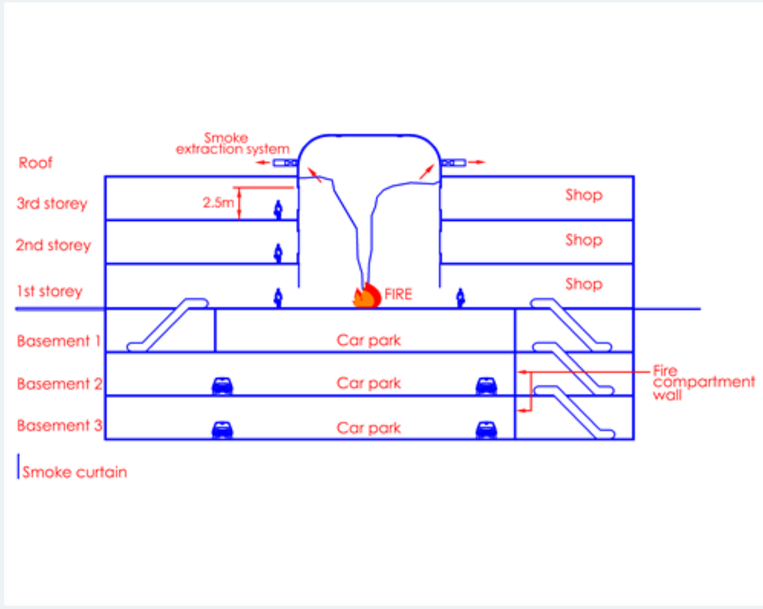
For purpose of calculating the fire perimeter, the values for Q_r given in *Table 7.4.5c.(2)(c)(ii)* are used.

TABLE 7.4.5c.(2)(C)(II) : HEAT RELEASE RATE	
Building Use	**Heat release rate per unit area, Qr (kW/m^2)**
Industrial	260
Storage	500

d. <u>Capacity</u>

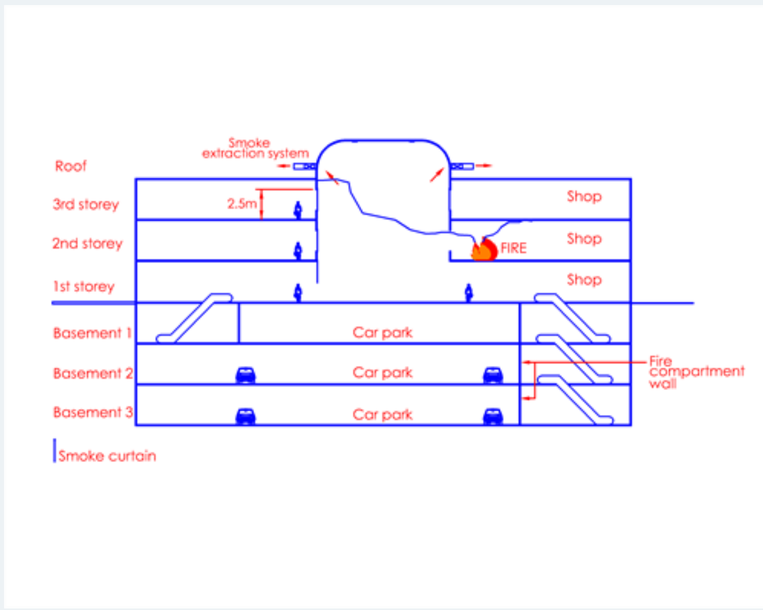
The capacity of an engineered smoke control system shall be capable of handling the demand for smoke exhaust in a worst case scenario.

Explanation and Illustrations



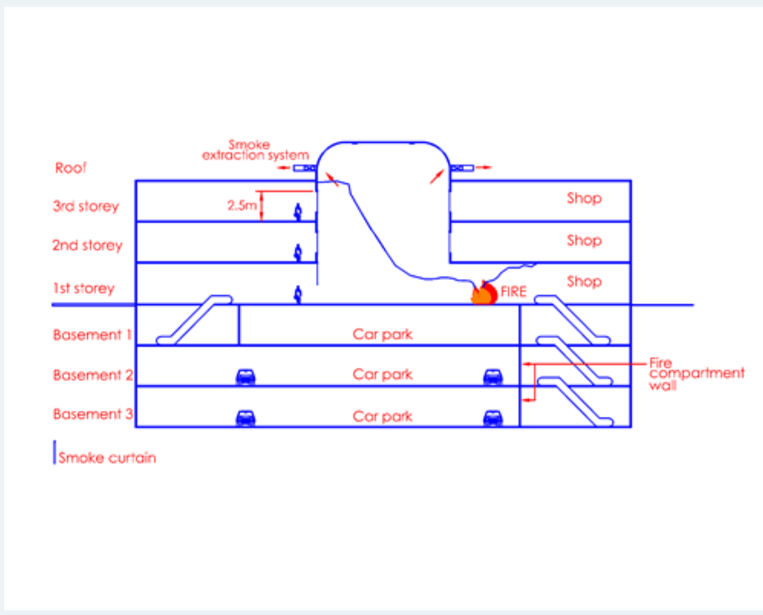
Section

Figure 7.4.5d. – 1 : Scenario A



Section

Figure 7.4.5d. – 2 : Scenario B



Section

Figure 7.4.5d. – 3 : Scenario C

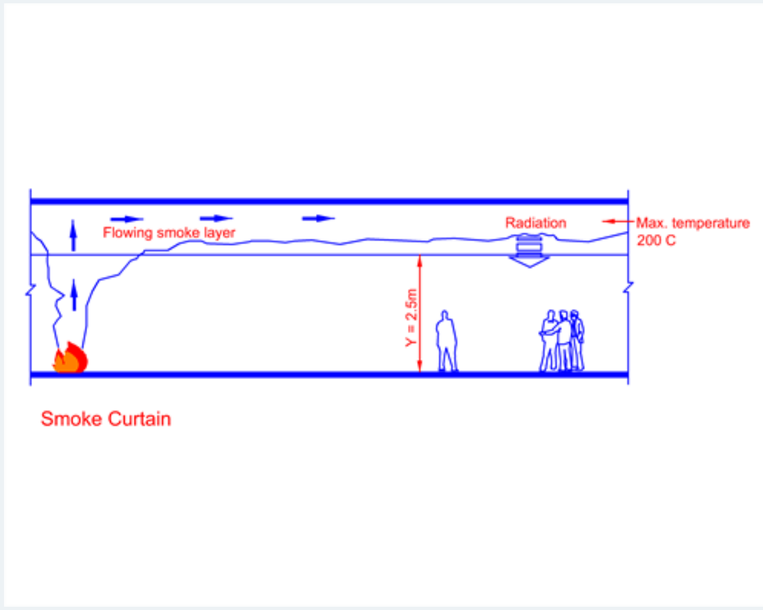
The engineered smoke control system can be designed based on smoke control zones, provided the system is capable of handling the largest demand of smoke produced under the worst case scenario. The worst scenario would be scenario C where the fire size occurring at 1st storey as shown in the figure above. As the smoke and hot gases rise through the upper levels, a very large quantity of smoke would be further generated through entrainment and greater cooling effect of smoke would occur.

e. Clear layer

The design smoke layer base shall be above the heads of people escaping beneath it. The minimum height shall be 2.5m.

f. Smoke reservoir

Explanation and Illustrations



Section

Figure 7.4.5e.

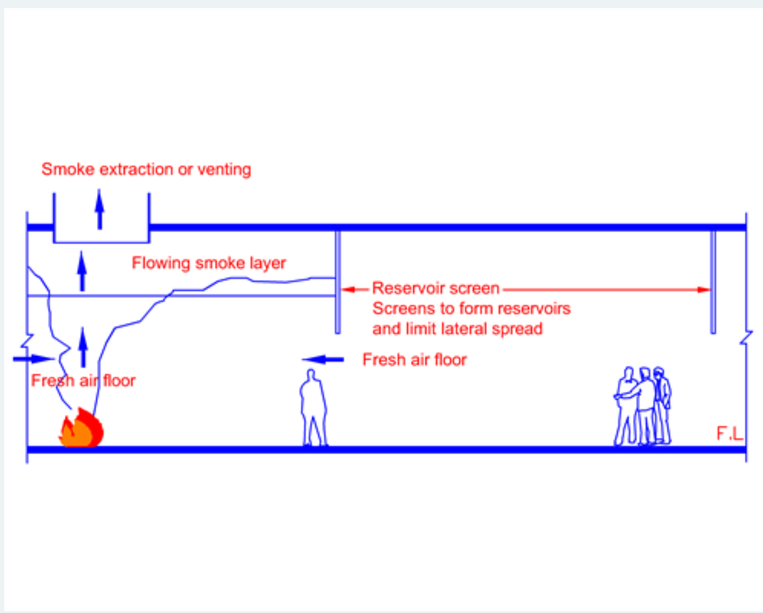
The clear height below smoke layer (Y) = 2.5m minimum.

The main purpose is to permit occupants to evacuate in a clear breathable layer. The maintenance of this clear layer will aid the firefighting operations. The lowest cceptable temperature of smoke layer to prevent loss of buoyancy is 20°C above ambient, i.e. 35°C (or 308K).

The highest temperature to prevent a radiation risk to people passing beneath the smoke layer should not exceed 200°C (or 473K). This temperature may appear high for areas such as means of escape, but it is considered acceptable.

(1) Smoke reservoirs to prevent the lateral spread of smoke, and to collect smoke for removal, shall be of non-combustible construction capable of withstanding smoke temperatures.

Explanation and Illustrations



Section

Figure 7.4.5f.(1)

Smoke reservoirs could be formed by using either the building's geometry or by using smoke curtains/shutters/non-combustible downstands, such as fire resisting boards, glazing. The screens, which extend downwards from the roof or ceiling to form the smoke reservoir, should preferable be smoke tight. They should be resistant to the effects of the fire. The main reasons for restricting lateral spread of smoke by providing smoke reservoir are:

a. to prevent damage or even ignition to combustible parts of ceiling lining or service components if hot smoke layers are allowed to spread uncontrolled over unlimited areas; and

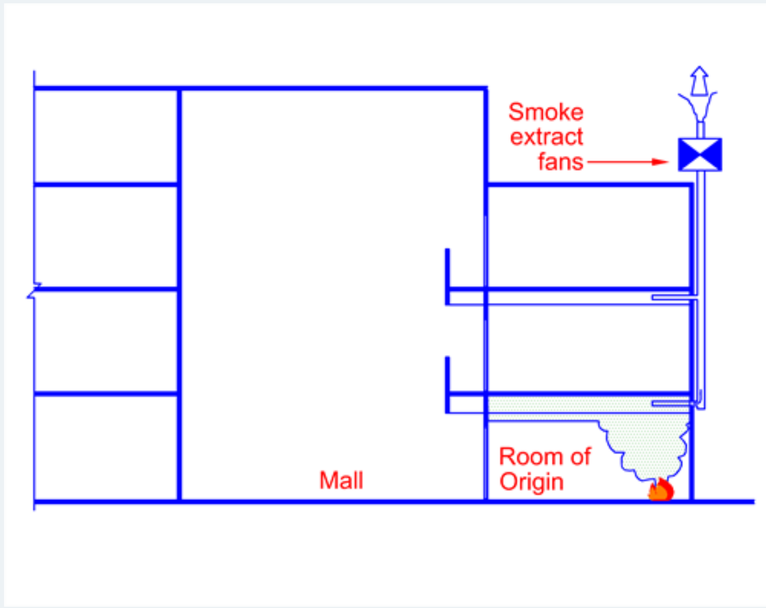
b. to prevent smoke layer (because of mixing with cold air in the course of lateral travel) become relatively cool and shallow. This will result in roof vents being unable to expel the smoke efficiently. Smoke vents would be most effective if the temperature of the smoke layer is high and that the layer beneath the vent is quite deep, thus developing a reasonable pressure differential to act to expel the smoke through the vent.

(2) For cases where smoke is removed from the room of origin, the smoke reservoir size for a smoke ventilation system shall not exceed:

(a) 2000m² for a natural smoke ventilation system; and

(b) 2600m² for a mechanical smoke ventilation system.

Explanation and Illustrations



Section

Figure 7.4.5f.(2)

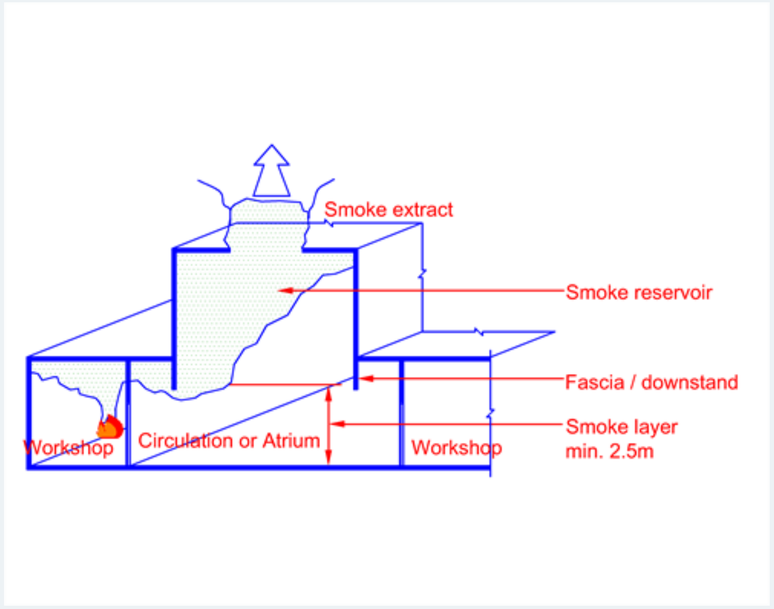
Room of origin includes atria, large shopping floor, rooms or spaces. Large reservoir will present a large surface area to the smoke layer, which can lead to considerable heat losses from it. Smoke control system is therefore designed with maximum specified smoke reservoir size to prevent excessive heat loss from the smoke layer, which leads to loss of its buoyancy for effective smoke venting or exhaust from the building.

(3) For cases where smoke is removed from a circulation space or atrium space, the smoke reservoir size for a smoke ventilation system shall not exceed:

(a) 1000m² for a natural smoke ventilation system; and

(b) 1300m² for a mechanical smoke ventilation system.

Explanation and Illustrations



Section

Figure 7.4.5f.(3) – 1 : Smoke extraction from atrium circulation space

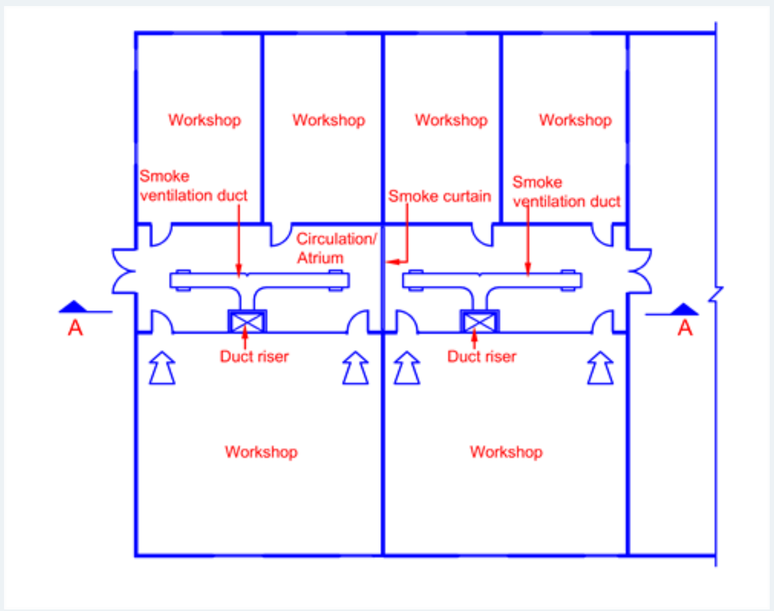
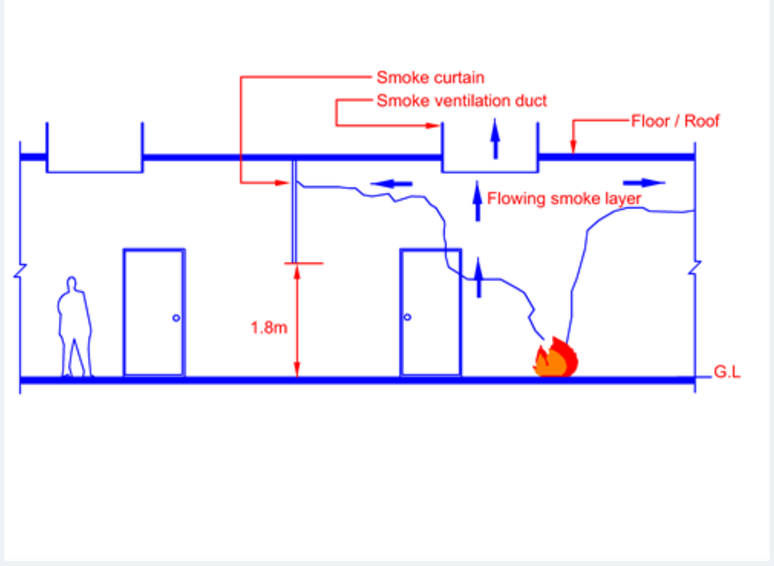


Figure 7.4.5f.(3) – 2



Elevation A

Figure 7.4.5f.(3) – 3

For cases where smoke is allowed to spill into the circulation or atrium space before extraction takes place, the smoke reservoir sizes are halved. Individual smoke reservoir can be created for circulation or atrium space, subject to 1300m² for mechanical ventilation or 1000m² for natural ventilation.

The smoke reservoirs could be formed by using either the building's geometry or by using smoke curtains/shutters/non-combustible downstands.

The depth of any screen used for subdivision shall be taken into account. Screens should terminate at a minimum of 500mm below the smoke layer base.

The main reasons for limiting the size of reservoirs are:

a. smoke from a fire leaves a workshop and enters the smoke reservoir in the circulation or atrium space, it will encounter turbulence and greater mixing occurs which produces more smoke; and

b. the movement of smoke from workshop into the circulation or atrium space would cause the smoke to lose heat to the surrounding structure through conduction and further loss occurring due to downward radiation. This movement would cause the smoke to lose some of its buoyancy.

For factory, the circulation or atrium space serves as a means of escape for people escaping from the workshop, before exiting to a safe area outside the building. The circulation or atrium space is therefore an additional stage to the escape route, which requires to be protected from the effects of fire and smoke.

For warehouse, which is primarily designed for storage, the smoke ventilation system provided would be for the purpose of heat and smoke release from the building. Warehouse should be treated differently from factory.

For warehouse, which is used for palletised storage, consideration should be given to the possible collapse of stacks or radiated heat spreading the fire to adjacent stacks. In tall warehouse, which is used for high rack storage, the smoke layer temperature may not go beyond 35°C and therefore, the smoke layer could well go below the level of the storage. Consideration should be given to the existence of ceiling jet occurring in the smoke layer.

(4) Reservoir length

The maximum length of the smoke reservoir shall not exceed 60m.

Explanation and Illustrations

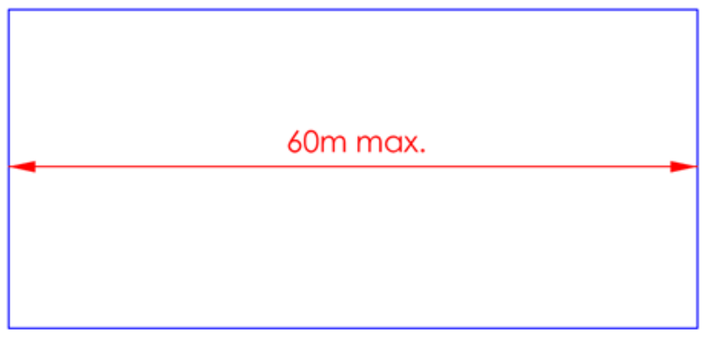


Figure 7.4.5f.(4) – 1 : Rectangle-shaped smoke reservoir

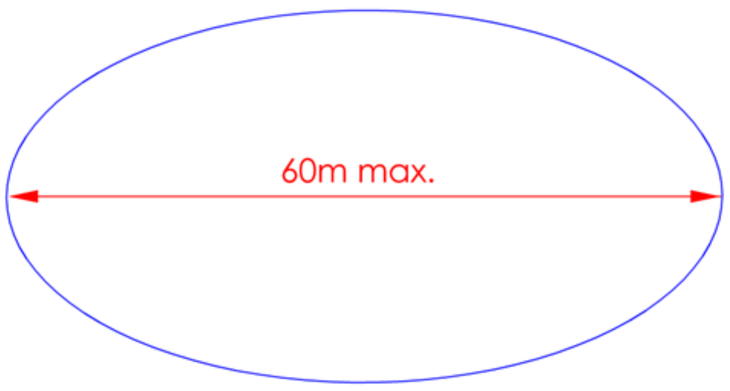


Figure 7.4.5f.(4) – 2 : Oval-shaped smoke reservoir

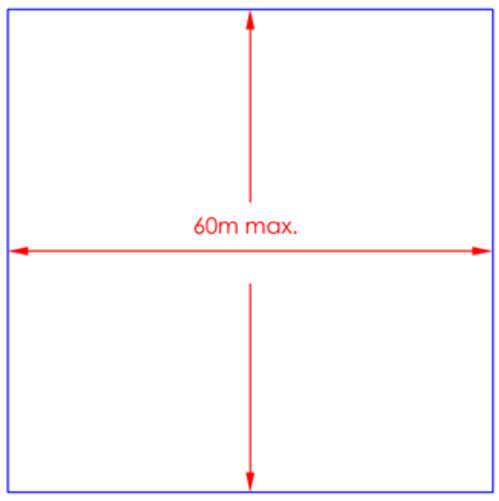


Figure 7.4.5f.(4) – 3 : Square-shaped smoke reservoir

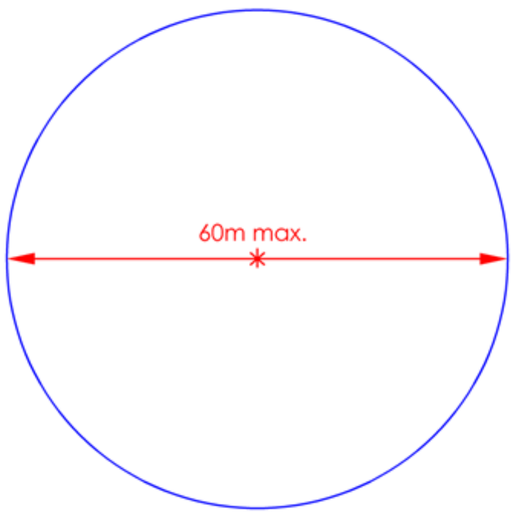


Figure 7.4.5f.(4) – 4 : Circle-shaped smoke reservoir

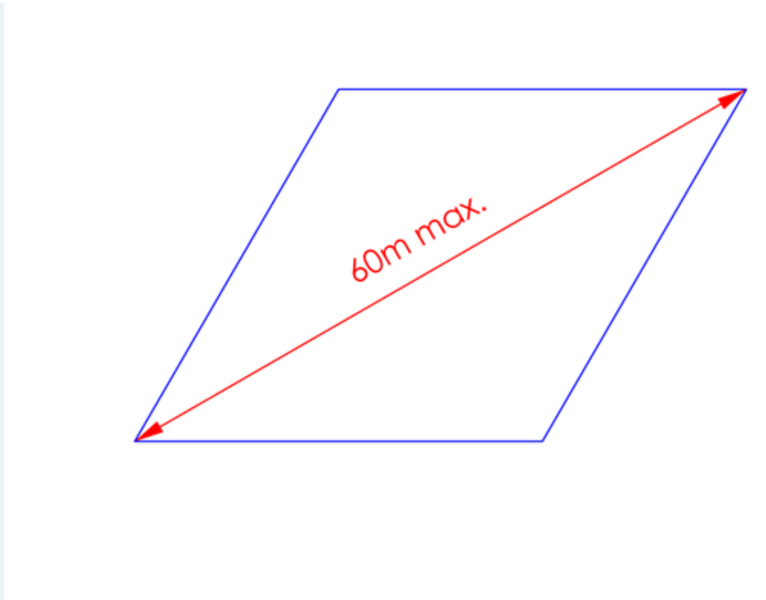


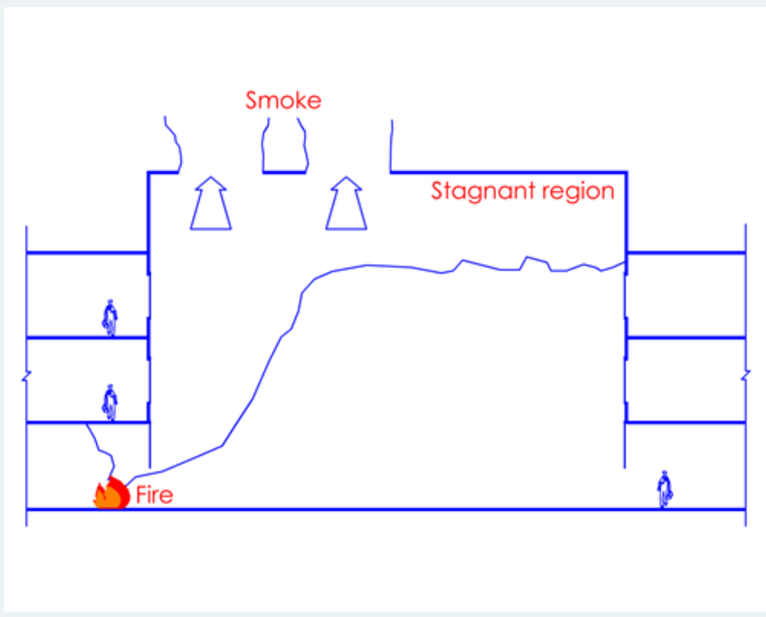
Figure 7.4.5f.(4) – 5 : Rhombus-shaped smoke reservoir

Smoke reservoirs can be formed of different shapes. In order to prevent smoke from excessive heat loss, the length of an individual smoke reservoir within a mall, factory or warehouse spaces shall not exceed 60m.

(5) Stagnant regions

Adequate arrangement(s) shall be made in each smoke reservoir for the removal of smoke in a way that will prevent the formation of stagnant regions.

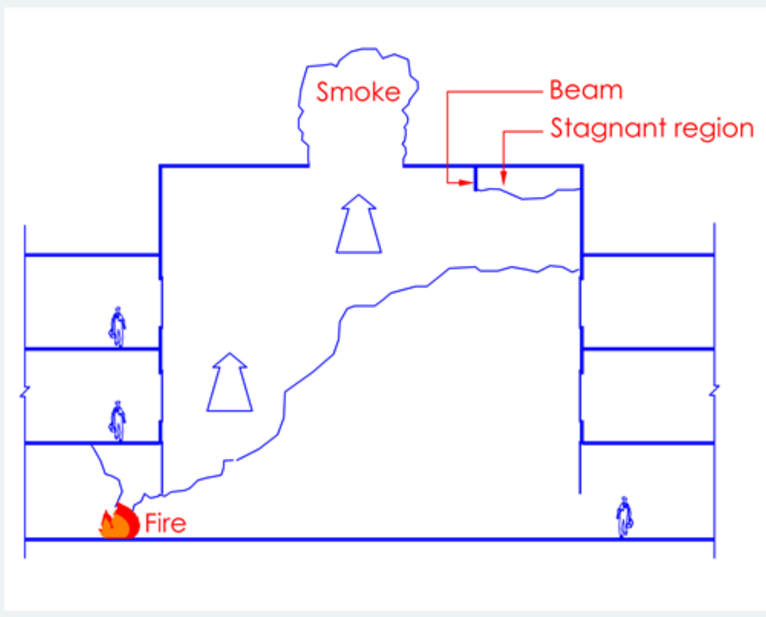
Explanation and Illustrations



Section

Figure 7.4.5f.(5) – 1

A stagnant region occurred in a long smoke reservoir when venting or extraction is not properly distributed or when circulation/atrium or mall has a closed end.



Section

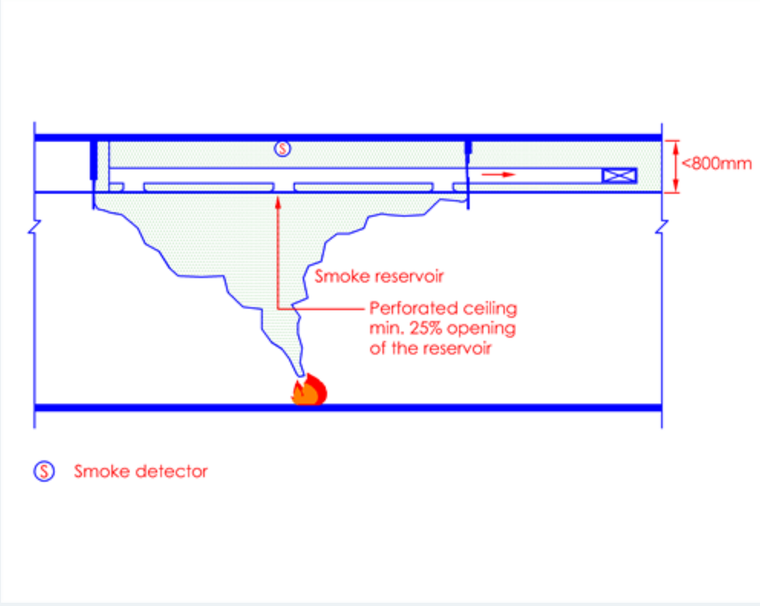
Figure 7.4.5f.(5) – 2

A stagnant region could also be formed by physical obstruction in the smoke reservoir e.g. Beam. If a smoke layer is stagnant, it will cool down and will mix into the air below. If the air space under a smoke layer is stagnant, it will tend to fill up with hazy smoke of sufficient density to affect visibility. Venting or extraction should be well distributed in the smoke layer or smoke reservoir. The air inlets at low level should also be well distributed so that the air, which is being drawn in will purge as much of the low-level clear air as possible.

(6) Perforated ceiling

For cases where the smoke reservoir is above the false ceiling, the ceiling shall be of perforated type with at least 25% opening.

Explanation and Illustrations



Section

Figure 7.4.5f.(6)

If the smoke reservoir incorporates a false ceiling, then the space above the false ceiling may be included in the depth of the smoke reservoir provided the screens forming the reservoir extend up to the structural ceiling, the perforations in the false ceiling are at least 25% of the total area of the reservoir, and the space occupied by services etc. above the ceiling is not greater than 50% of the volume above the ceiling.

g. Discharge of smoke

(1) Removal of smoke

For cases where smoke is removed from a circulation space or atrium space, the rooms discharging smoke into the circulation space/atrium spaces shall either:

(a) have a floor area of not exceeding 1000m² (for natural ventilation system) or 1300m² (for mechanical ventilation system), or

Explanation and Illustrations

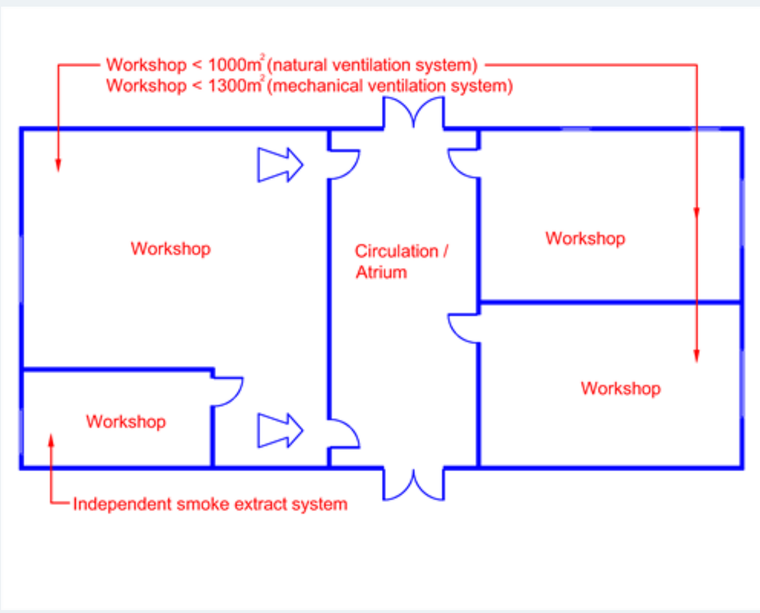


Figure 7.4.5g.(1) - 1

The main purpose of controlling the max. floor area is to limit the distance to the circulation or atrium space as smoke and hot gases would tend to cool and lose its buoyancy if floor area becomes larger.

Where the workshop units are not larger than 1000m² (natural ventilation in the circulation or atrium space) or 1300m² (with powered extraction in the circulation or atrium space), smoke from these units are allowed to discharge into the circulation or atrium space. If the units are larger than the sizes mentioned above, the smoke layer from a fire in any of these units would lose temperature to a great extent thereby losing its buoyancy as it would be controlled by sprinklers located within the units. In addition, the smoke layer would also lose some heat to the building structures. Thus, the venting of smoke layer into the circulation or atrium space becomes not effective, as cooling of smoke takes place leading to dispersal of smoke and smoke logging.

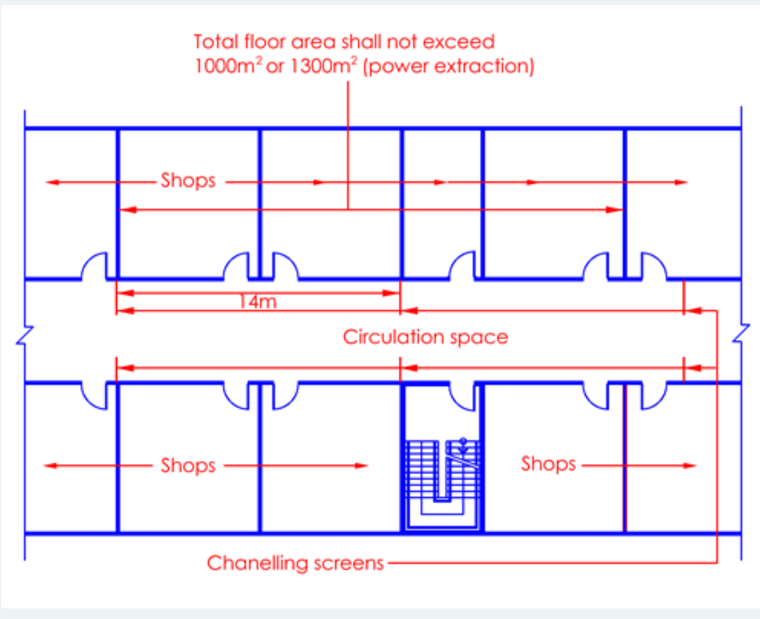


Figure 7.4.5g.(1) - 2

The combined floor area of multiple shops should not exceed 1000m^2 or 1300m^2 (power extraction) fronting circulation or atrium space. It is acceptable to use screen to channel the smoke from the shop into the circulation or atrium space, subject to maximum 14m separation between channel screens.

(b) be subdivided such that smoke is vented to the circulation space or atrium only from part of the room with floor area not exceeding 1000m² (for natural ventilation system) or 1300m² (for mechanical ventilation system), that is adjacent to the circulation space or atrium. However, the remainder of the room needs to be provided with an independent smoke ventilation system(s).

(2) Exhaust points

The minimum number and siting of exhaust points within a smoke reservoir shall be determined to prevent “plug-holing” effect at the exhaust points. The exhaust point shall comply with the following plugholing equation.

$$M_{CRIT} = \frac{2.05\ \rho_0\ (g\ T_0\ \theta_1)^{0.5}\ D^2\ W_V^{0.5}}{T_1}$$

where:

M_{CRIT} = critical exhaust rate at an exhaust point prior to the onset of 'plugholing' (kgs^{-1}),
ρ_0 = density of air at ambient temperature (kgm^{-3}),
g = acceleration due to gravity (ms^{-2}),
D = depth of smoke layer below the exhaust point (m),
T_0 = absolute ambient temperature (K),
θ_1 = excess temperature of smoke layer (°C),
T_1 = $T_0 + \theta_1$ (K)
W_v = characteristic width of the ventilator (m) (eg the diameter, or the diameter of the circle of the same area).

Explanation and Illustrations

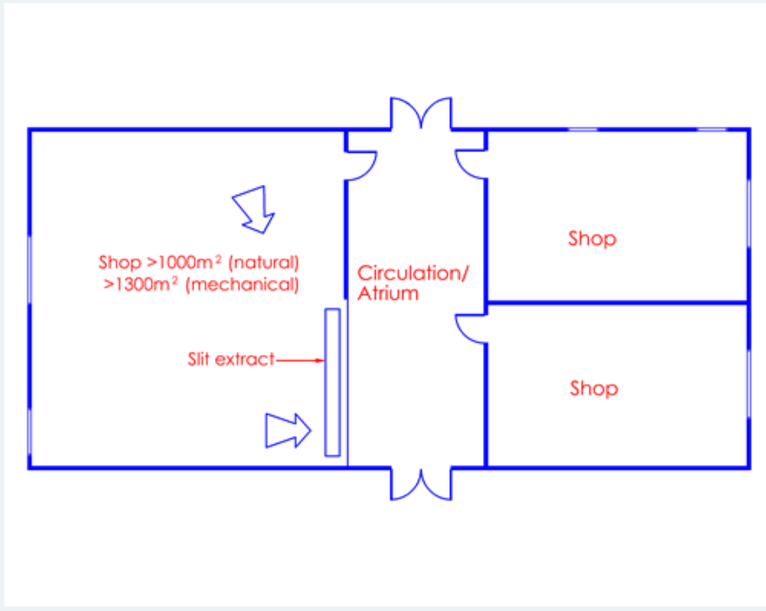


Figure 7.4.5g.(2)

Where a large workshop is extracted separately from the circulation/atrium space, it can have ceiling reservoirs up to twice the area permitted in the circulation/atrium space; 2000m² (natural ventilation system) or 2600m² (mechanical ventilation system) as no smoke is allowed to spill into the circulation/atrium space.

h. Limitations

Owing to practical limitations, a smoke ventilation system shall have:

(1) a maximum mass flow not exceeding 175kg/s; and

(2) a minimum smoke layer temperature of 18°C above ambient temperature.

Explanation and Illustrations

(No Illustration)

1. It has commonly been found that very large exhaust rates, typically larger than about 175 kg/s, become impractical as large and heavy fans or ventilators would be required. Large and heavy fans or ventilators required additional structural supports.

2. A minimum design temperature is required to maintain stability of the smoke layer. Smoke layers which have temperatures approaching that of the replacement air will have a tendency to mix with this air rather than to float above it.

The stipulated minimum design layer temperature is intended to be high enough to allow safe operation of the system for fires which are smaller than the full design size.

i. Replacement air

(1) Replacement air shall by natural means be drawn directly from the external space.

(2) The design replacement air discharge velocity shall not exceed 5m/s to prevent the escapees being hindered by the air flow.

(3) Replacement air intake shall be sited at least 5m away from any exhaust air discharge.

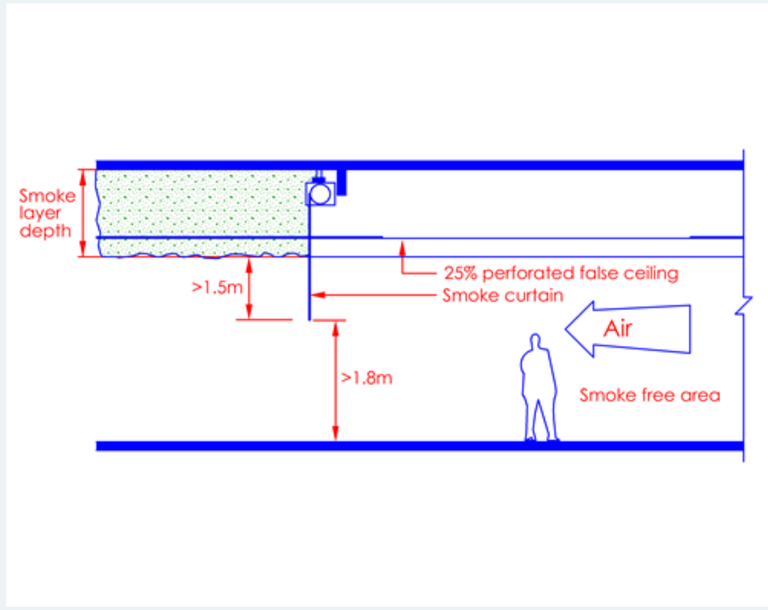
(4) Replacement air shall be discharged at a low level, at least 1.5m beneath the designed smoke layer, to prevent fogging up of the lower clear zone.

(5) Where the inlet cannot be sited at least 1.5m below the smoke layer, a smoke curtain or a barrier shall be used to prevent replacement air disrupting the smoke layer.

(6) Where replacement air is taken through inlet air ventilators or door- ways, devices shall be incorporated to automatically open such inlet ventilators and doors to admit replacement air upon activation of the smoke ventilation system.

(7) Where the roller shutters are used as replacement air inlets in the design and installation of an engineered smoke control system or smoke purging system, they shall be of perforated type, having the required effective free area for the effective operation of the engineered smoke control system. Non-perforated type of roller shutters with solid surface shall not be used.

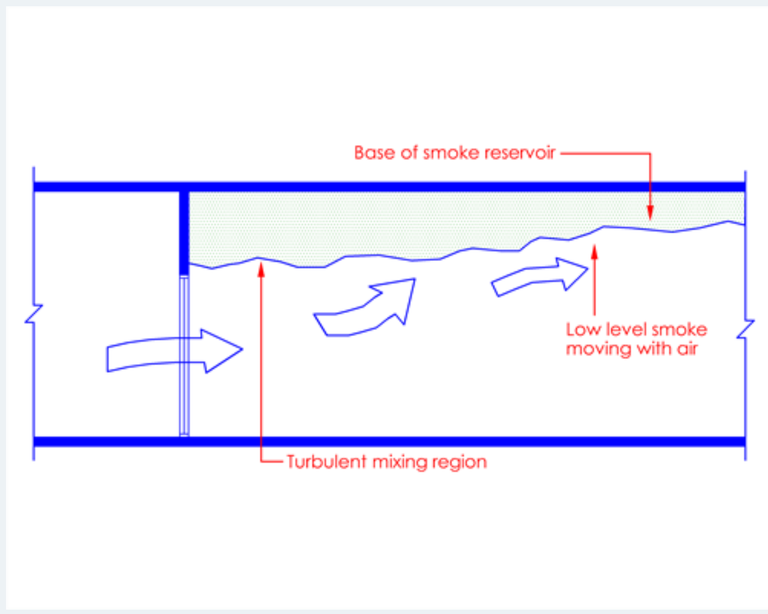
Explanation and Illustrations



Section

Figure 7.4.5i. – 1

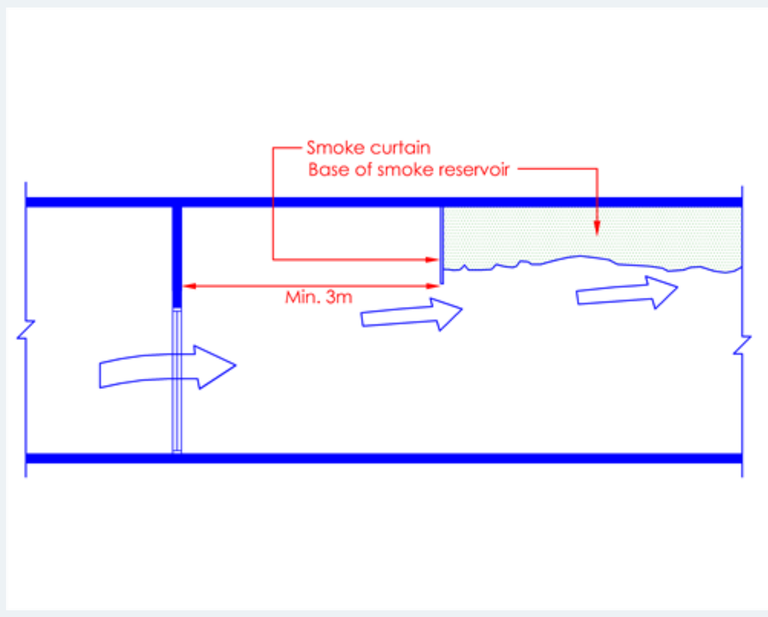
The use of fan-driven inlet air supply can give problems with mechanical extraction. This is because the warmed air taken out will have a greater volume than the inlet air. As the fire grows and declines, the mismatch in volume between the inlet air and the extracted fire warmed air will also change. This can result in significant pressure differences appearing across any doors on the escape routes. Hence, to avoid this "push-pull" effect, replacement air shall be drawn by natural means.



Section

Figure 7.4.5i. – 2

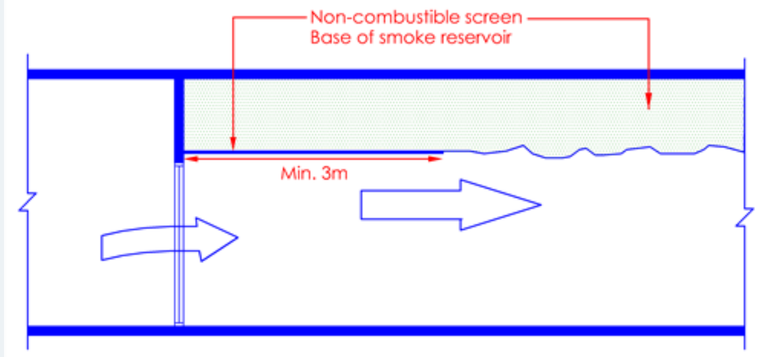
A moving airstream in contact with a region of stationary air (or smoke, or gas) will have a lower pressure than the stationary air – this is the Venturi effect. Hence, a moving airstream will attract the stationary air towards itself. The force of attraction increases with increasing velocity of the airstream. In Figure 7.4.5i – 2, the clean airstream flowing through the door attracts the smoke towards itself. The smoke reservoir base follows the surface of constant pressure, and bulges downwards near the door. Unless the reservoir base is high enough above the door (at least 1.5m), the smoke base will come just below the top of the door.



Section

Figure 7.4.5i. – 3

Where inlets (e.g. door) cannot be sited at least 1.5m below the base of smoke layer, either a smoke curtain or a horizontal shelf could be used to prevent inlet air distorting the smoke layer. *Figure 7.4.5i. – 3* shows a smoke-restraining curtain set back from the door. The curtain's bottom edge is higher than the door. The incoming air stream will increase in vertical section as it travels from the door to beneath the curtain, and so will slow down. There are fewer tendencies to pull down the smoke base. There is less turbulence at the smoke/air interface mixing smoke into the air stream and any such mixed smoke is at a higher level. The curtain shall be more than 3m away from the door.



Section

Figure 7.4.5i. - 4

Using a horizontal shelf instead of a smoke curtain, which permits the same air expansion and gives the same results. The shelf-edge should be more than 3m away from the door.

j. Emergency power supply

The engineered smoke ventilation system shall be provided with secondary source of power supply.

k. Mode of activation

(1) Automatic activation

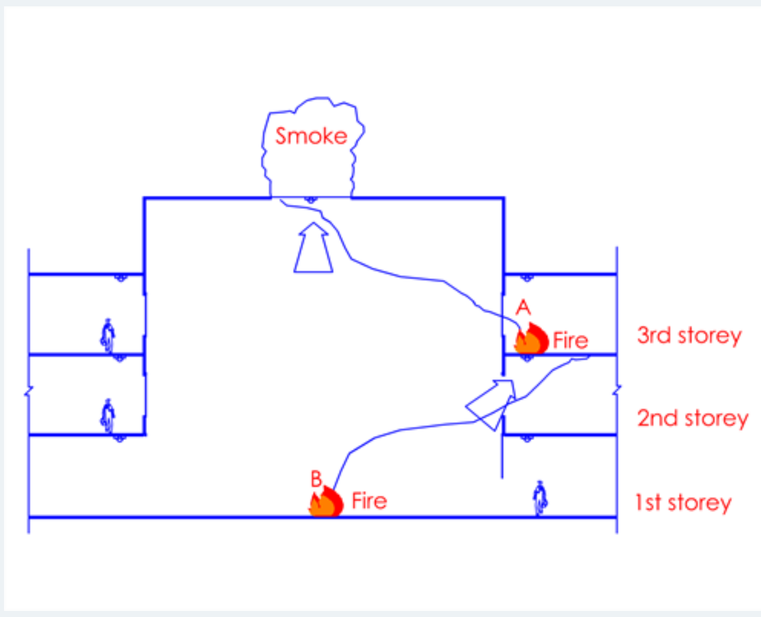
Explanation and Illustrations

(No Illustration)

All the associated systems/mechanisms, like the door venting actuators, are to be back-up by secondary power supply. This is necessary, as these devices are not incorporated with “standby” batteries that can operate the mechanisms to function as required in the emergency mode.

(a) The engineered smoke ventilation system shall be activated by smoke detectors located in the smoke control zone. Use of smoke detectors for activation shall be carefully designed, so that accidental or premature activation of smoke detectors in a non- fire zone (due to smoke spills or spread from other areas) are avoided.

Explanation and Illustrations



Section

Figure 7.4.5k.(1)(a)

Scenario A :

A fire occurring at 3rd storey failed to activate the smoke detector at that level owing to its poor location. Instead, smoke is allowed to spill into the atrium void and smoke control system for the building is activated. This would release all the smoke curtains overlooking the atrium void, including the fire floor, which is not correct. As a result, smoke and heat will be retained in the fire floor. The correct sequence of events should be that the smoke detectors at the fire floor should be activated first, thereby locking the smoke curtain, while releasing all smoke curtains in other parts of the building.

Scenario B :

A fire occurring at the atrium floor caused smoke to spill and activate the smoke detector in 2nd storey. The smoke curtain will remain locked but at other floors, the smoke curtains will descend down. As a result, part of 2nd storey will be smoke logged.

Smoke control system reacts to the first signal sent by the detector. To overcome the above problem, it is recommended that closer spacing of smoke detectors, closer than the permitted limit in *SS CP 10*, be adopted and that the detectors should be placed correctly in close proximity of the atrium void.

(b) Provision of activating smoke detectors shall comply with *SS 645*.

Explanation and Illustrations

(No Illustration)

The smoke ventilation system shall operate automatically upon detection of smoke by smoke detector placed strategically at the smoke control zone. The layout of smoke detectors shall comply with SS CP 10.

(2) Manual activation

A remote manual activation and control switches, as well as visual indication of the operation status of the smoke ventilation system, shall also be provided at the FCC. Where there is no FCC, it shall be indicated at the main fire alarm panel.

Rationale

The provision of remote manual activation and control switches located at Fire Command Centre or Fire Alarm Panel would permit better controlling of the smoke ventilation system.

In the event of the smoke detectors malfunctioning, the atrium smoke extract system can be activated by a manual switch, which performs the function of the smoke detectors in actuating the associated devices for the isolation and extraction of the smoke from the affected areas.

l. Interlocking with other ACMV systems

Except for ventilation systems in *Cl.5.2.1g.* and *Cl.5.2.1h.*, all other air-conditioning and mechanical ventilation systems within the areas served shall be shut down automatically upon activation of the smoke ventilation system.

m. Standby fans/ multiple fans

Explanation and Illustrations

(No Illustration)

Mechanical ventilation to the following room or space should not be affected:

a. exit staircases and exit passageways;

b. smoke-stop and fire lift lobbies;

c. areas of refuge within the same building;

d. basement car parks;

e. fire command centres;

f. flammable liquid/gas storage room;

g. emergency generator; and

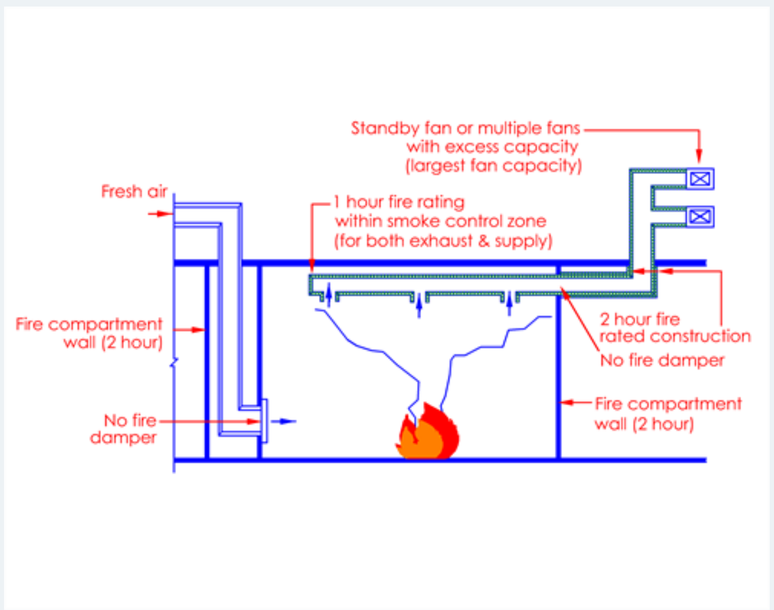
h. engine driven fire pump.

AHUs serving the affected smoke zone are to be shut down automatically upon activation of the smoke ventilation system, while the rest may continue to function.

(1) Either a standby fan or multiple fans with excess capacity shall be provided for each mechanical smoke ventilation system, such that in the event the duty fan or the largest capacity fan fails, the required smoke extraction rate will still be met. The standby fan shall be automatically activated in the event the duty fan fails.

(2) Fans shall be capable of operating at 250°C for 2 hours.

Explanation and Illustrations



Section

Figure 7.4.5m.(1)

(3) Protected circuits

The fans and associated smoke control equipment shall be wired in protected circuits designed to ensure continued operation in the event of fire.

Rationale

Since the smoke control system is installed to remove smoke and heat from the building to aid evacuation of occupants and firefighting operations, the system's circuits shall be protected to ensure operational reliability and sustained operation during fire emergency.

(4) Electrical supply

The electrical supply to the fans shall, in each case, be connected to a sub-main circuit exclusive thereto after the main isolator of the building. The cables shall be of at least 1-hr fire resistance rating in accordance with SS 299.

Rationale

The main purpose is to ensure that the electrical supply to the fans could be maintained continuously for at least 1 hour.

n. Smoke ventilation ducts

(1) Smoke ventilation ducts (both exhaust and replacement air ducts) shall be of at least 1-hr fire resistance rating. The rating shall apply to fire exposure from both the interior and exterior of the duct or structure and the duct shall also comply with *Cl.7.1.2h.*.

(2) Where a duct passes through another fire compartment with higher fire rating, the duct shall be constructed to have fire-rating as that of the compartment. Where a duct is installed in a single fire compartment and does not pass through another compartment, smoke control ducts (both exhaust and replacement air ducts) within that compartment need not comply with the 1-hr fire resistance rating requirement subject to the following conditions:

(a) the smoke ventilation ducts (both exhaust and replacement air ducts) are constructed of at least 1.2mm thick galvanised steel sheet;

(b) sprinklers, designed to *SS CP 52*, shall be provided above and below the entire length of the ducts (regardless of the duct dimensions) to protect the duct surfaces from the effect of water spray through the activated sprinklers; and

(c) the construction and support of the duct shall conform to the appropriate requirements of the duct construction standards contained in ASHRAE Handbook, IHVE Guild books or SMACNA Manuals.

o. Fire damper

(1) Fire dampers shall not be fitted in the smoke ventilation system, except where used in an engineered smoke control system. In such a situation, the fire-smoke dampers shall be constructed in accordance with *SS 333*.

(2) The damper shall be in closed position during fail-safe mode.

(3) The combination fire and smoke damper, and any duct extension between it and the protected vent shaft, shall be of the same rating as the element of structure.

(4) Sprinkler protection shall be provided to the electric actuator.

(5) The electrical power supply cables to the electric actuator shall be fire resistant.

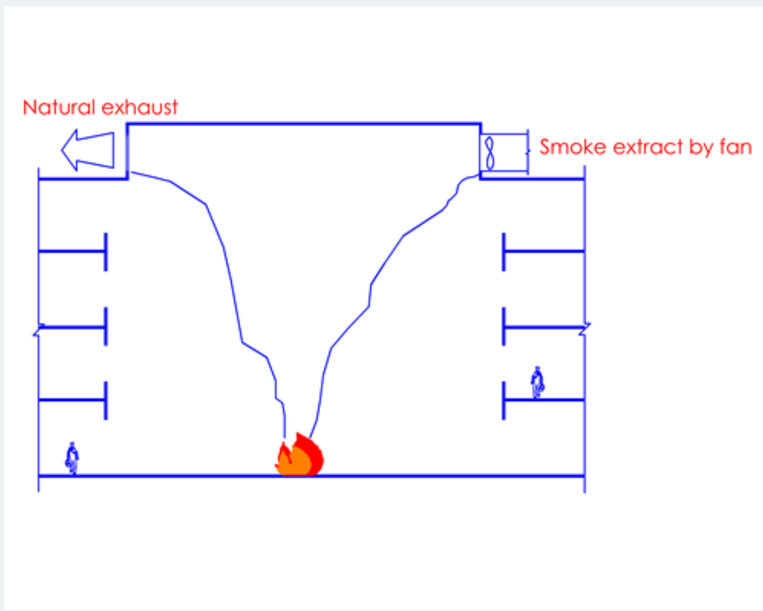
p. Time taken

The time for a smoke ventilation system within a smoke zone to be fully operational shall not exceed 60 secs from the time of activation.

q. Natural ventilation

Natural ventilation shall not be used together with mechanical ventilation.

Explanation and Illustrations



Section

Figure 7.4.5r.

The combination of natural exhaust ventilation and powered smoke exhaust ventilation in a building would create complications on the design of the distance between the bottom of the smoke reservoir and the floor and also the extent of the depth of the smoke reservoir.

r. Smoke curtain

All smoke curtains, where required, unless permanently fixed in-position, shall be brought into position automatically to provide adequate smoke-tightness and effective depth.

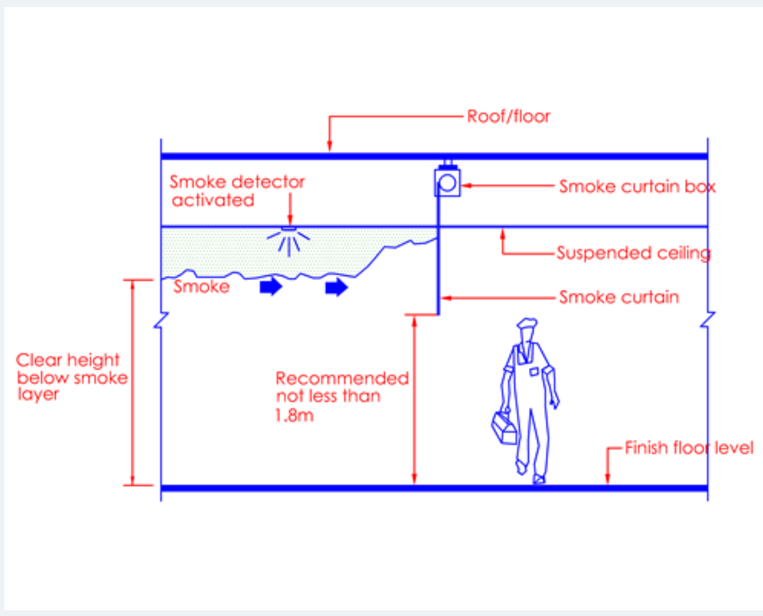
Rationale

The intent of the smoke curtain is to contain the smoke and to prevent spillage of smoke to other areas.

s. Obstruction to means of escape

A smoke curtain, or other smoke barrier, located at any access route forming part of or leading to a means of escape, shall not in its operational position obstruct said escape route.

Explanation and Illustrations



Section

Figure 7.4.5t.

Upon activation of smoke detector, the smoke curtain is automatically unfurled from its roller under gravity fall to impede smoke flow. The dropped curtains limit the area of smoke spread, maintain visibility and tenable conditions for escape purposes.

Smoke curtain in operation should not obstruct the escape routes. The clear height of smoke curtain across the escape routes should not be lower than 1.8m from its finished floor level.

t. Smoke or chanelling screens

Where glass walls or panels are being used as smoke screens to form a smoke reservoir or as channelling screens, they shall be able to withstand the design highest temperature.

Explanation and Illustrations

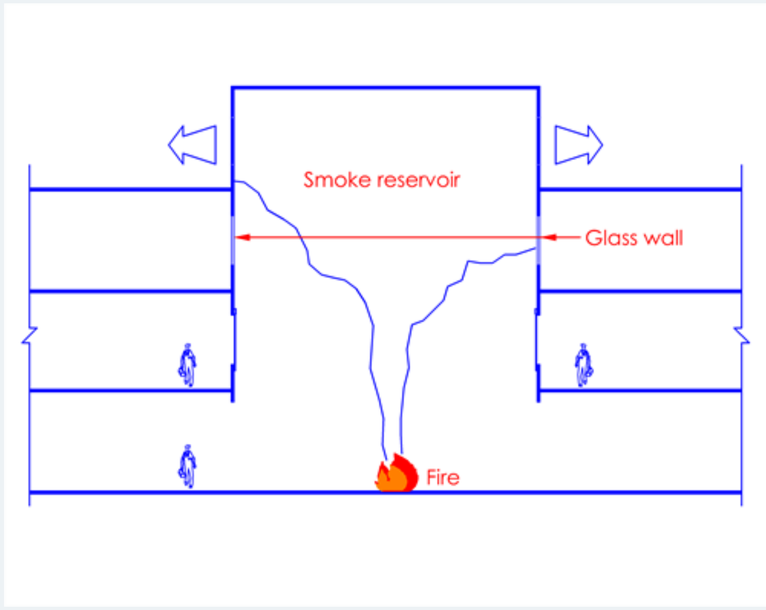
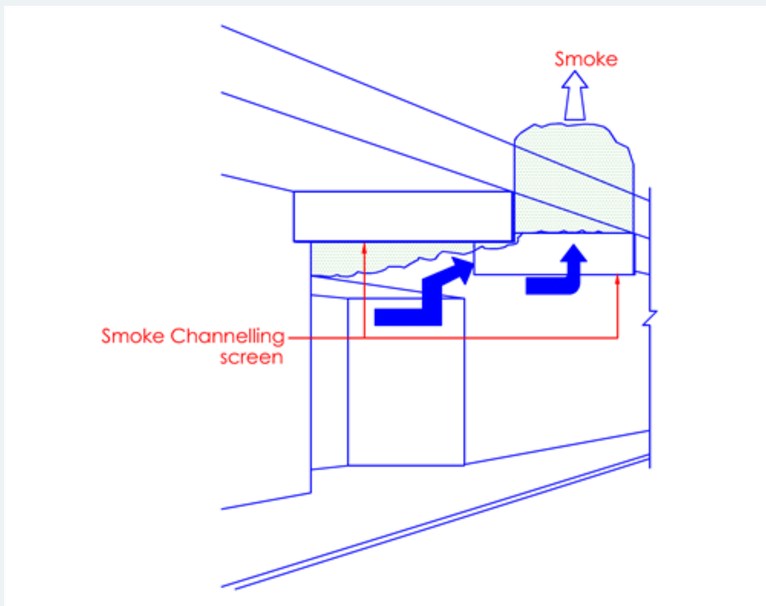


Figure 7.4.5u. - 1

Wired glass or tempered glass could be used as smoke screen to form smoke reservoir, provided they are able to meet the designed highest temperature. Glass walls or panels acting as smoke screen shall not be of sliding, louvers or openable type.



Section

Figure 7.4.5u. - 2

Smoke screens, which are to meet the designed highest temperature, could be used to form smoke reservoirs to limit lateral spread. Smoke channelling screens are used to channel smoke away from the origin of fire to smoke reservoirs where extraction can be carried out, or away from the building entrance canopies to the external open space as shown above.

It is recommended that the spacing between channelling screens should not be more than 14m so as to prevent lateral spread of smoke and excessive cooling.

u. Smoke control equipment

All smoke control equipment (including smoke curtains) shall be supplied and installed in accordance with *BS EN 12101-1, BS EN 12101-3* and *BS 7346 Part 7* or equivalent.

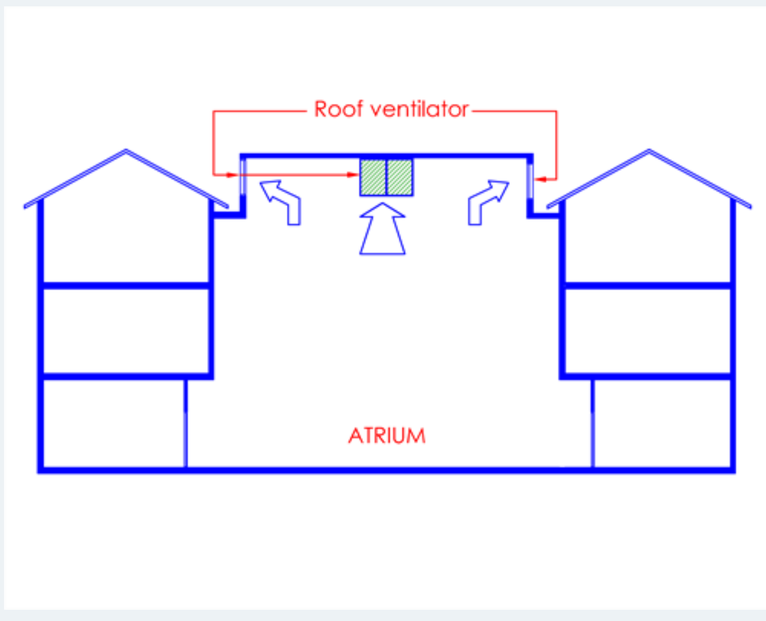
Explanation and Illustrations

(No Illustration)

Fixed screen shall be constructed of non-combustible materials capable of resisting the highest design temperatures. Automatic retractable smoke curtains are required to comply with BS 7346 and listed under Product Listing Scheme.

7.4.6 Fail-safe system

Explanation and Illustrations



Section

Figure 7.4.5q.

Wrong positioning of roof ventilators can cause the wind to be deflected into the atrium roof space, thereby pushing the smoke downward into the building. Roof adjacent to tall buildings could be subjected to positive pressure. It is for the designer to prove that his design will be satisfactory.

For natural smoke ventilation system, the natural ventilators shall be-

(1) in the “open” position in the event of power/system failure; and

(2) positioned such that they will not be adversely affected by positive wind pressure.

Note: Natural ventilators refer to any device e.g., entrance sliding doors or any other mechanised openings for fresh air replacement or smoke venting to external space.

CLAUSE 7.5 REDUNDANCY FOR MECHANICAL VENTILATION AND PRESSURISATION SYSTEMS

7.5.1 Provision

a. Powered system

A standby fan (N+1) shall be provided for each of the following systems, such that in the event one of the duty fans fails or taken out of service, the standby fan shall be automatically activated to meet the required ventilation rate.

(1) mechanical ventilation systems for:

(a) smoke-free/ fire lift lobbies;

(b) exit staircases; and

(c) essential rooms (e.g., sprinkler/ wet riser/ hydrant/ hose reel pump room, standby generator room, FCC, etc.).

(2) engineered smoke control systems;

(3) car park smoke purging systems*; and

(4) pressurisation systems for smoke-free/ fire lift lobbies, exit staircase and hotel internal guestroom corridor.

Note * redundancy (N+1) achieved by having at least 2 zones for ductless system in operation, in which N+1 fans for each zone is not required.

b. Non-powered system

Where automatic smoke ventilators are used as part of the smoke control system, there shall be at least 10% redundancy on the quantities of ventilators and shall be located such that they are not affected by the wind. The quantity of the redundant ventilators shall be round up to whole numbers, based on the largest size of the ventilators used.

Diagram 7.1.13c.(1) - 1 : Unprotected opening perpendicular to the kitchen exhaust duct

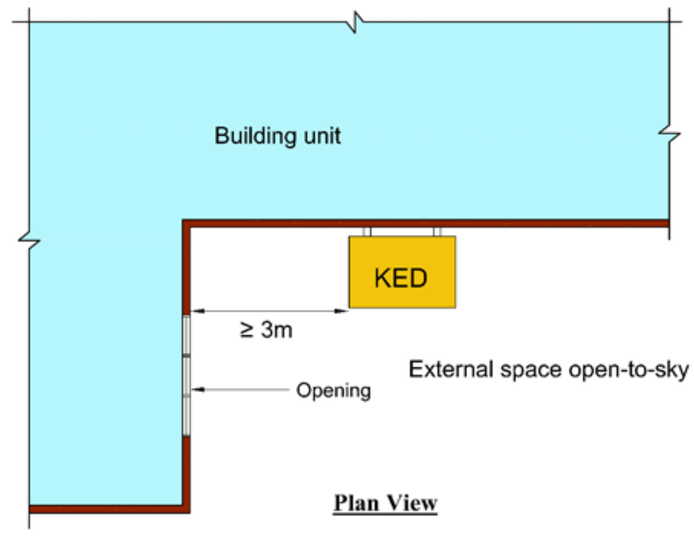


Diagram 7.1.13c.(1) – 1 : Unprotected opening perpendicular to the kitchen exhaust duct

Diagram 7.1.13c.(1) - 2 : Unprotected opening parallel to the kitchen exhaust duct

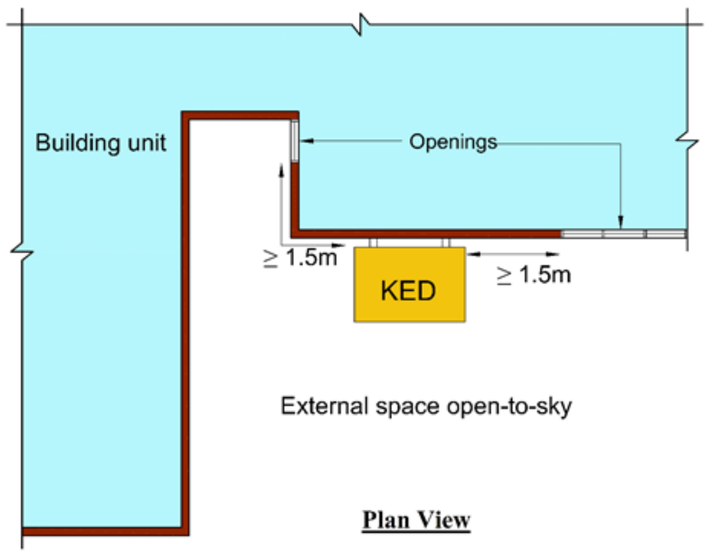


Diagram 7.1.13c.(1) – 2 : Unprotected opening parallel to the kitchen exhaust duct

Diagram 7.1.13c.(2) : Fire resistance construction for kitchen exhaust duct

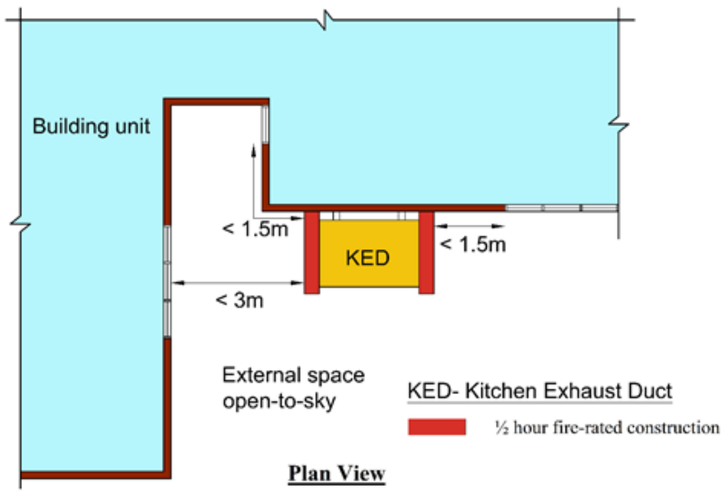


Diagram 7.1.13c.(2) : Fire resistance construction for kitchen exhaust duct

Diagram 7.1.13c.(3) : Installation of non-fire-rated kitchen exhaust duct above LPG cylinders

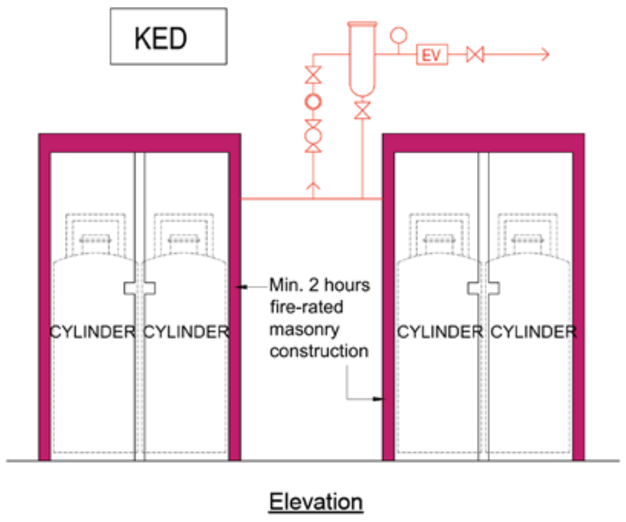


Diagram 7.1.13c.(3) : Installation of non-fire-rated kitchen exhaust duct above LPG cylinders

Diagram 7.1.13c.(4) : Installation of non-fire-rated kitchen exhaust duct in close proximity to LPG cylinders and vapouriser

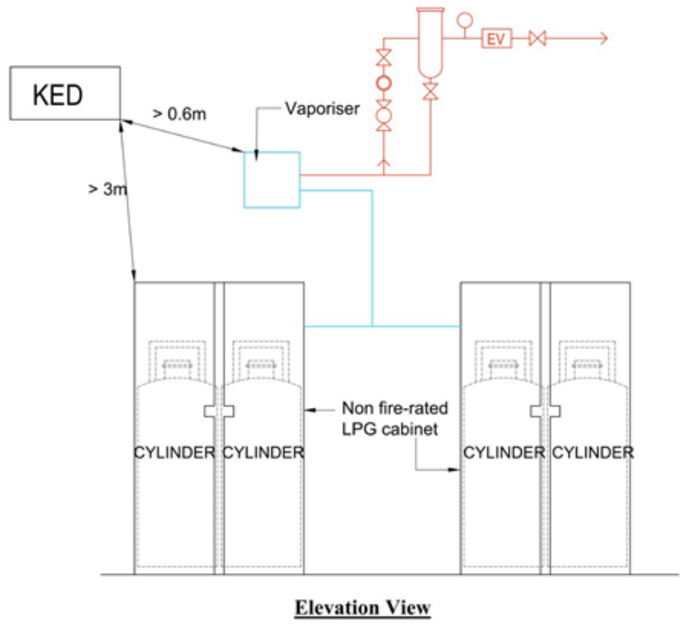


Diagram 7.1.13c.(4) : Installation of non-fire-rated kitchen exhaust duct in close proximity to LPG cylinders and vapouriser

Diagram 7.4.4e.(4) - 1 & 2 : Wiring arrangement of jet fan system

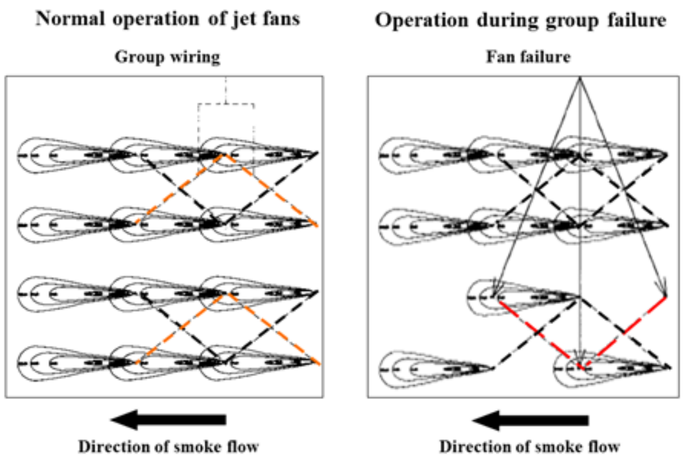


Diagram 7.4.4e.(4) - 1 : Wiring arrangment of jet fan system

Diagram 7.4.4e.(4) – 1 : Wiring arrangement of jet fan system

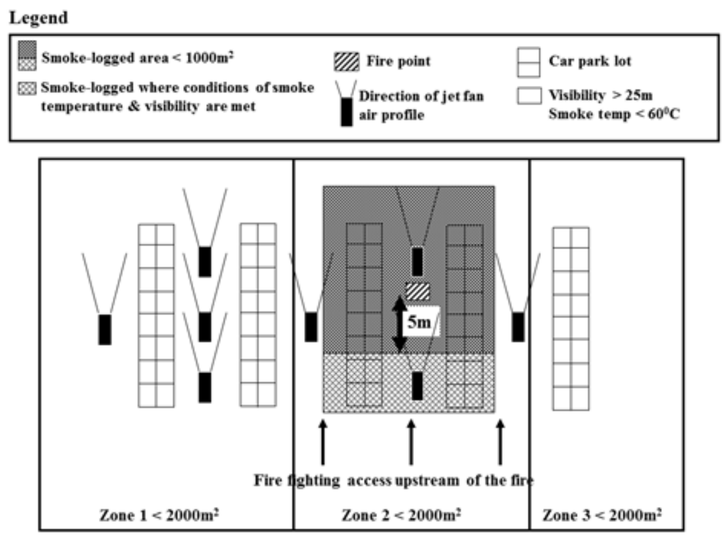


Diagram 7.4.4e.(4) – 2 : Wiring arrangement of jet fan system

Amendment History - Chapter 7 - Mechanical Ventilation & Smoke Control Systems

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
7.1.10	1 Dec 2020	1 Dec 2020	Clarification	Ventilation system for smoke-free lobby and fire lift lobby a. changes per hour. b. less than 5m from any exhaust discharge or openings for natural ventilation. c. which it serves shall either be enclosed or constructed to give a 1-hr fire resistance rating. The SCDF may, at its discretion, require a higher fire resistance rating if the duct passes through an area of high fire risk. d. building fire alarm system. In addition, a remote manual start-stop switch shall be made available to firefighters at the FCC, or, where there is no FCC, at the main fire alarm panel. e. shall be provided.	1 Dec 2020
7.1.11	2 Sep 2024	2 Sep 2024	Clarification	7.1.11 Ventilation system for engine-driven fire pump room and generator room Where mechanical ventilation is installed to provide a smoke-free environment for the room housing the engine-driven fire pump or emergency generator, such systems shall be independent of each other and of any other system serving other parts of the building, and shall comply with all the following requirements: a.	2 Sep 2024
7.1.13b.(2)(a) and (b)		01 Mar 2019	Revised, formerly Cl.7.1.7(b)(ii)		---
7.1.13c.	1 Mar 2023	1 Mar 2023	Revised/Clarifications	Kitchen exhaust duct (1) A kitchen exhaust duct running outside a building shall not be located within 3m of any unprotected openings. This separation distance can be reduced to 1.5m if the unprotected opening is on the same plane as the duct. (See Diagram 7.1.13c.(1) - 1 and 2) (2) Where the distances mentioned above cannot be achieved, a fire resistant construction having at least ½-hr fire resistance shall be placed between the duct and the unprotected opening. (See Diagram 7.1.13c.(2)) (3) A non-fire-rated kitchen exhaust duct shall not be located above an LPG storage cabinet, unless they are separated from LPG cylinders by a minimum of 2-hr fire-rated masonry construction above and beside the cylinders. (See Diagram 7.1.13c.(3)) (4) The kitchen exhaust duct shall be located at least 3m from any unprotected LPG cylinders. Non-fire-rated kitchen exhaust duct shall be located at least 600mm from the vapouriser or any liquid-phase LPG pipeline. (See Diagram 7.1.13c.(4))	1 Sep 2022
7.1.13c. and d.		1 Dec 2014	Extracted from SCDF's circular		29 May 2014
7.1.13d.	1 Mar 2023	1 Mar 2023	Revised/Clarifications	Maintenance All kitchen exhaust systems shall be properly maintained. The entire (interior and exterior) exhaust duct and kitchen hood shall be degreased and cleaned at least once every 12 months. The work shall be carried out by a specialist and the records of cleaning and degreasing shall be kept by the owner/operator for verification by the authority having jurisdiction. This requirement shall be included in the Fire Safety Instruction Manual.	1 Sep 2022
7.1.14b		01 Mar 2019	Revised, formerly Cl.7.1.8(a)		---
7.1.15		01 Mar 2019	New		---
7.1.2i	1 Sep 2021	1 Sep 2021	Clarification	7.1.2h.(5) Control panels serving engineered smoke control and smoke purging systems shall be clearly visible and located within a common location readily accessible for operation and maintenance, preferably within circulation space, with a mounting height of not less than 1.5m or more than 1.8m from the finished floor level. For smoke purging systems in car parks, the control panel shall be sited at least 1.5m away from any car park lot or other fire hazards. If a common accessible location is not possible, the control panels shall be protected with at least 1-hr fire resistance rating.	1 Sep 2021
7.1.7	1 Sep 2025	1 Sep 2025	Clarification/ Revised	7.1.7 Locations of intakes and return air openings a. ventilation systems, pressurisation systems of exit staircases and internal corridors, and smoke control systems shall be no less than 5m from any exhaust discharge openings. b. that sources of ignition, such as lighted matches and cigarette butts, which accidentally enter the openings and intakes cannot be deposited onto the filter media.	1 Sep 2025
7.2.1c		01 Mar 2019	Revised, formerly Cl.7.2.1(c)		---
7.3		01 Mar 2019	Revised, formerly Cl.7.3		---

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
7.4.1a.(3)	3 Mar 2025	Relaxation/ Revised	Relaxation/ Revised	7.4.1a. An engineered smoke control system as specified in Cl.7.4.5 shall be provided where: (1) ..... (2) ..... (3) the total aggregate floor area of all basement storeys exceeds 2000m², except in any of the following situations: (a) park shall comply with the requirements of Cl.7.4.3, provided it is compartmented from the rest of the basement. (b) compartmented from rest of the basement, two doors remotely located from each other for better reach in firefighting operations shall be provided. The provision of a single door opening for this room is permitted provided the most remote part of the room is less than 8m from the door, and the equipment found inside this room, does not obstruct the throw of a water jet from a firefighting hose.	3 Mar 2025
7.4.1a.(3)(a)	10 May 2019	Immediate	Clarification	Where the basement or a portion of the basement is used as a car park, the car park shall comply with the requirements of Cl.7.4.5, provided it is compartmented from the rest of the basement.	10 May 2019
7.4.4d.(15)	1 Mar 2021	1 Mar 2021	Reinstatement of past requirement	Nil	1 Mar 2021
7.4.4g.(1)	1 Mar 2021	1 Mar 2021	Reinstatement of past requirement	Exhaust fan design (1) The car park shall be provided with at least 12 air changes per hour during a fire. (2)	1 Mar 2021
7.4.4i	1 Mar 2021	1 Mar 2021	Reinstatement of past requirement	Nil	1 Mar 2021
7.4.4j	1 Mar 2021	1 Mar 2021	Reinstatement of past requirement	Nil	1 Mar 2021
7.4.5g	15 Sep 2020	15 Sep 2020	Clarification	Discharge of smoke For cases where smoke is removed from circulation space or atrium space, the rooms discharging smoke into the circulation space/atrium (1) 1300m² (for mechanical ventilation system), or (2) from part of the room with floor area not system) or 1300m² (for mechanical ventilation system), that is adjacent to the circulation space or atrium. However, the remainder of the room needs to be provided with an independent smoke ventilation system(s).	15 Sep 2020
7.4.5g. (dated 25 Aug 2023)	25 Aug 2023	25 Aug 2023	Revised/Clarification	7.4.5g. Discharge of smoke (1) For cases where smoke is removed from a circulation space or atrium space, the rooms discharging smoke into the circulation space/atrium spaces shall either: (a) have	25 Aug 2023
7.4.5i.	15 Sep 2020	15 Sep 2020	Clarification	Replacement air (7) design and installation of an engineered smoke control system, it shall be of perforated type having the required effective free area for the effective operation of the engineered smoke control system.	15 Sep 2020
7.4.5n		01 Mar 2019	Revised, formerly Cl.7.6.24. Extracted from SCDF's circular.		17 Apr 2015
7.4.5o.(2) to (5)		01 Mar 2019	New		---
7.4.5v	10 May 2019	9 Nov 2019	New requirement	All smoke control equipment (including smoke curtains) shall be supplied and installed in accordance with BS 7346 or equivalent.	10 May 2019
7.4.6	25 Aug 2023	25 Aug 2023	Revised/Clarification	7.4.5q. Fail-safe system For natural smoke ventilation system, the natural ventilators shall be- (1) in the “open” position in the event of power/ system failure; and (2) positioned such that they will not be adversely affected by positive wind pressure.	25 Aug 2023
7.5		01 Mar 2019	New		---
7.5.1	1 Dec 2020	1 Dec 2020	Clarification	The fan and its associated controller for the following systems shall be provided with redundancy such that the system performance is not affected when one of the fans and/or controllers is out of operation due to routine maintenance or breakdown: a. mechanical ventilation systems for: (1) smoke-free/fire lift lobbies; (2) exit staircases; and (3) essential rooms (e.g. sprinkler/wet riser/hydrant/hose reel pump room, standby generator room, FCC, etc.). b. engineered smoke control systems; c. car park smoke purging systems; and d. pressurisation systems for smoke-free/fire lift lobbies, exit staircase and hotel internal corridor.	1 Dec 2020
Table 7.4.5C.(1)	15 Sep 2020	15 Sep 2020	Clarification	Existing Table 7.4.5C.(1)	15 Sep 2020

CLAUSE 8.1 EXIT LIGHTING AND EXIT SIGN

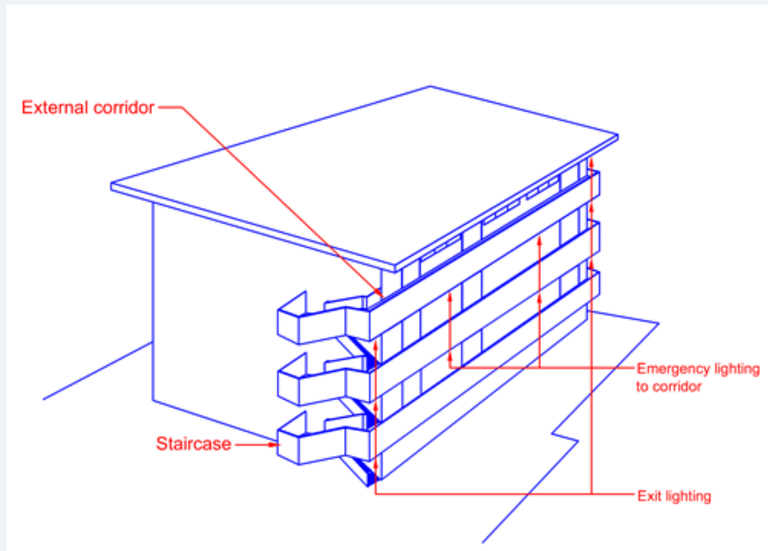
8.1.1 Exit lighting

Rationale

The exit lighting shall be positioned so that the failure of any single lighting unit will not leave any area in darkness. For essential areas such as exit staircases, internal and external passageways, there shall be no interruption of illumination exceeding 1 sec during the changeover from one energy source to another. This will ensure occupants can see their way down via exit staircase without fear of tripping.

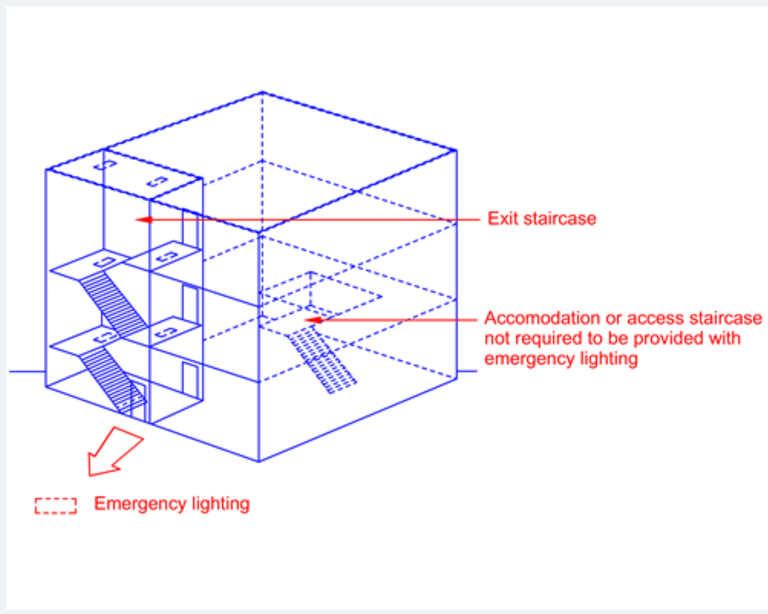
a. Exits of all buildings, except for PG I, shall be provided with artificial lighting facilities to the satisfaction of the requirements under this Code.

Explanation and Illustrations



Axonometric View

Figure 8.1.1a. – 1



Axonometric View

Figure 8.1.1a. – 2

1. When a fire occurs in a building, the degree of visibility in corridors, staircases and passageways plays a vital part in facilitating evacuation of occupants.

2. Street lighting should not be relied upon to provide the emergency lighting as they could malfunction or there could be district power failure during an emergency or they could be shaded by trees/building structures. All buildings shall be self-sufficient in the provision of artificial lighting without any reliance on other or external sources.

b. The minimum illuminance to be provided for all exits and the spacing for luminaires shall be in accordance with the requirements in *SS 563*.

c. The delay between the failure of the electrical supply to normal lighting and the energisation of the exit lighting shall not exceed 1 sec.

Explanation and Illustrations

(No illustration)

SS.563 requires that horizontal illuminance in the centre line of any escape route shall not be less than 0.5 lux, measured at the floor, for minimum duration of 1 hour.

The positioning of lighting shall be so arranged that the failure of any single lighting unit, such as the burning out of a bulb, will not leave any area in darkness.

Exit areas, such as exit staircases, internal and external exit passageways, are critical areas, there shall be no interruption of illumination exceeding 1 second during the changeover from one energy source to another. This would help ensure the occupants to see their way for example, down the exit staircases without fear of tripping. For ease of reference, the value of 1 foot candle is equivalent to 10 lux, measured at the floor.

8.1.2 Emergency lighting for corridors and lobbies

Explanation and Illustrations

(No illustration)

The requirements for provision of emergency lighting for corridors and lobbies in respect of:

a. min. level of luminance;

b. spacing of luminaires; and

c. delay (1 second) for the emergency lighting are similar to C.8.1.1.

Corridors and lobbies, including routes of escape, smoke-stop lobbies, common lobbies, are required to have min. 0.5 lux, measured at the floor, for minimum duration of 1 hour, notwithstanding that residents may be presumed to be familiar with exit facilities by reason of regular usage of such facilities.

The emergency lighting system shall be so arranged to provide the required illumination by means of standby generator set upon failure of public utility supply. The changeover from one energy source to another shall not incur a delay of more than 15 secs. This is considered a reasonable short time for the generating plant to start. However, where battery packs are used for emergency power, they must be the type that will automatically be kept charged and be able to perform for a minimum duration of 1 hour.

a. Emergency lighting shall be provided in all corridors and lobbies of all buildings except PG I.

b. The minimum level of illuminance, the spacing of luminaires and the maximum delay for emergency lighting required in this clause shall be the same as that for the exit lighting.

8.1.3 Emergency lighting for occupied areas

a. For all buildings except PG I or II, emergency lighting shall be provided in the occupied areas following the requirements below:

(1) along paths leading to corridors, lobbies and exits in all occupied areas where the direct distance from the entry point of the corridor, lobby or exit to the furthest point in the area concerned exceeds 13m; or

Explanation and Illustrations

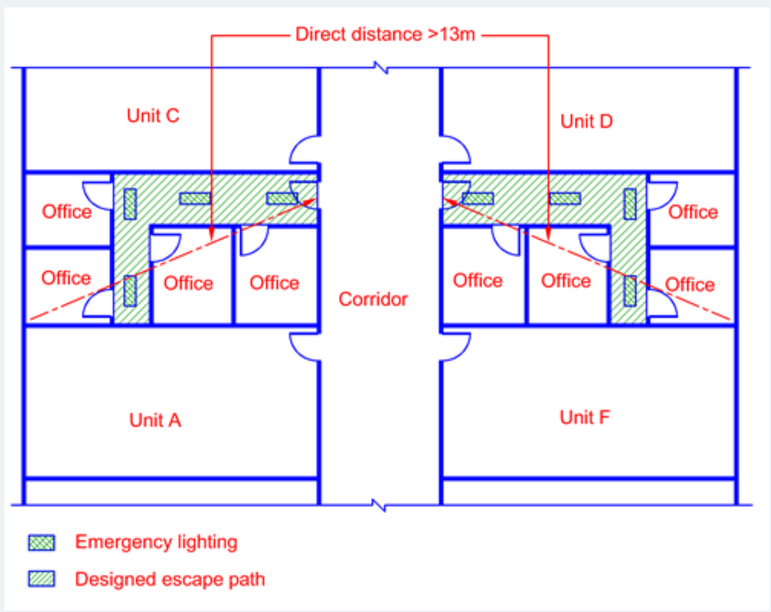


Figure 8.1.3a.(1)

Room having a direct distance > 13m and designed with defined escape path shall be provided with emergency lighting.

(2) over the whole of such area if there are no explicit paths leading to corridors, lobbies and exits.

Explanation and Illustrations

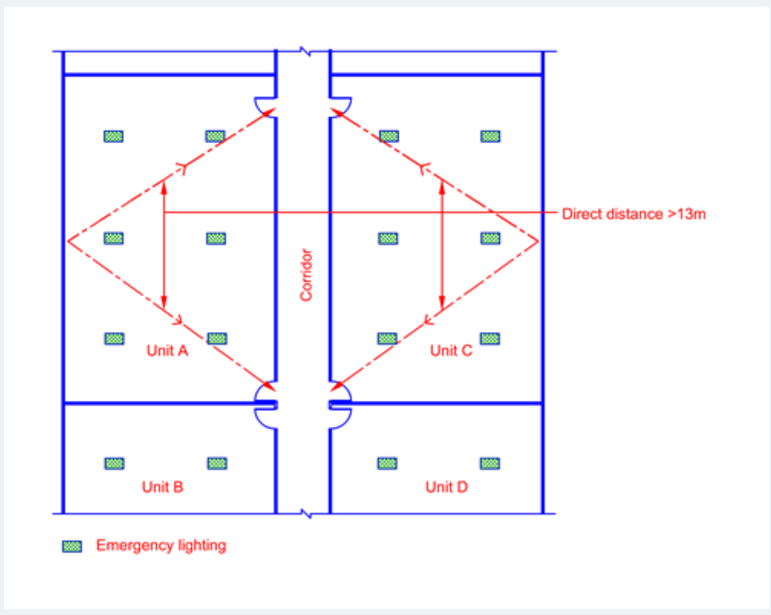


Figure 8.1.3a.(2)

Room having a direct distance > 13m and not provided with defined escape path or where escape path is not defined, emergency lighting shall be provided to cover the whole floor space. The level of illuminance shall comply with SS 563.

b. The provision of emergency lighting is exempted for:

(1) open-to-sky roof terrace/ garden; and

(2) open-sided single storey building with openings that constitute at least 80% of the perimeter wall area (measured along the roof eaves) and complying with any of the following.

(a) AFA not exceeding 200m^2, or

(b) For PG III field training usages without any storage and with AFA not exceeding 300m^2.

c. Notwithstanding the requirements in *Cl.8.1.3a.* above, emergency lighting shall be provided in the following locations:

(1) Lift cars as stipulated in this Code;

(2) Fire Command Centres;

(3) Generator rooms;

(4) Basement and aboveground multi-storey car parks;

(5) Fire pump rooms; and

(6) Areas of refuge within the same building.

d. The minimum level of illuminance shall comply with the requirements in *SS 563*.

e. The delay between the failure of the electrical supply to normal lighting and the energisation of the emergency lighting for occupied areas shall not exceed 15 secs.

Rationale

The emergency lighting enable the occupants/maintenance personnel in the mentioned locations to evacuate safely in times of power failure. In addition, the emergency lighting will help firefighters to gain access into any of these rooms or spaces for firefighting or operations purposes.

Explanation and Illustrations

(No illustration)

Emergency lighting is required to be provided to lift car, generator rooms & fire pump rooms to enable maintenance personnel to evacuate safely in times of emergency. The emergency lighting would help firefighters if there is a need to gain access into any of these rooms or spaces.

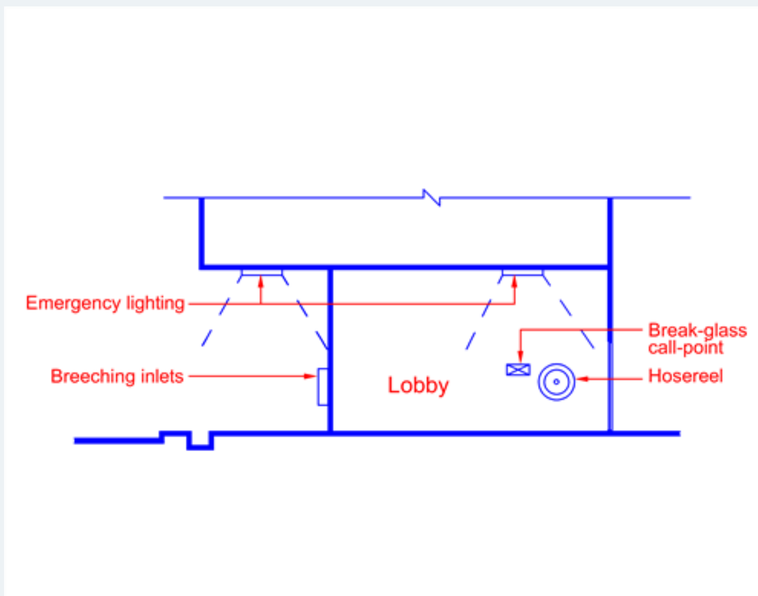
Basement car parks are also required to be provided with emergency lighting regardless of the floor area. It would help to lead public to the nearest exit escape routes. Car lighting cannot be taken and relied upon as emergency lighting.

8.1.4 Emergency lighting for firefighting facilities

Rationale

The purpose of illuminating these locations is to facilitate the occupants and/or firefighters to readily locate fire protection devices and firefighting equipment when normal power supply is interrupted during a fire emergency.

Explanation and Illustrations



Section

Figure 8.1.4 : Emergency lighting to breeching inlets/alarm call point

The emergency lighting system shall be so arranged as to provide the required illumination automatically at places where firefighting facilities are provided e.g. breeching inlets, fire alarm panels, fire alarm call points etc..

This is to facilitate the occupants and firefighters to locate the firefighting facilities. The emergency illumination shall not incur a delay of more than 15 secs during the changeover from normal supply to secondary source via generator supply.

a. Fire alarm panels, fire alarm call points and firefighting equipment shall be adequately illuminated at all times so that they can be readily located.

b. The minimum level of illuminance shall comply with the requirements in *SS 563*.

c. The delay between the failure of the electrical supply to normal lighting and the energisation of the emergency lighting for firefighting facilities shall not exceed 15 secs.

8.1.5 Secondary source of power supply

Explanation and Illustrations

(No illustration)

1. Where maintenance of illumination depends upon changing from normal power supply to secondary source via generator sets, there should be minimal delay during the switch over, which should not exceed 15 secs.

2. The emergency lighting system shall be capable of maintaining a supply of at least 1 hour, long enough for evacuation of occupants and to serve the initial stage of firefighting.

3. Generally, the time for changeover should not exceed 15 secs for emergency lighting to be provided at occupied areas and at places where immediate visibility is not essential. As for critical areas such as exit points and along defined exit routes, the minimum level of lighting must be available at all times so that occupants would not panic when making their escape.

a. The delay for energisation of the exit and emergency lighting systems between normal supply and the secondary source shall be as stipulated in the relevant clauses.

b. Duration of the secondary source of power supply shall comply with the requirements in *SS 563*.

c. Location, arrangement and control, installation of electrical wiring of the secondary source of supply, be it in the form of battery, standby generator, inverter or other accepted equipment, shall comply with the requirements in *SS 563*.

8.1.6 Luminaire

All exit and emergency luminaires required by this Code shall be of approved type as specified in *SS 563*.

8.1.7 Exit and exit directional signs

a. Exit sign

(1) The entrance to every exit on every floor shall be clearly indicated by an exit sign placed over the exit door. Such signs shall be placed so as to be clearly visible at all times.

Explanation and Illustrations

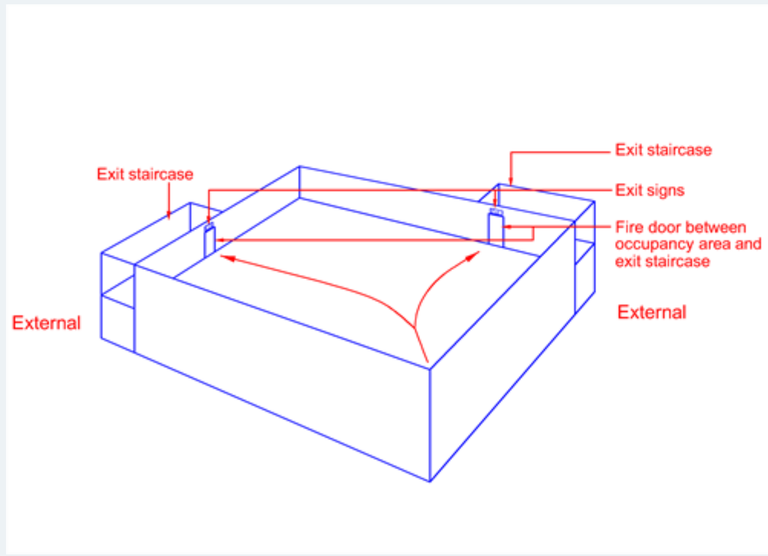


Figure 8.1.7a.(1) : Exit signs to exit on every floor

Decorations, furnishings or equipment, which impair visibility of an exit sign shall not be allowed; nor shall there be any brightly illuminated sign (for other than exit purposes), display or object in or near the line of vision to the required exit sign.

(2) Exit sign shall be provided over all the exit access doors for rooms with more than one door. (See *Diagram 8.1.7a.(2)*)

(3) Exit sign shall be provided over final discharge door within exit enclosure such as exit staircase and internal exit passageway having other exit/ exit access door opening into the exit enclosure at the discharge floor (see *Diagram 8.1.7a.(3)*).

(4) Exemption

Exit sign is not required under the following situations:

(a) PG I and II buildings

(b) Room provided with emergency lighting

When a room is provided with only one door (see *Diagram 8.1.7a.(4)(b).*)

(c) Room without emergency lighting

(i) When a room is provided with only one door and the direct distance from the furthest distance in the room to the exit access door is 7m or less (see *Diagram 8.1.7a.(4)(c)(i) – 1 & 2*); or

(ii) When the furthest point in the room to the exit access door is 13m or less and wall of the room comprises not less than 50% clear glazing facing (see *Diagram 8.1.7a.(4)(c)(ii)*):

- an internal corridor covered by emergency lighting,
- an external corridor, or
- the external of the building.

(d) Open-sided single storey building with openings that constitute at least 80% of the perimeter wall area (measured along the roof eaves) and complying with any of the following:

(i) AFA not exceeding 200m^2, or

(ii) For PG III field training usages without any storage and with AFA not exceeding 300m^2.

(e) When a room or internal space is fully open towards an external corridor or the external of a building.

(f) Exit enclosure such as exit staircase and internal exit passageway not provided with final discharge door (see *Diagram 8.1.7a.(4)(f)*).

b. Directional signs

(1) In long corridors, in open floor areas, and in all situations where the location of the exits may not be readily visible, directional signs shall be provided to serve as guides from all portions of the corridors or floors. (See *Diagram 8.1.7b.(1)*)

(2) In rooms where the line of sight to the exit access door is obstructed, directional sign shall be provided.

(3) Exemption

Directional sign is not required under the following situations:

(a) PG I and II buildings.

(b) Open-to-sky roof terrace/ garden.

(c) Open-sided single storey building with openings that constitute at least 80% of the perimeter wall area (measured along the roof eaves) and complying with any of the following:

(i) AFA not exceeding 200m^2, or

(ii) For PG III field training usages without any storage and with AFA not exceeding 300m^2.

Explanation and Illustrations

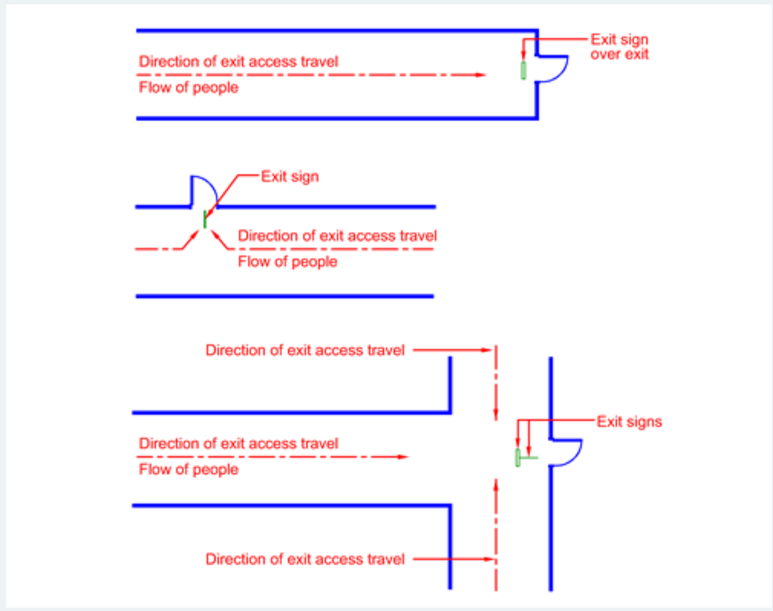


Figure 8.1.7b.(1) - 1

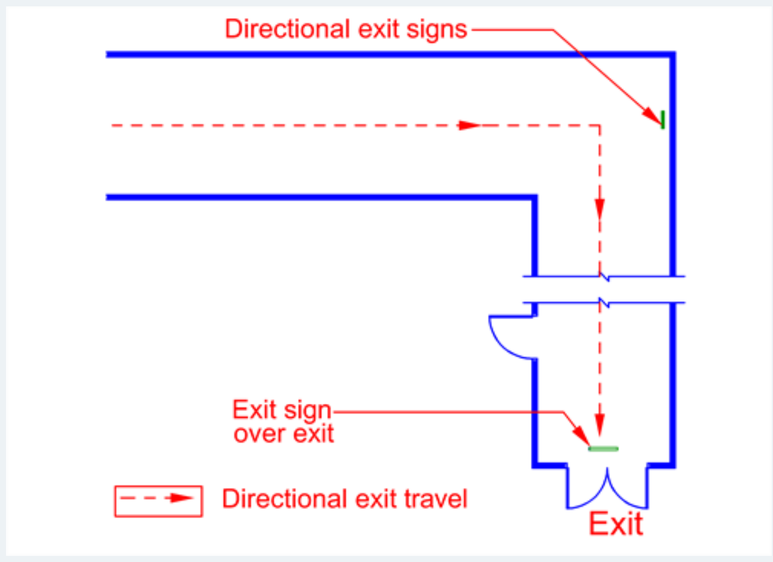


Figure 8.1.7b.(1) - 2

The above show a few variations of the placing of exit / directional signs. Access to exits shall be marked by readily visible signs in all cases where the exit or way to reach it is not immediately visible to the occupants. Sign placement shall be such that no point along the exit route is more than 30m from the nearest visible sign.

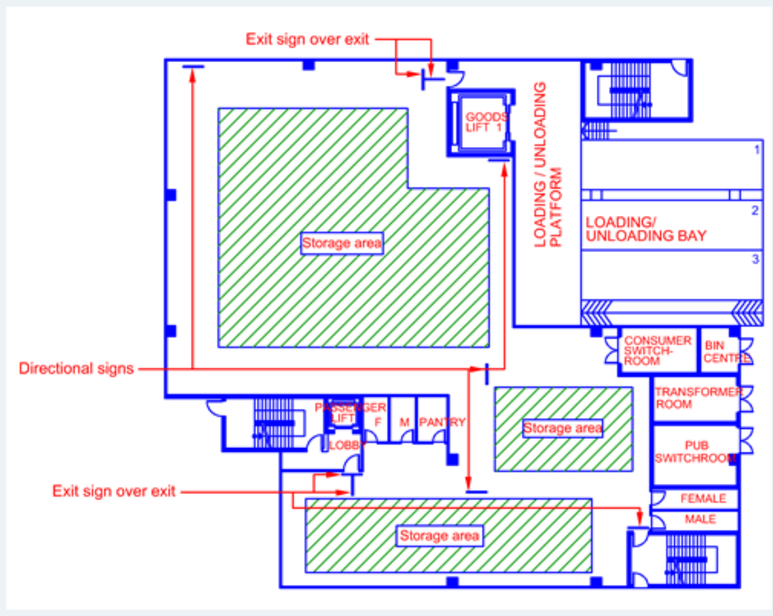


Figure 8.1.7b.(1) - 3

In factory/warehouse premises, with high storage rack areas ,the vision to exits and directional exit signs may be blocked, hence the signs are shifted or additional signs should be provided to help occupants to evacuate in times of emergency.

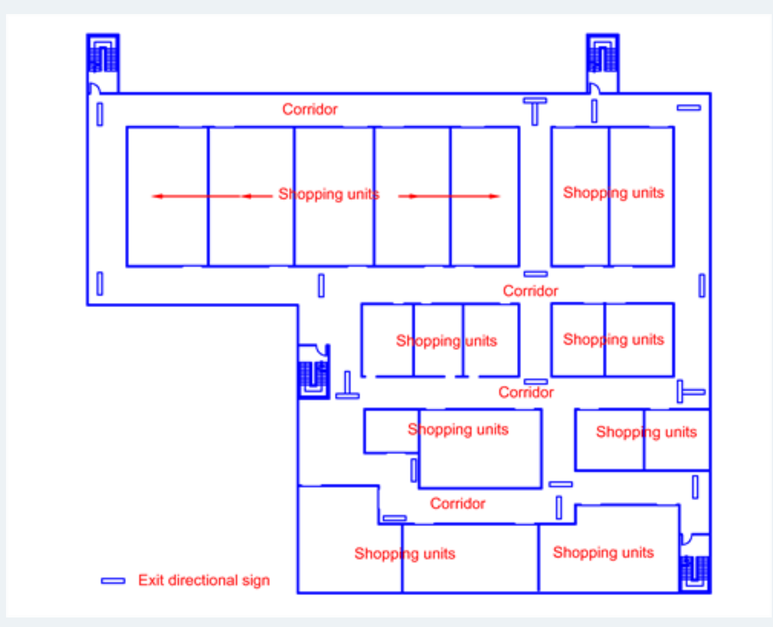


Figure 8.1.7b.(1) - 4

In shopping centre/institutional occupancy areas, exit directional signs are to be placed at strategic locations so that members of public/shoppers could rely on the signs to evacuate in times of emergency.

c. Low level signs

Additional low level or floor-mounted exit and exit directional signs shall be provided in hotel accommodation floors including boarding houses.

Rationale

Low level or floor-mounted signs are not intended to replace standard exit signs but are designed to aid building occupants to get to the exits should smoke obscure the exits and exit directional signs mounted at above door height.

Explanation and Illustrations

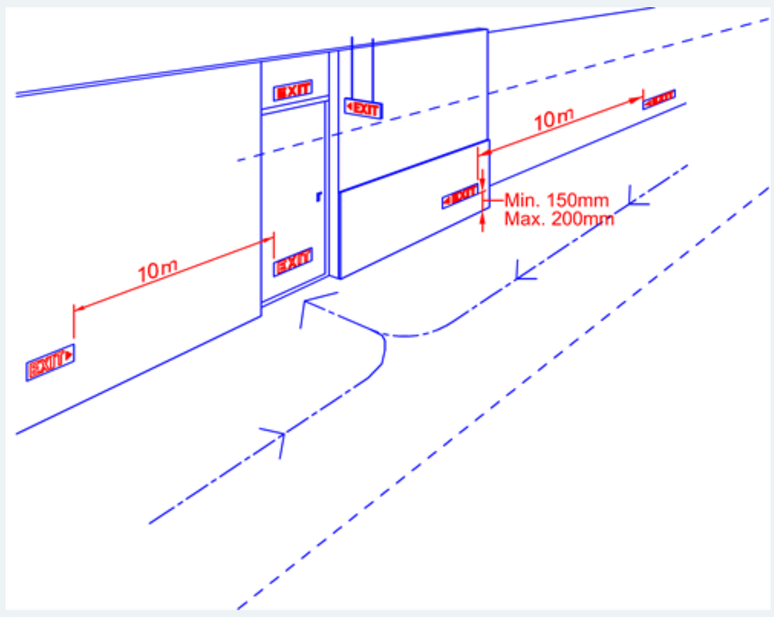


Figure 8.1.7c. : Low level signs

This requirement is mandatory for hotel usage, although it is not applicable to public resort occupancies, it would be a good practice to have it.

1. Such signs strategically located in the common corridor would help the occupants to find their way to the floor exits should smoke obscure the exits & exit directional signs normally mounted at above door height.

2. Low-level or floor mounted signs are not intended to replace standard exit signs but are designed to aid building occupants to get to the exit in a smoke-filled environment.

3.The bottom of the low-level sign shall be not less than 150mm or more than 200mm above the floor level. It shall be placed at not more than 10m interval. For exit doors, the sign shall be on the door or adjacent to the door with the closest edge of the sign within 100mm of the door frame.

d. Signs within exit staircase

(1) Where the SCDF has allowed under *Cl.2.3.5d.* for upper storey staircase to be continuous with that serving the basement, appropriate signage, including pictorials, shall be placed at strategic location inside the staircase to direct occupants out of the building in times of emergency.

(2) Where the direction of travel to exit discharge is upward, the staircase signage required under *Cl.2.3.1b.* shall comply with *SS 508*.

Rationale

The purpose of providing signage within exit staircases is to prevent occupants from travelling beyond the discharge level into the basement. The signage helps to inform occupants in the exit staircase enclosure on the level of exit discharge to the safe external space.

e. Electrically-powered exit and/ or directional signs

(1) The legends, dimensions, design and/ or installation of electrically-powered exit and directional signs shall comply with *SS 563*. Either graphic or text format can be used for the design of the signage.

(2) Exemption

(a) Exit signs (other than low level or floor-mounted signs) are permitted to be mounted more than 2.5m and at most 3.5m above the finished floor level provided the following is complied with:

(i) For spaces provided with engineered smoke control system, the top edge of the exit sign shall be below the designed smoke layer of the space it serves.

(ii) For spaces not provided with engineered smoke control system, there shall be a gap of at least 500mm between the top edge of the exit sign and the soffit of the ceiling/ roof.

Explanation and Illustrations

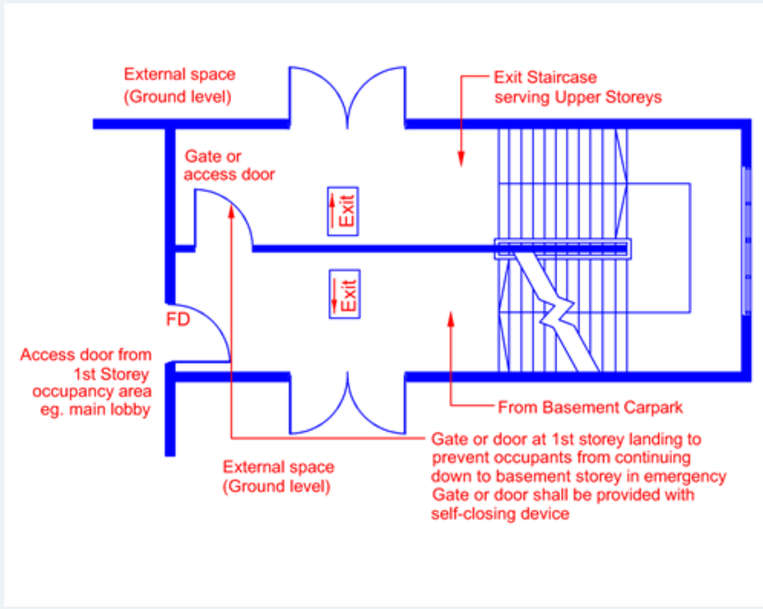


Figure 8.1.7d(1) - 1

This can be done by placing a physical barrier to prevent occupants from continuing below the level of exit discharge into the basement. This helps to warn occupants in the staircase enclosure that they are on the level of exit discharge.

Cl.2.3.5d. allows upper storey staircase to be continuous with that serving the basement, which is naturally ventilated.

To prevent occupants exiting continuously from upper storeys into the basement floor during an emergency, a physical barrier in the form of a door or a gate (as shown above) could be provided across the staircase landing at ground level to separate the discharge route of upper storeys from the basement staircase.

In addition, appropriate signage should be provided inside the staircase enclosure to direct occupants out of the building at ground level.

Applicable to staircase serving more than 4 storeys inclusive of basement.

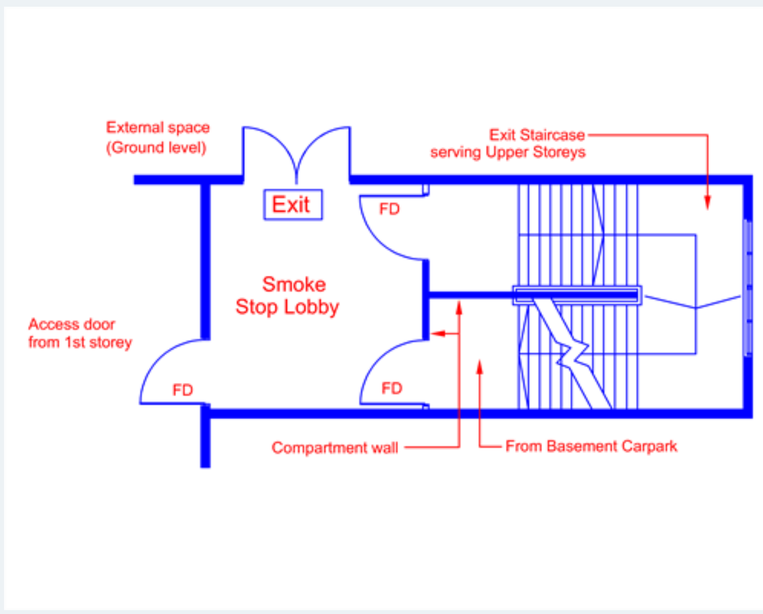


Figure 8.1.7d(1) - 2

f. Self-luminous sign

The use of self-luminous exit and directional signs powered by radioactive material are permitted in buildings, provided the signs comply with *UL 924, SS 563* and *SS 508 (Part 1, 2, 3 & 5)*. Either graphic or text format can be used for the design of the signage. In addition, *SS 563 Part 1* shall be complied with for determination of the viewing distance with distance factor (Z) fixed at 50.

Note

With the withdrawn of BS 5499 Part 2, all self-illuminating exit and directional signs powered by radioactive materials shall comply and tested to the testing standard UL 924. For radioactive materials to be permitted, such material shall meet the minimum 50 lux illuminance. Where the minimum 50 lux illuminance is not achievable, such signs shall be externally lit by a nearby emergency luminaires.

Explanation and Illustrations

Viewing distance is derived as follows:

$l = z_0 h$, where l (m) is the viewing distance; z_0 is the distance factor with observation position normal to the centre of the pictogram /'EXIT' legend, and h (m) is the height of pictogram / 'EXIT' legend

8.1.8 Photoluminescent marking

Rationale

The provision of photoluminescent marking/tape was introduced to eliminate total darkness scenario where all essential emergency lighting failed during a fire emergency.

Explanation and Illustrations

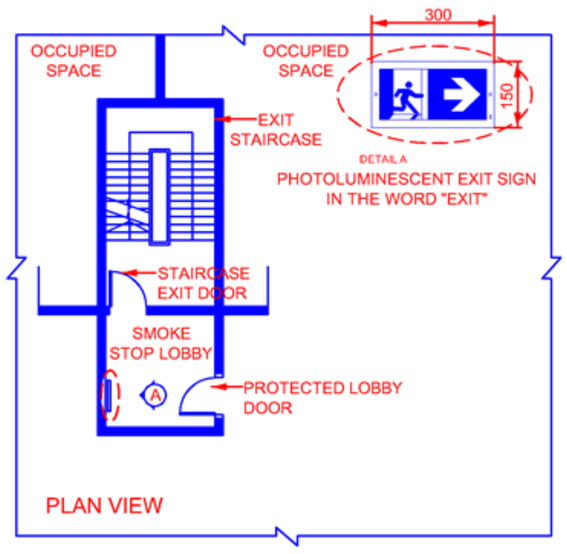


Figure 8.1.8 – 1

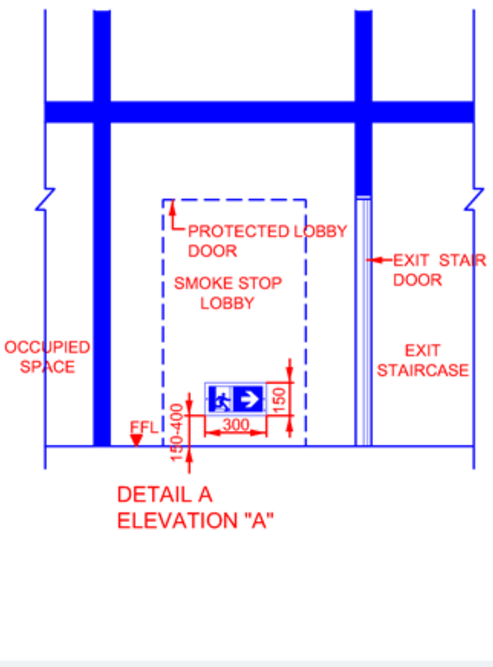


Figure 8.1.8 - 2

1. Performance of Photoluminescent marking / tape

The basic function of photoluminescent marking / tape is to provide some luminance lighting at low level to aid evacuation of occupants under total power failure condition or low ambient lighting condition. Photoluminescent marking / tape shall be made of pigments that will absorb electrical or day lighting under normal ambient condition and emit light automatically in invisible wavelength and glow brightly upon
immediate depletion of light source.

As a guide, the Photoluminescent marking / tape should deliver a luminance level at least 800 mcd/m^2 at 1 min after removal of light source and at least 80 mcd/m^2 at 10 mins thereafter. The Photoluminescent marking / tape would remain visible after 6 hour at the luminance level of at least 1 mcd/m^2.

2. Substrate of Photoluminescent marking / tape

For tape, direct printing of directional arrow in green on surface of vinyl or decal sticker with full photoluminescent background. For marking, direct printing of directional arrow, “EXIT” or exit legend. With green background on thin plastic or metal sheet or silk printed with green background on reverse side of thin transparent Perspex sheet.

For Photoluminescent nose strip, it shall be made of materials of the non-skid and able to resist abrasion and wear.

3. Method of fixing

The marking / tape could be affixed by strong adhesive glue on dry and smooth surface.

4. Product listing

Product listing requirement is not required at this point of time.

For buildings under PG III to VIII, where the emergency lighting and exit signs are not of the self-contained battery pack type, integral with the lighting and sign fittings, self-luminescent marking or tapes shall be provided to both edges of the treads and handrails and/or walls of the exit staircase. The rationale of the provision would ensure escape facilities are always visible during an emergency situation.

The purpose is to provide illumination for escape path in the event of a total power failure i.e. failure of both self-contained battery pack system and standby
generator provision in a building at the same time. Thus, the occupant groping in the dark is almost “impossible”. Both the provision would complement each other and facilitate orderly evacuation process.

a. In all buildings, except PG I & II, photoluminescent marking/ tape to guide occupants along evacuation routes to appropriate exit shall be provided:

(1) along internal walls and/ or floors of the exit staircase, smoke-free lobby and fire lift lobby;

(2) on the doors of smoke-free lobby, fire lift lobby and exit staircase; and

(3) along corridor with exit directional signs.

b. The width of photoluminescent marking or tape shall be at least 50mm and be placed at low level. The bottom of the low level sign shall not be less than 150mm or more than 400mm above the floor level.

c. Omission of photoluminescent marking/ tape is permitted on the following conditions:

(1) the emergency power supply of the exit lightings, exit signs and directional signs in the above locations shall be self-contained battery pack (single point emergency lighting system) in compliance with *SS 563* or central battery supply backed up by stand-by generator;

(2) there shall be at least 2 emergency luminaires in the smoke-free lobby, fire lift lobby and corridor with exit directional signs, such that no part of such spaces shall be left in total darkness should there be failure of any one of the emergency luminaires; and

(3) there shall be at least one emergency luminaire at every exit staircase landing.

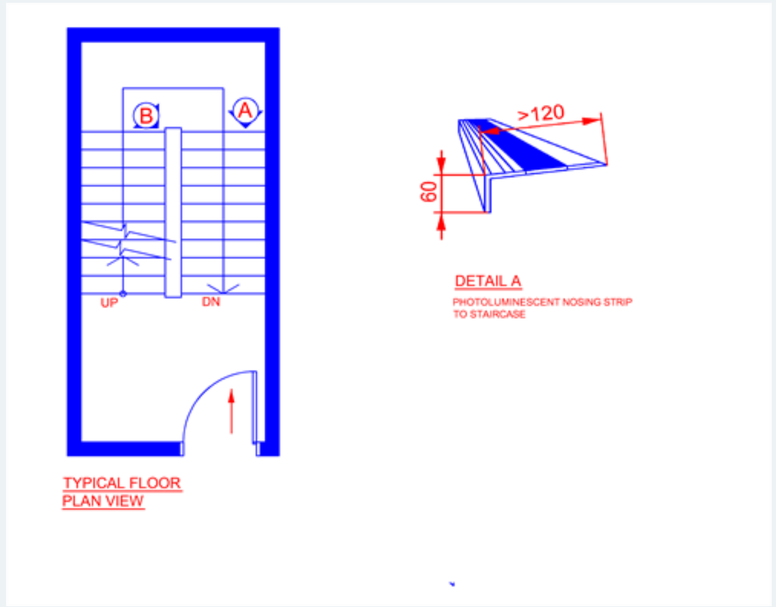
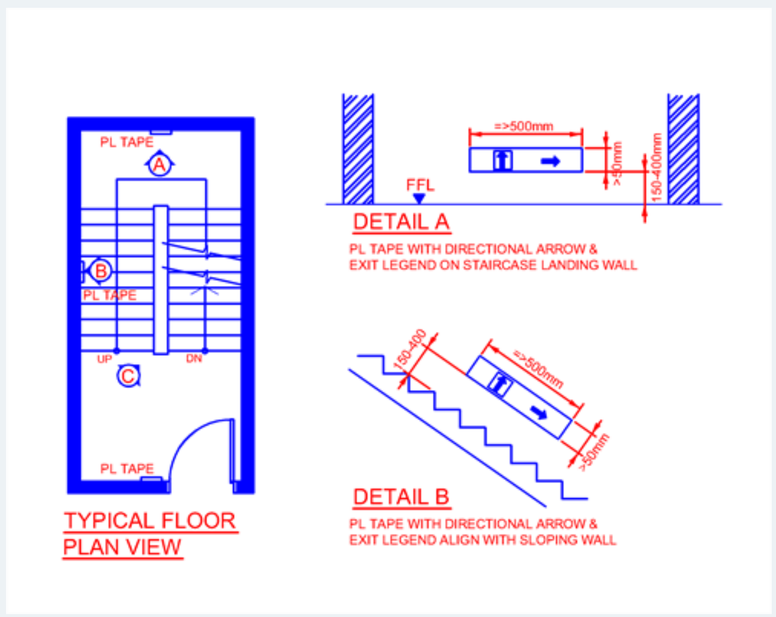


Figure 8.1.8b. – 1 : Photo luminescent nose strip at the leading edge of stair riser

The strip shall be at least 50mm in width and to be placed at the leading edge of each stair rise.



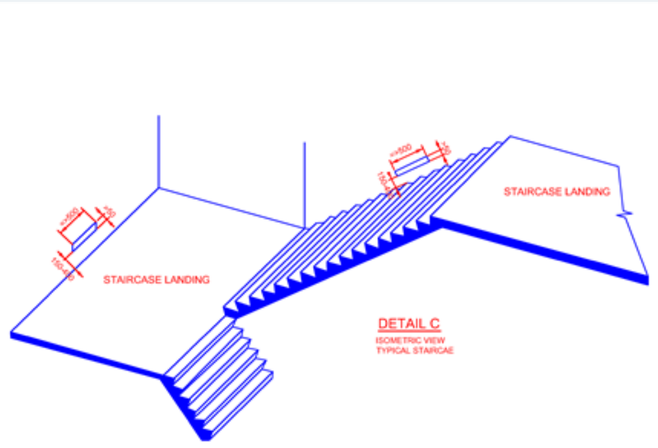


Figure 8.1.8b. – 2

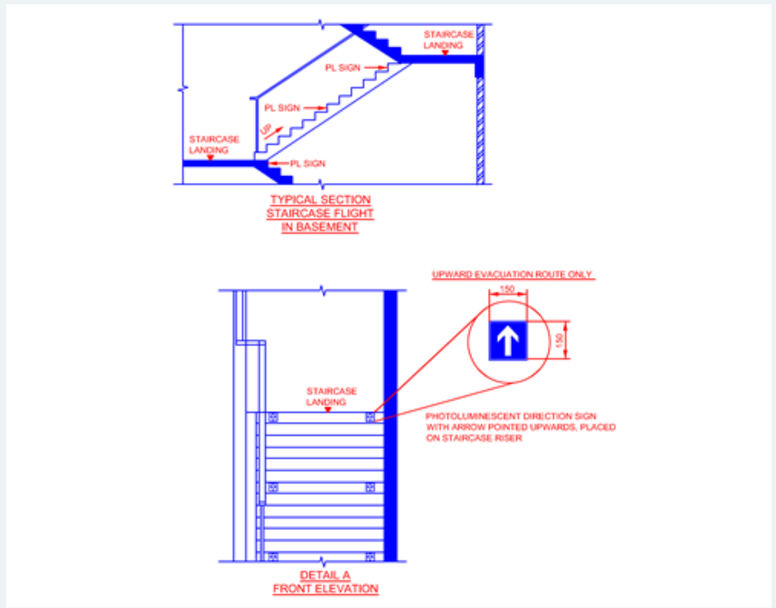


Figure 8.1.8b. – 3

In designated corridor with exit directional sign.

Applicable to building with fixed corridor leading to exit staircase, except hotel guest room floor where low level electrical exit directional sign is mandatory.

Photo luminescent exit directional sign with the word “EXIT” or Exit legend as per SS 508 and directional arrow with green ground printed on the surface or silk screened on reverse surface, along one side of the walls of the designated corridor. For long corridor, the photoluminescent exit directional sign shall be affixed at not more than 10m interval. Additional sign would be required at junctions.

The wall affixed sign shall be at least 300mm long and 150mm wide and be placed not less than 150mm or more than 400mm from the lobby landing level. Depending on the length and configuration of the designated corridor, numerous number of signs to be provided on one side of the walls with directional arrow pointing towards the exit direction within designated corridor.

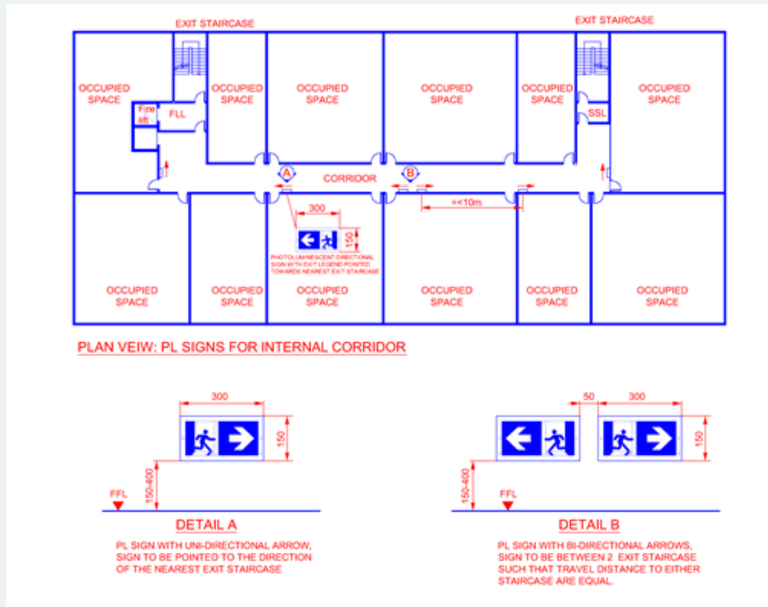


Figure 8.1.8b. - 4

CLAUSE 8.2 EMERGENCY VOICE COMMUNICATION SYSTEM AND FIRE COMMAND CENTRE (FCC)

8.2.1 One-way emergency voice communication system

One-way emergency voice communication system and a FCC shall be provided as follows:

a. For all large buildings under PG III (not applicable to primary school, secondary school and junior colleges), IV, V, VI, VII and VIII with AFA greater than 5000m² or having a total occupant load exceeding 1000 persons. The calculation of AFA and occupant load shall exclude the aboveground or underground car park; or

Rationale

The life safety risk of car park is relatively low as it is a transient space and the occupant load is low. Including the car park area in the calculation of accessible floor area will result in many developments requiring FCC and one-way emergency voice communication system, which could be excessive and may not be practical.

Explanation and Illustrations

(No illustration)

During fire emergency, the one-way emergency voice communication system will be used to notify occupants in the building. Under phase evacuation, occupants will be advised to relocate to 'Safe area of refuge' in which to wait out the fire. Occupants could also be advised to evacuate the building during fire emergency. In phase evacuation, communication with these people can be maintained to prevent panic and to allow further relocation, if necessary.

The one-way emergency voice communication system shall consist of microphone input, selector switches, amplifiers and remote loudspeakers to perform the functions specified. Loud speakers operated from the FCC shall be of sufficient number and appropriate design to provide effective voice communication to the following areas:

a. all habitable rooms;

b. all basement floor areas;

c. all escape staircases;

d. all staircase lobbies and lift lobbies forming parts of the means of escape;

e. the main entrance;

f. all corridors leading to exits;

g. all service areas where people may be working;

h. all areas of refuge;

i. all assembly areas;

j. all patients accommodation floors, hotel bedroom floors etc.; and

k. all other areas as may be required by the SCDF.

b. For all buildings belonging to PG III, IV, V, VI, VII, and VIII of more than 24m in habitable height; or

c. For building of mixed commercial-cum-residential usage:

(1) where the commercial component of the building occupies only the lower portion of the building and is separated from the residential occupancies, the habitable height of the commercial component of the building exceeds 24m, or

(2) where a commercial component of the building is located above any residential occupancies, the habitable height of the building exceeds 24m.

d. Exception

For hotel or healthcare buildings of less than 24m in habitable height, AFA not greater than 5000m² and total occupant load not exceeding 1000 persons, an ordinary public address system shall be provided. However, FCC is not required. Loudspeakers for the ordinary public address system shall be provided in every lift lobby, staircase enclosure and other strategic positions within audible distance of all parts of all storeys throughout the building.

Rationale

The provision of ordinary public address system serves to effect early and orderly evacuation of occupants in times of emergency.

Explanation and Illustrations

(No illustration)

To address the concerns of transient guests and sleeping risk in hotels, boarding houses and the like which are less than 24m in habitable height, an ordinary public address system shall be provided to effect early and orderly evacuation of occupants in times of emergency.

The ordinary public address system shall consist of the microphone input, selector switches and remote loudspeakers to perform the functions specified. Loud speakers shall be of sufficient number and appropriate design to provide effective voice communication to the following areas:

a. all habitable rooms;

b. all basement floor areas;

c. all escape staircases;

d. all staircase lobbies and lift lobbies forming parts of the means of escape;

e. the main entrance;

f. all corridors leading to exits;

g. all service areas where people may be working;

h. all areas of refuge;

i. all assembly areas;

j. all patients' accommodation floors, hotel bedroom floors etc.; and

k. all other areas as may be required by the SCDF.

8.2.2 Two-way emergency voice communication system

a. Two-way emergency voice communication system shall be provided for

(1) buildings, which are required to be provided with one-way emergency voice communication system under *Cl.8.2.1 a., b.* or *c.*; and

(2) all multi-level basements of buildings under PG II to VIII, except the following:

(a) Single-level basement, irrespective of its usage of building under PG II to VIII and basements of building of PG I.

(b) Multi-level basements of building under PG II, provided the basements are used solely for car parking and not exceeding two basement storeys in depth.

Explanation and Illustrations

(No illustration)

1. The requirement would be applicable to buildings having any basements greater than a depth of 9m from the averaged ground level outside the building. This is to complement the need to provide fire lift to serve the basement storeys under Cl.6.6.4 of the Fire Code.

2. In view of the adequacy of the lift intercom system, the SCDF will accept the lift intercom system in-lieu of the handset provided it complies with SS 546 on 'Installation and Power Supply'.

b. Two-way emergency voice communication system, where required, shall provide two-way communication between the FCC and the following areas:

(1) Every fire lift lobby, including 1st storey.

(2) All firefighting-related mechanical equipment rooms. These include sprinkler pump room, wet rising main pump room, hose reel pump room, switch rooms and generator rooms.

(3) All rooms housing smoke control equipment.

(4) All lift machine rooms.

(5) Fire lift. Where the lift car is equipped with built-in intercom system that complies with SS 546, the two-way communication system can be exempted.

(6) Each area of refuge.

(7) Air-handling control rooms. Where AHU can be remotely monitored and controlled at the FCC, and cannot be by-passed locally, and the electrical cabling between AHU rooms and FCC are fire-rated, the two-way emergency voice communication system can be exempted.

Explanation and Illustrations

(No illustration)

The two-way communication system shall consist of the main telephone handset and selector switches at the control console located in the FCC and the other remote handset installed at various locations as mentioned in the *Cl.8.2.2b(1)* to *(7)*.

In general, at least one emergency handset shall be located on each floor. When a floor is divided into two or more fire-isolated zones used as areas of refuge for one another, each zone shall be provided with a handset. The criteria to be considered in determining the position of each handset shall be such that, wherever possible, the handset is near the protected staircase or near the central position of the zone covered by it, and as remote as possible from the nearest alarm sounding device.

In view of the adequacy of the lift intercom system, the SCDF will accept the lift intercom system in-lieu of the handset provided it complies with SS 546 on 'Installation and Power Supply'

8.2.3 Standard

Where a one-way or two-way emergency voice communication system is required by this Code, it shall comply with the requirements stipulated in *SS 546*.

8.2.4 Fire Command Centre

a. Provision

A FCC shall be provided in any building, with the exception of buildings under PG I and II (PG II building having not more than two basement storeys used solely for car parking), which requires any of the following installations:

(1) Fire lift.

(2) Emergency voice communication system.

(3) Engineered smoke control system.

b. Supporting equipment

A FCC is a room within a building dedicated to the controlling and monitoring of fire protection systems during a fire emergency. As such, equipment/services not meant for this purpose shall not be located inside the FCC with exception of the following:

(1) Lift supervisory panel.

(2) Background music system connected to one-way emergency voice communication system rack.

(3) Workstation/server rack for security card access & CCTV system for security monitoring.

(4) Workstation/server rack for car park access control system.

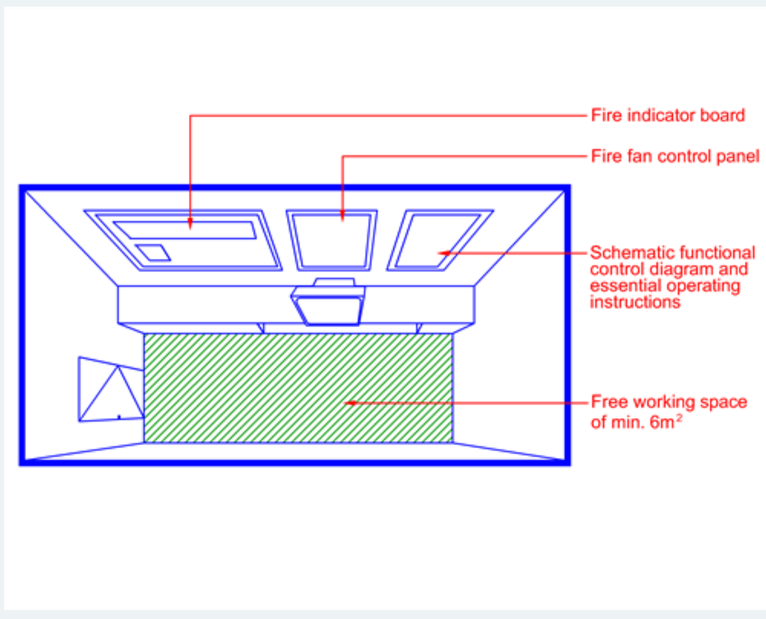
(5) Workstation/server rack for fire alarm's colour graphics system.

(6) Workstation/server rack for BMS/BAS monitoring and controlling other ACMV system.

(7) Walkie-talkie charging stations.

(8) UPS system with totally sealed battery capacity not exceeding 750Amp-hr.

Explanation and Illustrations



Planal isometric view

Figure 8.2.4b. : Fire Command Centre

The actual size of a FCC should be provided at plan submission stage. The minimum net working space of 6m² shall exclude spaces for equipment and furniture.

c. Size

A FCC shall be of adequate size to house all the terminals and supervisory/ control equipment etc. of the building's fire protection/detection systems, as well as a free working space (unobstructed by door swing) of at least $6m^2$ and minimum clear width of 2m.

d. Location

(1) The FCC shall be located at the same level as the fire engine accessway or fire engine access road and its entrance shall be located in the following order of priority:

Explanation and Illustrations

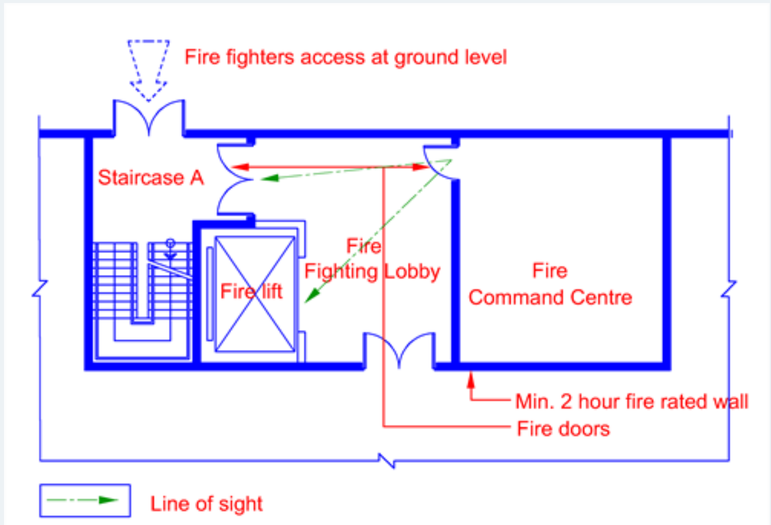


Figure 8.2.4c.(1) – 1

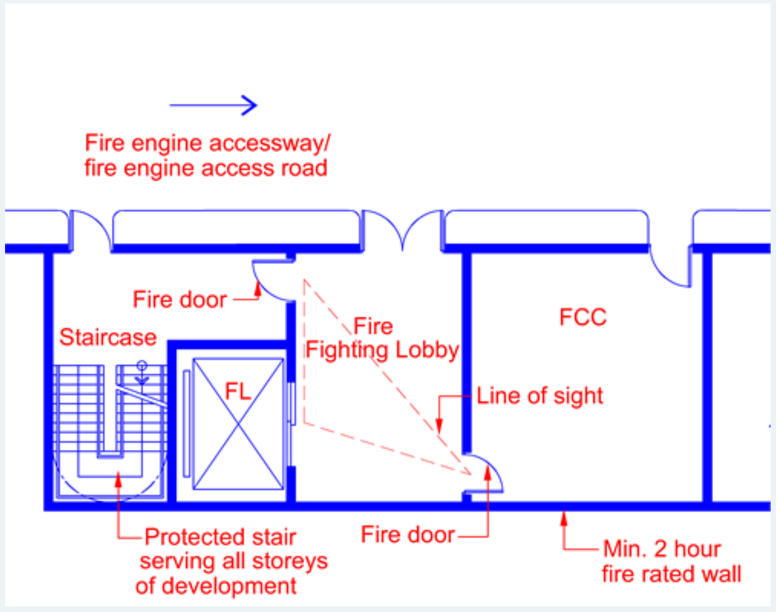


Figure 8.2.4c.(1) - 2

For both scenarios, it is desirable that a "line of sight" could be achieved from the door of FCC to the door of the fire lift and the door of the exit staircase adjacent to the fire lift lobby.

This arrangement would assist the communication linkage amongst the areas greatly & lead to better command of firefighters operationally.

However, where direct linkage between FCC & fire lift/exit staircase could not be achieved, prior approval from the SCDF should be obtained before building plan submission.

(a) The travel distance between the nearest edges of the FCC door and fire lift lobby door at the designated storey of the building shall not exceed 5m.

(b) In the case where there is no fire lift lobby, it shall be located within vicinity of the fire engine accessway or fire engine access road. The travel distance between the nearest edges of the FCC door and entrance of one of the protected stairs serving all storeys of the development shall not exceed 5m.

(c) It shall be at any other location as may be designated by the SCDF.

(2) In the case of a site consisting of more than one building which required FCC in accordance with Cl.8.2.1, there shall be more than one FCC. For such cases, the SCDF shall be consulted.

e. Construction

The construction of enclosure, facilities and lighting of a FCC shall comply with the *SS 546*.

Rationale

As the term "adjacent" previously used is ambiguous, it is replaced with specific distance for clarity. 5m is considered a distance reasonably close to the fire lift lobby.

f. Air-conditioning and/ or mechanical ventilation

Air-conditioning and/ or mechanical ventilation where required for the FCC shall be provided with secondary power supply and shall have ductworks independent of any other ductwork serving other parts of the building.

Rationale

The purpose of having independent ductwork for the ACMV system serving the FCC is to prevent fire or smoke from being conveyed into the FCC via the ducts.

Explanation and Illustrations

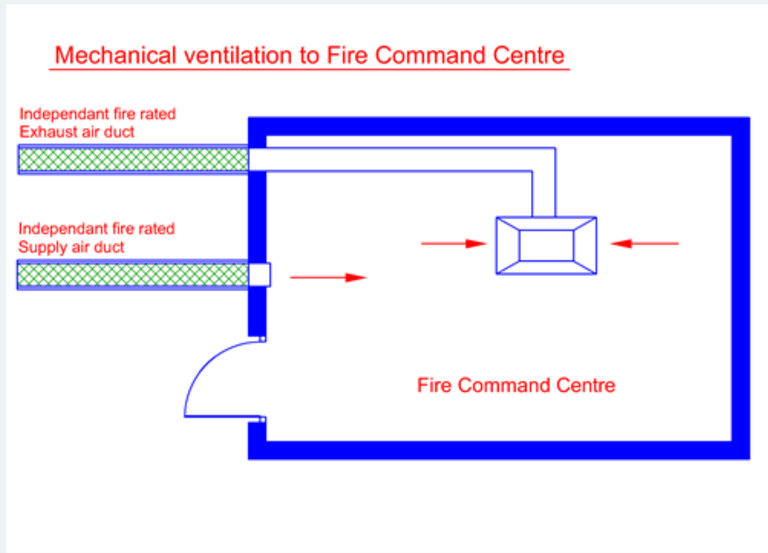
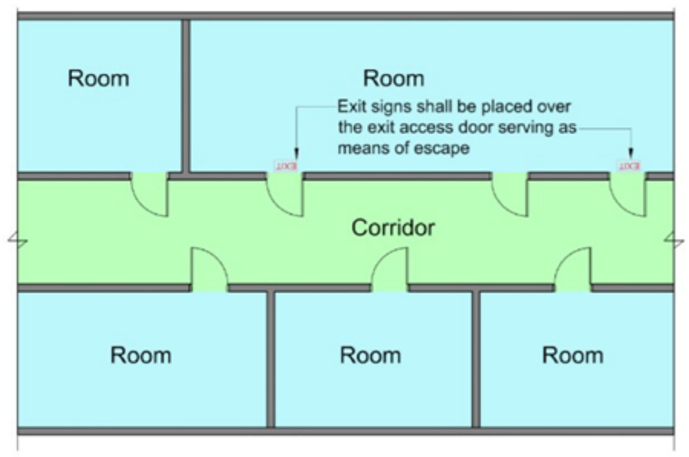


Figure 8.2.4e. : Mechanical ventilation to Fire Command Centre

The critical usage of FCC during fire emergency requires that lighting/ventilation and other power supply should come from standby power source e.g. generator set. The supply & exhaust ductworks of the mechanical ventilation shall be independent of any other ductwork serving other parts of the building. This is to prevent heat or smoke from being conveyed into the FCC via the ducts.

RELATED TABLES AND DIAGRAMS OF CHAPTER 8

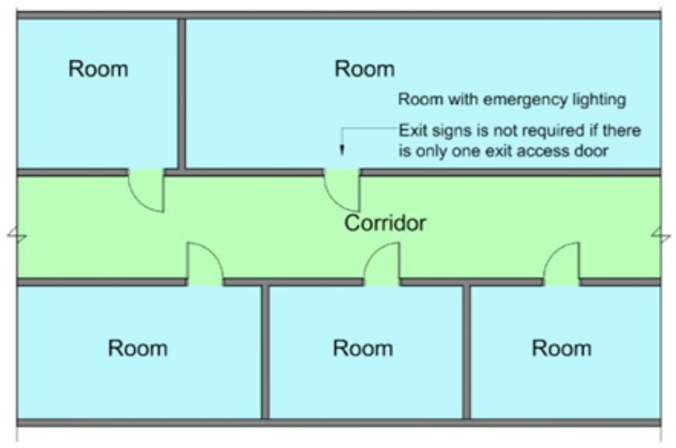
Diagram 8.1.7a.(2)



When a room is provided with more than one door, exit signs shall be provided over the exit access doors intended to be used as means of escape.

Diagram 8.1.7a.(2)

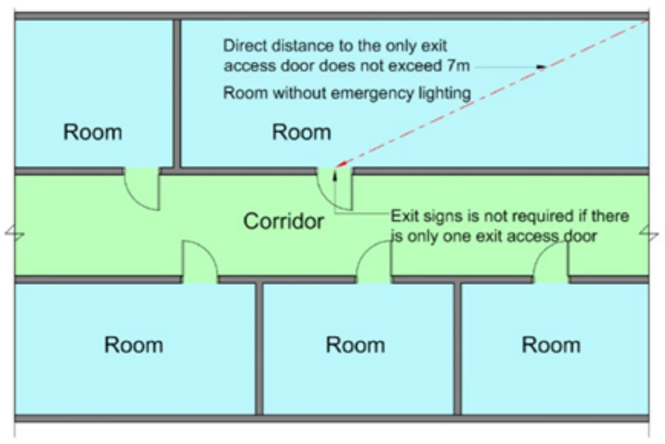
Diagram 8.1.7a.(4)(b)



When an occupied space is provided with emergency lighting, exit sign is not required if there is only one exit access door

Diagram 8.1.7a.(4)(b)

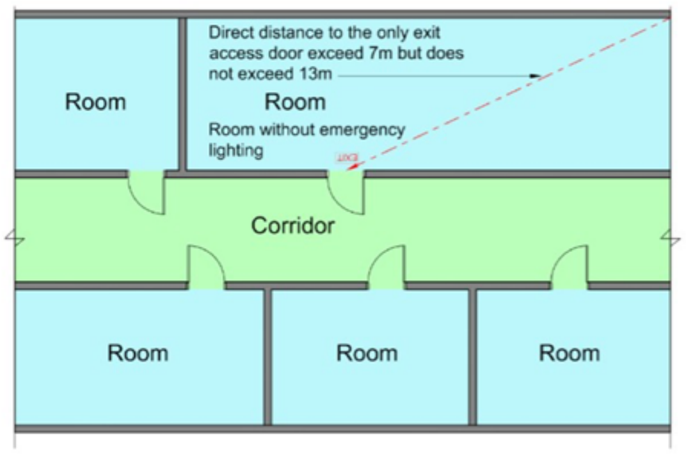
Diagram 8.1.7a.(4)(c)(i) - 1



In a room without emergency lighting where the room is provided with only one door and the direct distance from the furthest distance in the room to the exit access door is 7m or less, exit sign is not required if there is only one exit access door.

Diagram 8.1.7a.(4)(c)(i) – 1

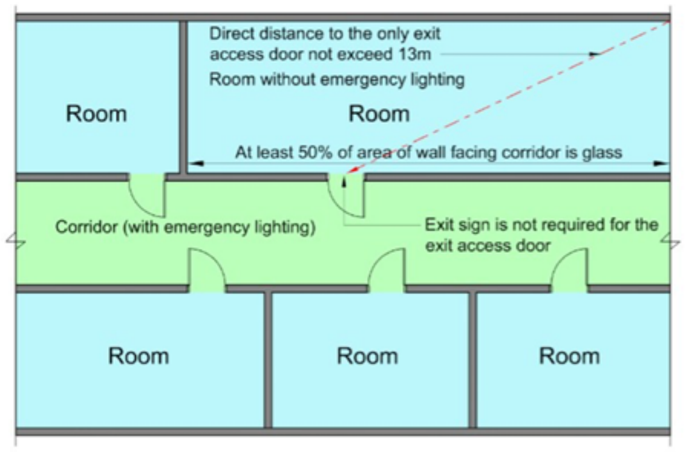
Diagram 8.1.7a.(4)(c)(i) - 2



In a room without emergency lighting where the furthest point in the room to the exit access door exceeds 7m but does not exceed 13m, exit sign shall be provided over the door. Alternatively, the room can be provided with emergency lighting.

Diagram 8.1.7a.(4)(c)(i) – 2

Diagram 8.1.7a.(4)(c)(ii)



In a room without emergency lighting where the furthest point in the room to the exit access door is 13m or less and wall of the room comprises not less than 50% clear glazing facing:

- an internal corridor covered by emergency lighting
- an external corridor, or
- the external of the building.

Exit sign is not required to be provided over the exit access door.

Diagram 8.1.7a(4)(c)(ii)

Diagram 8.1.7a.(3)

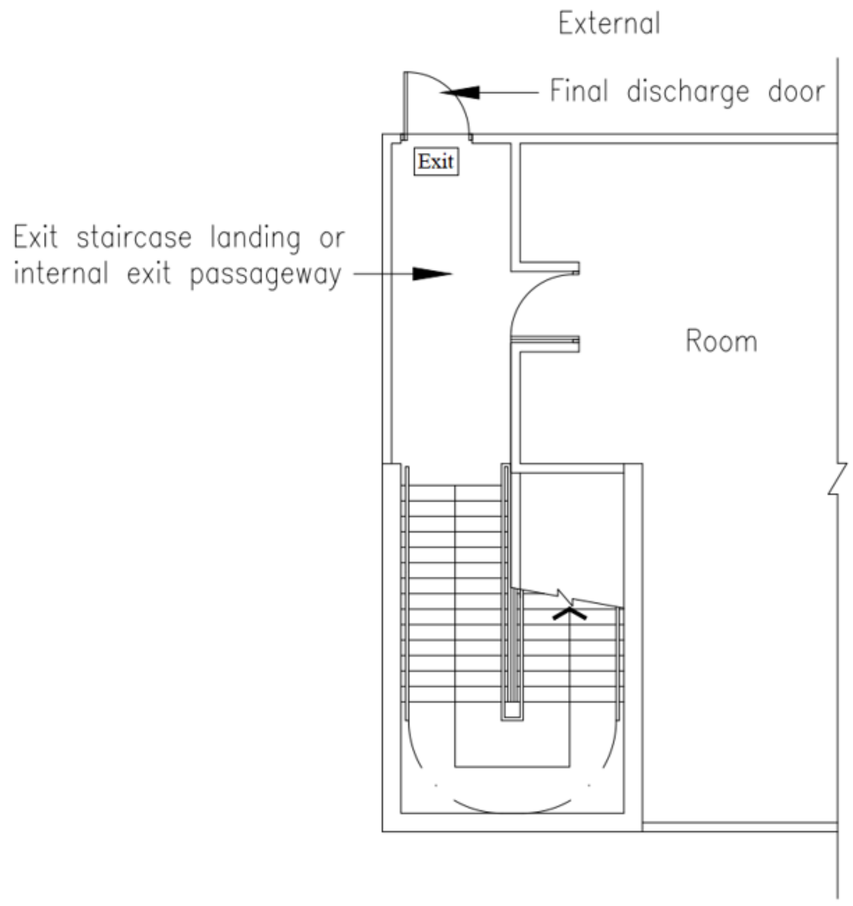


Diagram 8.1.7a(3)

Diagram 8.1.7a.(4)(f)

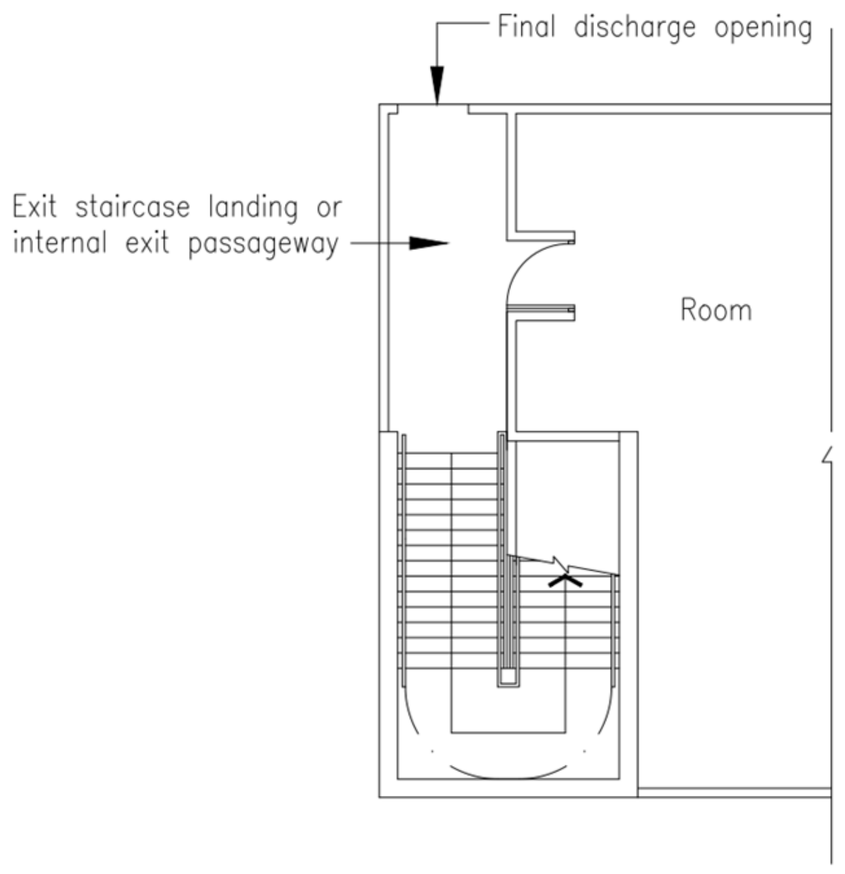


Diagram 8.1.7a(4)(f)

Diagram 8.1.7b.(1)

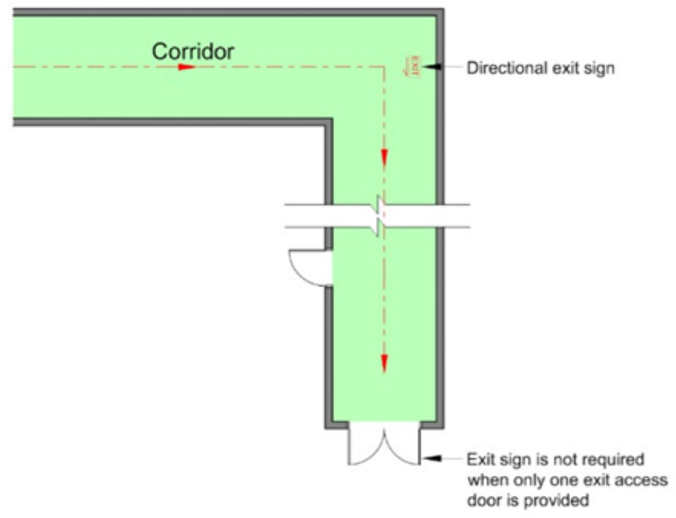


Diagram 8.1.7b.(1)

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
8.1.3b		01 Mar 2019	New		---
8.1.7a.(3)	1 Mar 2023	1 Mar 2023	Revised/Clarification	Exit and exit directional signs a. Exit sign (1) ..... (2) ..... (3) Exemption Exit sign is not required under the following situations: (a) PG I and II buildings (b) Room provided with emergency lighting (i) When a room is provided with only one door (see Diagram 8.1.7a.(3)(b)(i)); or (ii) When a room or internal space is fully open towards an external corridor or the external of a building. (c) Room without emergency lighting (i) When a room is provided with only one door and the direct distance from the furthest distance in the room to the exit access door is 7m or less (see Diagram 8.1.7a.(3)(c)(i) – 1 & 2); (ii) When the furthest point in the room to the exit access door is 13m or less and wall of the room comprises not less than 50% clear glazing facing (see Diagram 8.1.7a.(3)(c)(ii)): • an internal corridor covered by emergency lighting, • an external corridor, or • the external of the building. (iii) When an internal space is fully open towards an external corridor or the external of a building. (d) Open-sided single storey building, with floor area not exceeding 200m2 and openings that constitute at least 80% of the perimeter wall area (measured along the roof eaves).	1 Mar 2023
8.1.7e.	2 Sep 2024	2 Mar 2025	Relaxation/ Revised	8.1.7e. The legends, dimensions, design and installation of electrically-powered exit and directional signs shall comply with SS 563. Either graphic or text format can be used for the design of the signage.	2 Mar 2025
8.2.1.b.	2 Dec 2019	2 Dec 2019	Revised	b. For all buildings belonging to PG III, IV, V, VI, VII, and VIII of more than 24m in habitable height.	2 Dec 2019
8.2.1a		01 Mar 2019	Revised, formerly Cl.8.2.1(a)(i)		---
8.2.1c.(1)		01 Mar 2019	Revised, formerly Cl.8.2.1(c)(i)		---
8.2.2.a.(1)	2 Dec 2019	2 Dec 2019	Revised	Two-way emergency voice communication system a. Two-way emergency voice communication system shall be provided for (1) buildings, which are required to be provided with one-way emergency voice communication system under Cl.8.2.1 a., b. and c.; and	2 Dec 2019
8.2.4b.	2 Mar 2020	2 Mar 2020	Clarification	b. A FCC shall be of adequate size to house all the terminals and supervisory/ control equipment, etc. of the building's fire protection/detection systems and a free working space (unobstructed by door swing) of at least 6m².	2 Mar 2020
8.2.4d	1 Mar 2023	1 Mar 2023	Revised/Clarifications	Location (1) The FCC shall be located at the same level as the fire engine accessway or fire engine access road and its entrance shall be located in the following order of priority: (a) It shall be within 5m from entrance of the fire lift lobby at the designated storey of the building. (b) In the case where there is no fire lift lobby, it shall be located within vicinity of the fire engine accessway or fire engine access road and within 5m from the entrance of one of the protected stairs serving all storeys of the development.	1 Mar 2023

CLAUSE 9.1 PURPOSE GROUP I OCCUPANCY

This chapter specifies the additional requirements peculiar to buildings of respective purpose groups. These additional requirements shall be read in conjunction with other requirements relevant to the respective purpose groups stipulated in Chapter 1 to 8 of this Code. Where there are conflicting requirements between this chapter and the preceding chapters, the requirements stipulated in this chapter shall take precedence.

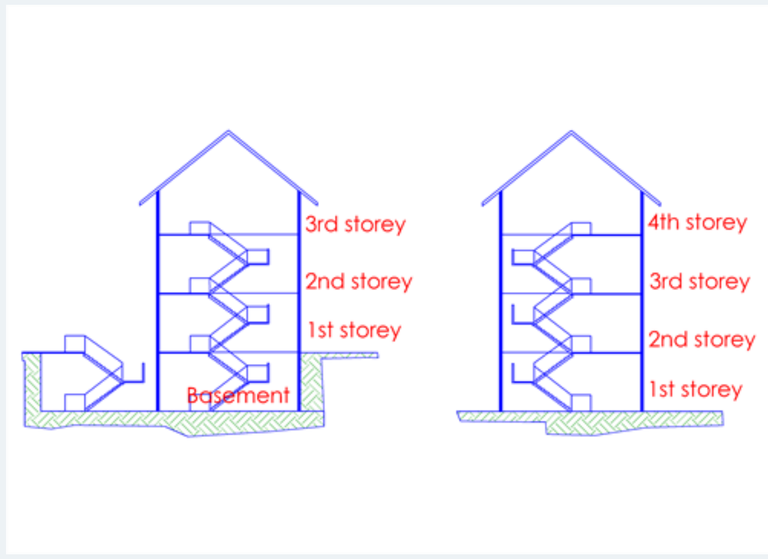
9.1.1 General

a. Means of escape

(1) Single household dwelling

Buildings under PG I can consist of more than three floors if they are occupied as a single household dwelling.

Explanation and Illustrations



4 storeys or levels form one compartment

Figure 9.1.1a.(1) : Single household dwelling

Building having 4 stories or levels under PG I are permitted. The above relaxation was introduced in 13 June 1996 to take into consideration of proliferation of 4-level PG I buildings due to the sudden surge in the public demand for two storey conventional houses with attic and basement.

The SCDF reviewed the above matter and issued a circular on 14 Dec 1999 to allow buildings under PG I to have more than 3 levels or floors if they are occupied as a single household dwelling without the need to provide automatic fire system or external staircase.

(2) Basement levels

Explanation and Illustrations

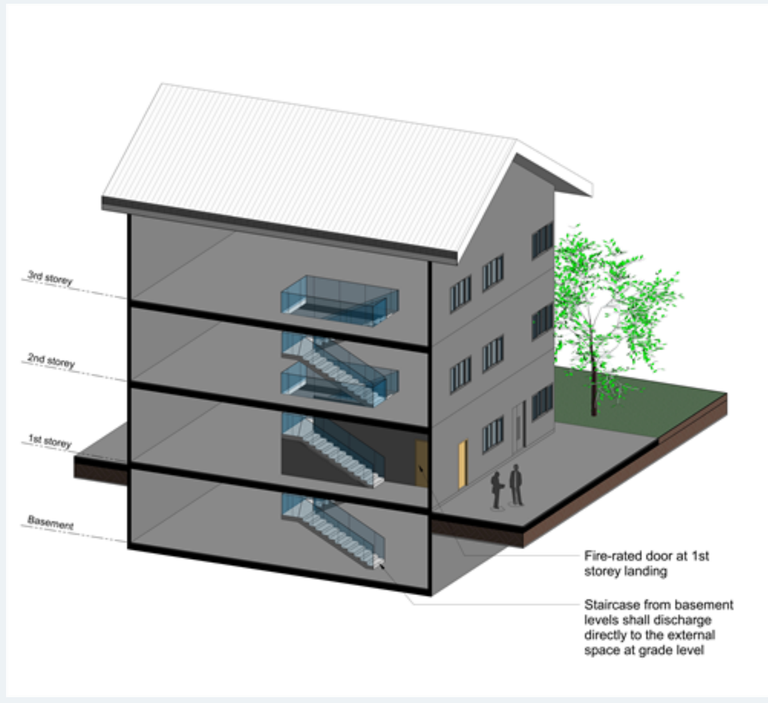


Figure 9.1.1a.(2) -1

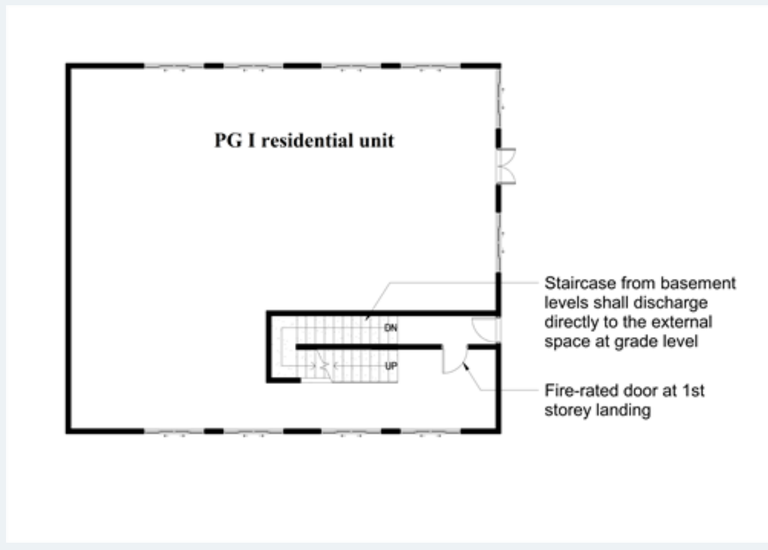


Figure 9.1.1a.(2) -2

For PG I building which has four or more levels (including the basement levels and attics), the basement levels shall discharge directly to the external space at grade level.

(3) Access staircases

Means of escape for a building or a separate part of a building of single occupancy of PG I can be provided via access staircase(s).

Explanation and Illustrations

Buildings which exceed 3 storeys or levels, inclusive of attic and basement but not exceeding 4 storeys or levels are not required to comply with either the provision of an automatic fire alarm system or the provision of an external exit staircase to serve the topmost storey or level. See Figure 9.1.1a.(3) - 1 and 9.1.1a.(3) - 2, subject to complying with the clear width of staircase and corridor as mentioned in Table 2.2A.

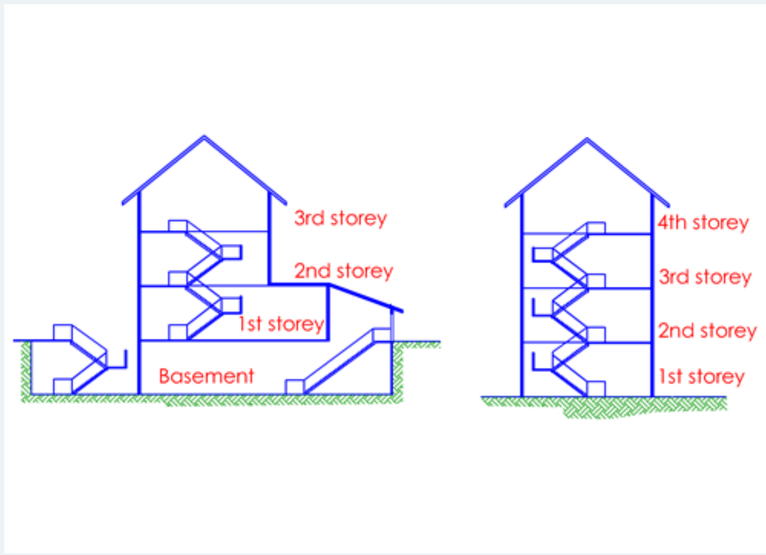


Figure 9.1.1a.(3) -1 : Unenclosed internal staircase serving as means of escape for the building

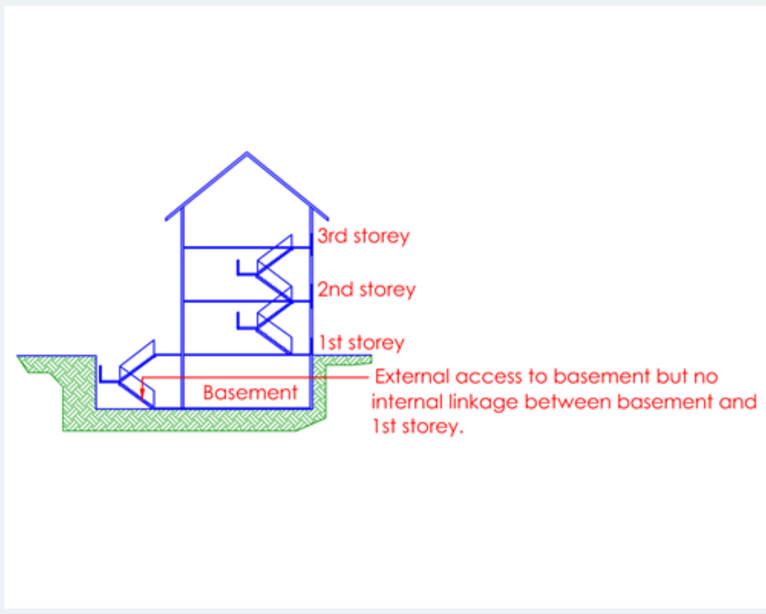


Figure 9.1.1a.(3) -2

An alternative arrangement to fire separates the basement from upper storeys. Basement level shall be compartmented and separated from upper storeys such that discharge shall be directly to external space.

b. Structural fire precautions

(1) Attic floor

An attic in buildings under PG I can be constructed of timber boarding on timber joists, provided it is protected to achieve the fire resistance rating required of the elements of structure of the building or compartment.

(2) Floor over a basement

For PG I building which has four or more levels (including the basement storeys and attics), the floor immediately over the basement storeys shall be compartmented by compartment walls/ floors. Where there is an internal connection between the basement storeys and upper levels, it shall be compartmented by a fire-rated door at the 1st storey landing or basement landing.

Explanation and Illustrations

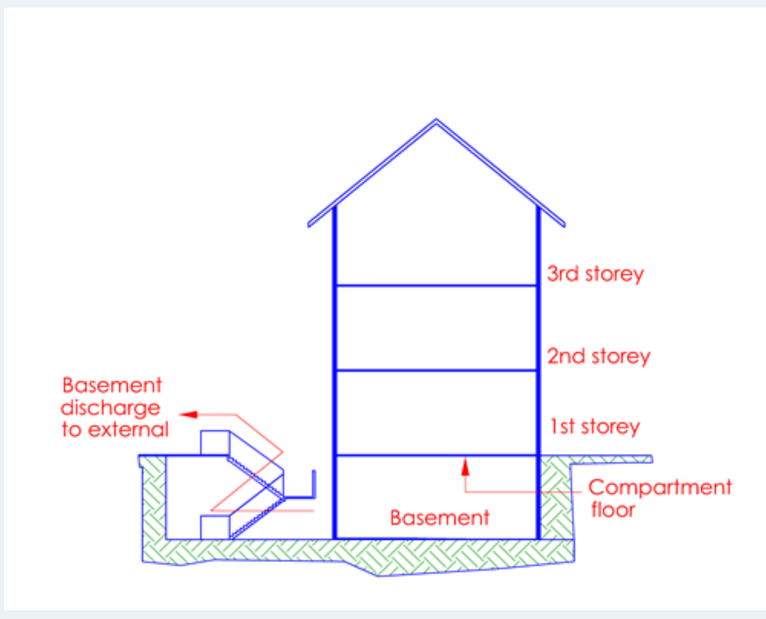


Figure 9.1.1b.(2) : Floor over a basement

Any floor immediately over a basement storey, if such storey forms part of a building of PG I which has four or more storeys (including the basement storey), shall be constructed as a compartment floor, i.e. horizontally separating the upper storeys from the basement. The exit staircase serving the basement shall be made to discharge into the exterior at grade level.

c. Extent of unprotected openings

(1) The extent of unprotected openings in an external wall of a building under PG I, in relation to its distance from the relevant boundary, can be based on the internal room/space in the building that has the largest extent of unprotected openings to comply with *Table 1 of Annex 3B*.

(2) Internal walls enclosing the room/space in the building except glazing, are not required to be fire-rated, but shall be constructed of non-combustible materials.

d. PV installation

For PV installations the requirements shall be as follows:

(1) For access to the PV installations on the roof, a portable sturdy or cat/ ship ladder to the roof access shall be provided.

(2) All access hatches, if provided, shall be readily accessible from the roof. The access hatch opening shall have a minimum clear width of 1m in diameter.

(3) A clearance of 1m around the access/ hatch opening shall be provided.

(4) For fire resistance of PV modules, it shall be in accordance with *Cl.10.2.1c.*.

(5) For emergency disconnection of the PV modules, it shall be in accordance with *Cl.10.2.1e.*.

CLAUSE 9.2 PURPOSE GROUP II OCCUPANCY

9.2.1 General

a. Means of escape

(1) Means of escape for a building or a separated part of a building of PG II shall comply with the provision of Cl.2.3.

(2) Number of exit staircases or exits per storey

In a block of residential apartments or maisonettes, at least two independent exit staircases or other exits from every storey shall be provided, in compliance with the requirements of Cl.2.2.11, unless otherwise permitted.

Rationale

The provision of minimum two remotely located staircases or other exits provides for alternate escape for the occupants in the event that one staircase or alternate exit is blocked off or rendered unusable during an emergency situation.

Explanation and Illustrations

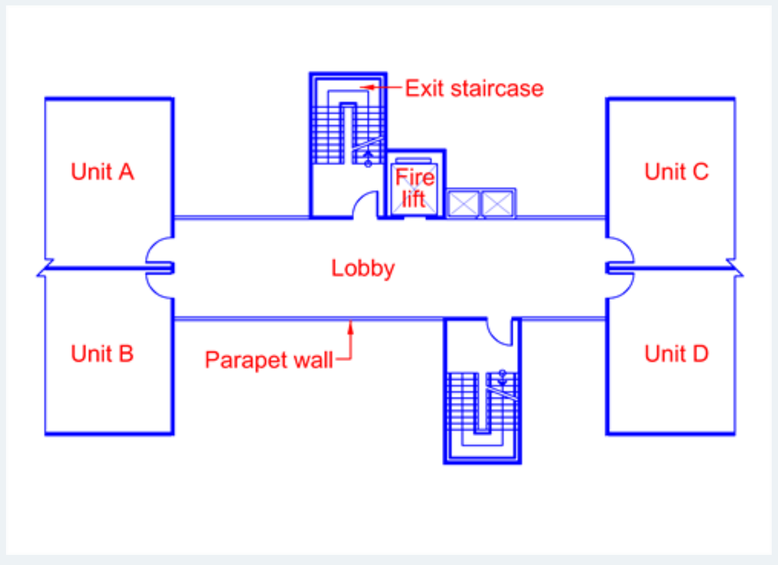


Figure 9.2.1a.(2)

The provision of two remotely located staircases or other exits provides for alternate escape for the occupants if one staircase or alternate exit is blocked off or rendered unusable in an emergency situation.

(3) Provision for buildings not exceeding 24m in habitable height

In a block of residential apartments or maisonettes not exceeding 24m in habitable height, one exit staircase can be allowed provided the one-way travel distance is complied with.

Explanation and Illustrations

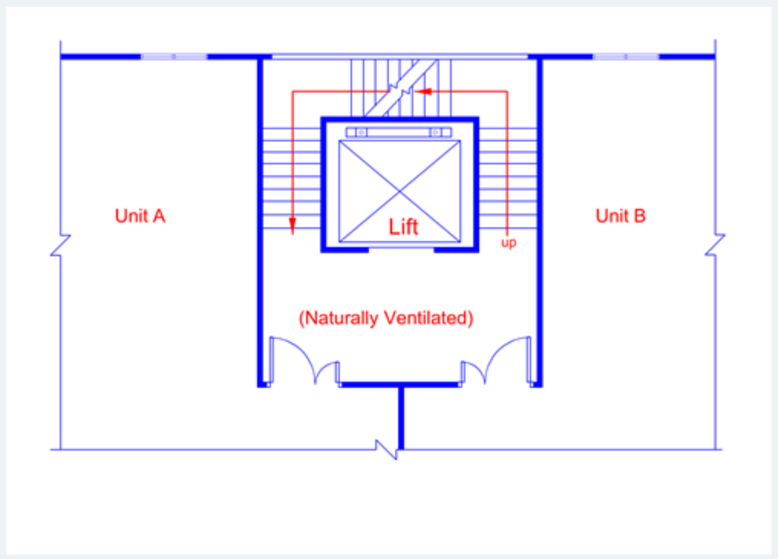


Figure 9.2.1a.(3) - 1

Single staircase is only permitted for buildings not exceeding 4 storeys as the exit staircase is not separately enclosed. The above figure shows a protected lift shaft, which is wrapped around by an exit staircase.

The space between the entrance doors and the lift shaft serves as a staircase landing, lift lobby and entrance to the residential units. It is not considered as a smoke-stop lobby. Buildings, which are not more than 4 storeys, are not required to be provided with smoke-stop lobby. Instead, the residential units have direct entry into the staircase enclosure.

The above arrangement, with or without a protected lift shaft, is not acceptable for buildings exceeding 4 storeys.

The above arrangement is also not acceptable if the staircase is fully enclosed and provided with mechanical ventilation. The reason is that the movement of the lift car could cause a 'piston effect' to push or draw smoke into the staircase should a fire occur in the lift car or any of apartment units.

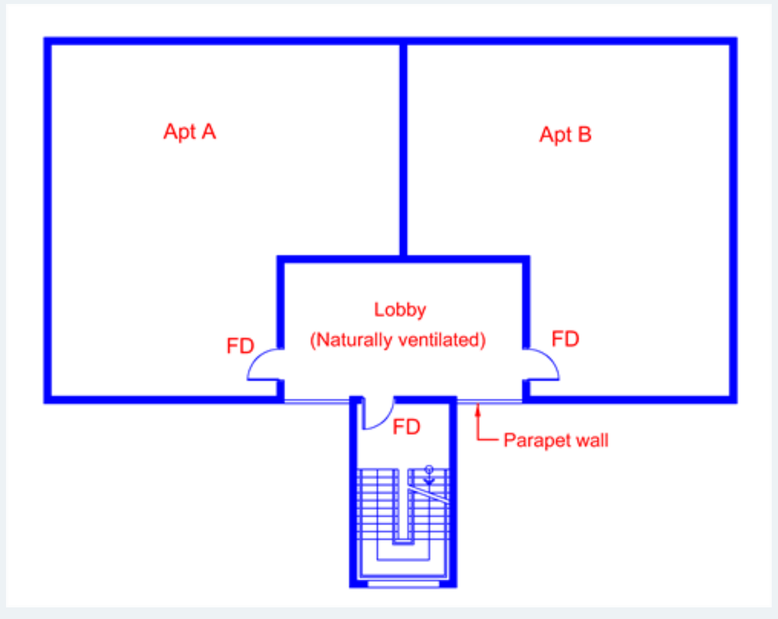


Figure 9.2.1a.(3) - 2

Single exit staircase is permitted in buildings more than 4 storeys and with habitable height not exceeding 24m, if there is smoke-free approach to the exit staircase. This can be achieved by providing a smoke-stop lobby or corridor which is open-sided, in compliance with Cl.2.3.10.

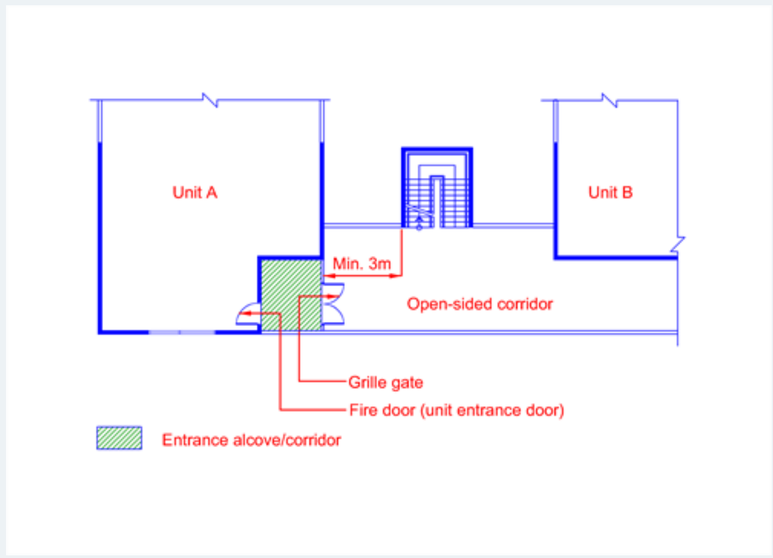
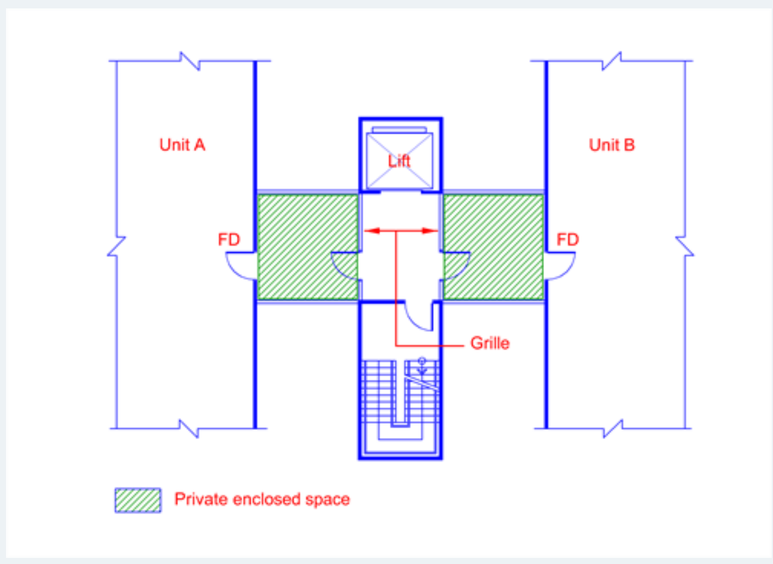


Figure 9.2.1a.(3) - 3

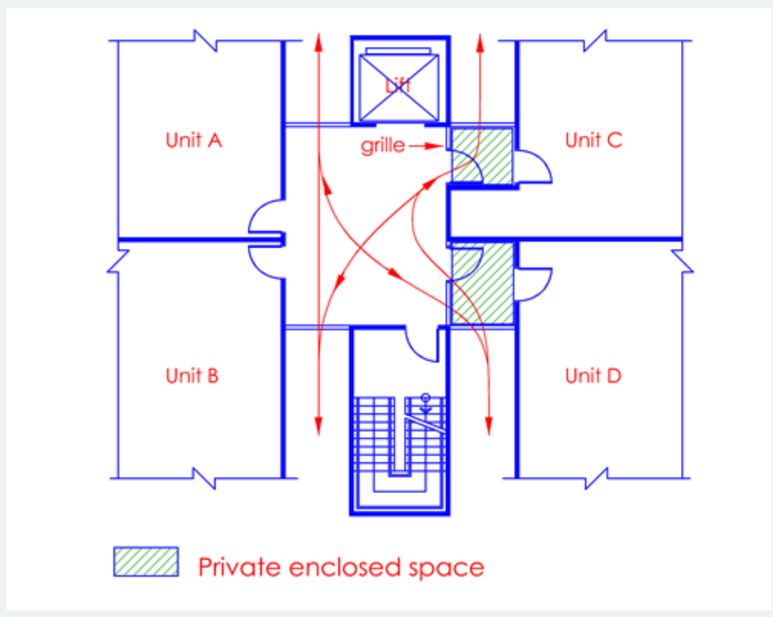
Single exit staircase is permissible in buildings with 'slab-block' design and with habitable height not exceeding 24m, if there is an open-sided corridor between the unit and the exit staircase and where the exit staircase is cross-ventilated, provided that the travel distance requirements are complied with.



Not Acceptable

Figure 9.2.1a.(3) - 4

Ventilation of the lobby through private enclosed space is not acceptable.



Not Acceptable

Figure 9.2.1a.(3) - 5

The provision of ventilation shall not be made via private spaces, as such spaces are subject to modification by the unit owner. In order to ensure the permanency of the means of ventilating the smoke-stop lobby, openings for such must always be provided through common areas.

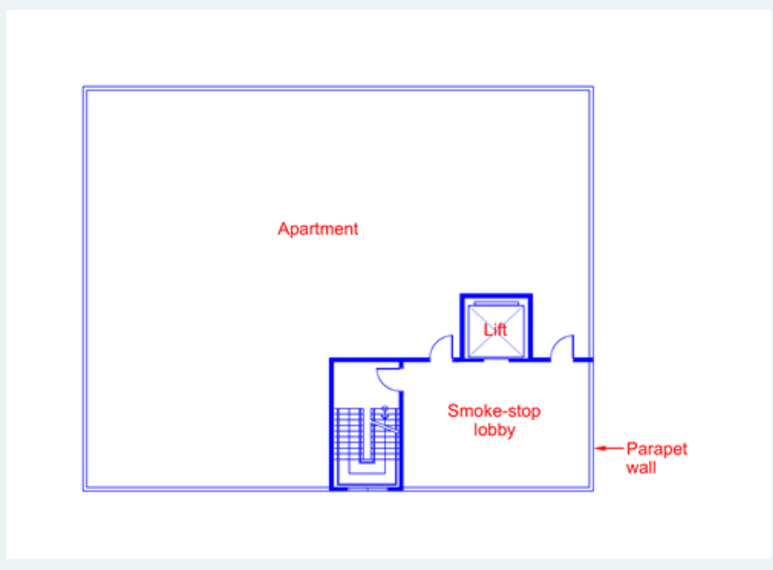


Figure 9.2.1a.(3) - 6 : Protected lobby to single-unit storeys

For single unit per storey design, the smoke-stop lobby or fire lift lobby shall not be converted to other usage. It shall be kept free of any article or furniture. Therefore, it shall be kept as a common area and not be included as part of the strata unit. The lobby area acts as buffer zone against smoke migration into the staircase. The fire lift lobby is required for use by firefighters during fire emergency.

(4) Provision for buildings exceeding 24m in habitable height

In a block of residential apartments or maisonettes exceeding 24m in habitable height, one exit staircase can be provided, subject to all of the following conditions:

(a) The building's habitable height shall not exceed 60m, unless otherwise permitted by the SCDF.

(b) The single exit staircase shall serve not more than four apartments or maisonettes at each storey.

(c) Provision of exits for each residential apartment or maisonette shall comply with the requirements under *Cl.9.2.1a.(5)*.

(d) Travel distance from the most remote exit door to the exit staircase from each apartment or maisonette shall not exceed 15m.

Explanation and Illustrations

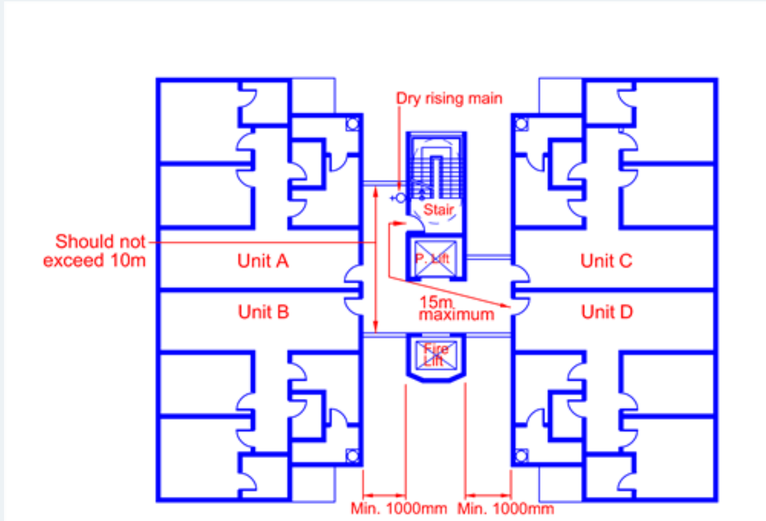


Figure 9.2.1a.(4) : Provision of single staircase for residential building not exceeding 60m in habitable height

Residential buildings not exceeding 60m in habitable height can be provided with single exit staircase, but the approach to exit staircase must be via cross-ventilated lobby. In designing the cross-ventilated lobby, there are instances where building designers only provide the minimum 2m wide and 1.2m high ventilation openings on the opposite ends of the lobby so as to minimize rain water from splashing into the lobby space. There may also be overhang structures at the openings. While the code specifies the minimum opening size for cross ventilation of the lobby, building designers are encouraged to go beyond this specification. A well-designed cross-ventilated lobby that also addresses rain water from splashing into it can be achieved through thoughtful design at the planning stage. Building designers should also note that the protrusion of any overhang structures at the openings shall not exceed 1.4m. Neither should its design be such that it results in a smaller ventilation openings size e.g. a downward sloping overhang.

(e) The approach to the exit staircase shall be through cross ventilated corridor/ lobby in accordance with Cl.1.4.29, except that the ventilation openings shall have a minimum width of 2m and a minimum height of 1.2m, as well as the following requirements:

(i) the openings shall be unobstructed from the parapet wall or balustrade level upwards and be positioned on opposite sides of the corridor/ lobby such that they provide cross ventilation throughout the entire space of the corridor/ lobby; and

(ii) the entire cross ventilated corridor/ lobby shall be unobstructed and maintained at minimum 2m width throughout.

(f) Where multiple ventilation openings are provided on opposite sides of the corridor/ lobby, the minimum width and height of each opening shall not be less than 1m and 1.2m, respectively, provided the aggregate width of the openings at each opposite side is not less than 2m. See *Diagram 9.2.1a.(4)(f)*.

Rationale

The minimum size of ventilation openings in a cross-ventilated lobby minimises the risk of the lobby being smoke-logged. These dimensions have been validated through a fire engineering study.

Explanation and Illustrations

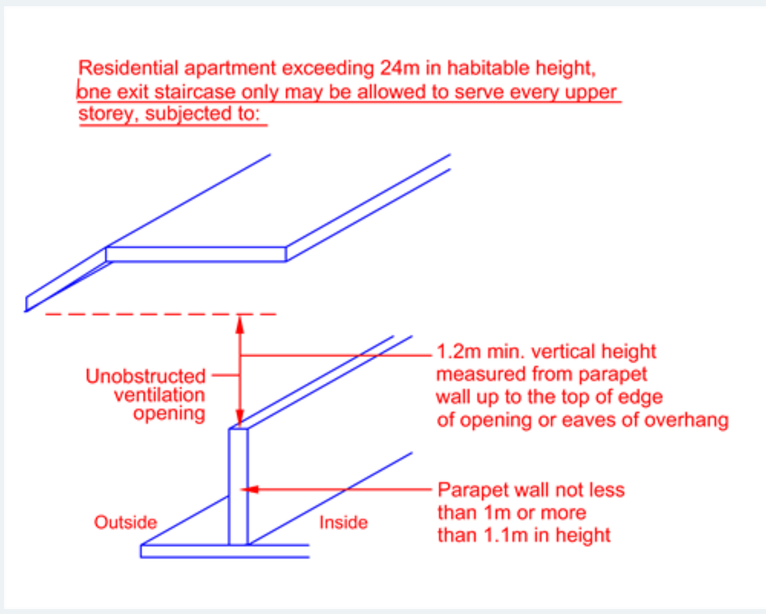


Figure 9.2.1a.(4)(e) :

Single exit provision – In a block of residential apartments or maisonettes with habitable height not exceeding 60m, one exit staircase only can be provided to every storey.

The provision of single exit staircase must be seen as a relaxation from the two exit staircases requirement. If only one exit staircase is provided, it is important that the smoke-free approach to the single exit staircase is absolutely maintained at all times. For this concern, the cross ventilation openings to the lobby must be maintained and shall not be blocked or obstructed by air-con condensing unit or other structures that may be introduced to keep rainwater away from the lobby.

(5) Exits from residential unit

(a) In each residential apartment or maisonette unit, the exit access door or doors shall be provided such that the travel distance measured from any point within the unit to the entrance door(s) of the unit shall not exceed 20m. See *Diagram 9.2.1a.(5)(a)*.

Explanation and Illustrations

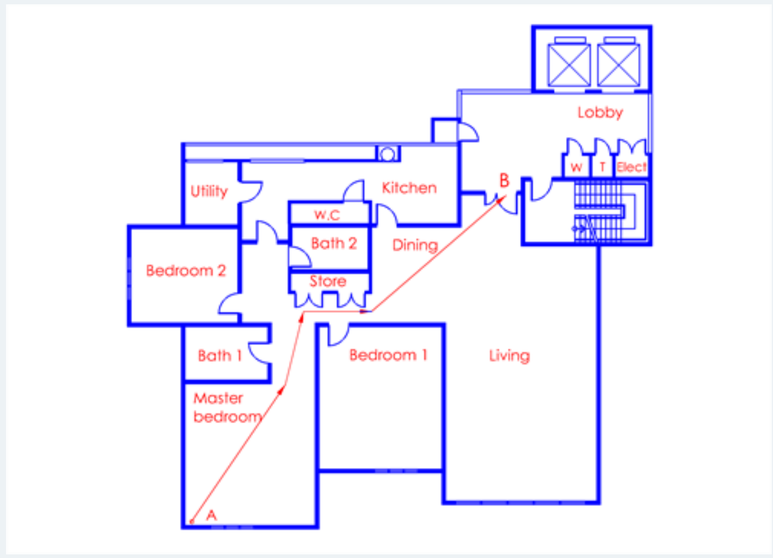


Figure 9.2.1a.(5)(a) - 1

The travel distances measured from the most remote point (A) in the unit in *Figure 9.2.1a.(5)(a) – 1* to its exit door (B) shall not exceed 20m.

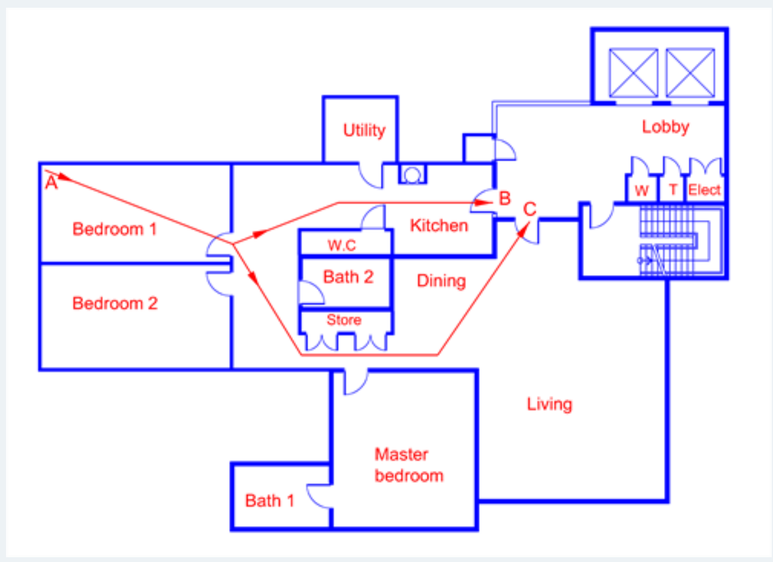


Figure 9.2.1a.(5)(a) - 2

If the travel distance from the most remote point (A) in *Figure 9.2.1a.(5)(a) – 2* to the unit's main exit door (C) exceeds 20m, then a second door (B) to the unit is required. The doors shall be located such that the travel distance from any point in that unit to the nearest exit door (B or C) is within 20m. Where a 2nd exit from a unit is required, it shall not pass through utility or storeroom.

(b) In the case of a maisonette unit comprising not more than two storeys, where a single entrance door is provided:

Explanation and Illustrations

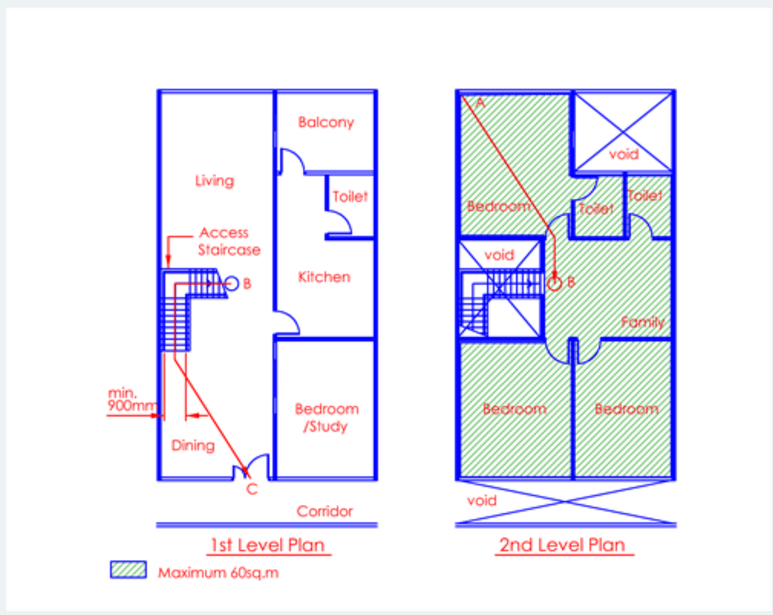


Figure 9.2.1a.(5)(b) : Exit from maisonette unit

The maisonette unit shall not comprise more than 2 storeys and the main exit shall be located at the main storey. If the upper storey exceeds 60m², there shall be at least one exit door from each storey that have direct access to the exit staircase or exit passageway.

In the single exit situation, the travel distance (ABC in *Figure 9.2.1a.(5)(b)*), measured from the most remote point in the maisonette (point A on the second level), to the main exit door opening to the corridor (point C), shall not exceed 20m.

(i) the door shall not be located on the upper storey of the unit; and

(ii) the floor area of the upper storey shall not exceed 60m², unless a separate exit is provided on this upper storey.

(c) The escape route within the unit to the unit entrance/ rear door(s) shall be kept readily accessible and unobstructed at all times, any room denied of access shall not serve as part of the escape route

(d) All exits from residential, or maisonette units shall have direct access to an exit staircase, exit passageway or external space.

(6) Measurement of travel distance

Travel distance of a residential unit shall be measured from its entrance door(s) to the exit staircase. Where a residential unit requires two entrance doors at the same storey level, and if only one exit staircase is required, the travel distance shall be measured from the most remote door. If two or more exit staircases are required, the travel distance shall be measured from the entrance door of each unit.

Explanation and Illustrations

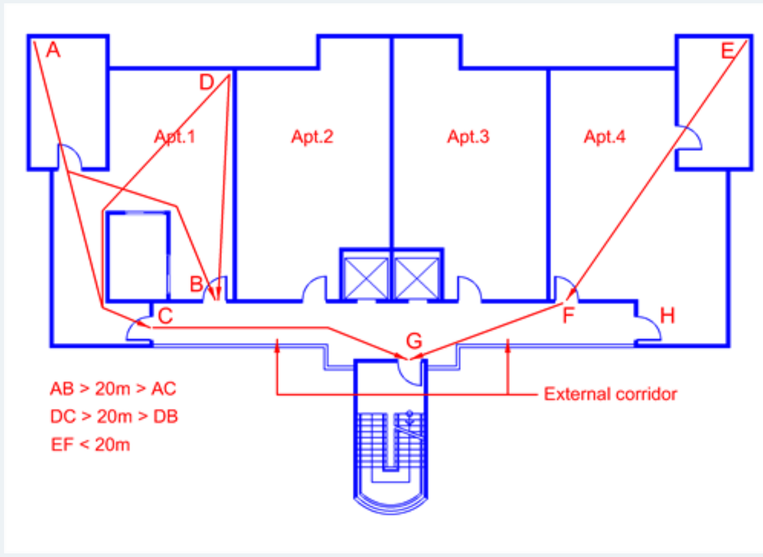


Figure 9.2.1a.(6) - 1

Doors B and C in the above figure are the required exits to Apt.1, as both doors are needed to satisfy the internal travel distances from the remote points A and D. Hence, the travel distance from Apt.1 to the exit staircase shall be measured from its most remote door to the exit staircase, which is CG.

In the case of Apt.4, the travel distance to the exit staircase shall be taken from Door H.

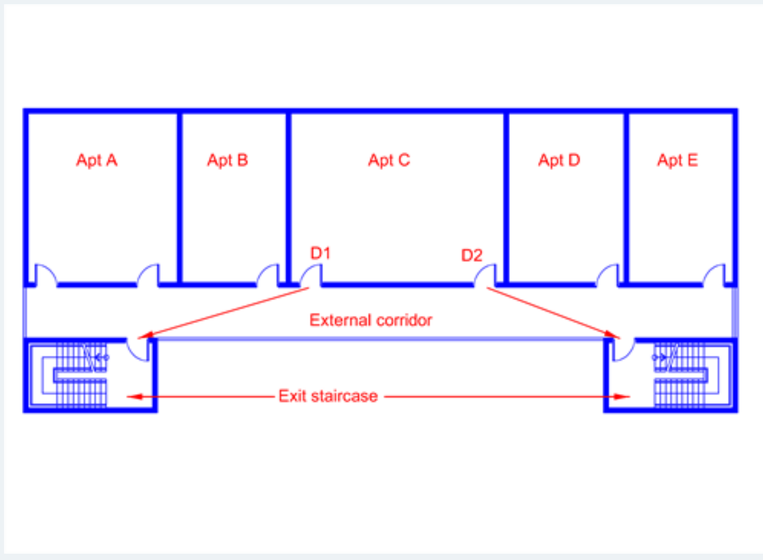


Figure 9.2.1a.(6) - 2

Where two way escape is available from an apartment in a residential block with multiple exit staircases, e.g. Apt. C in the above figure, each of its doors must be within the desired travel distance to their nearest respective exit staircase.

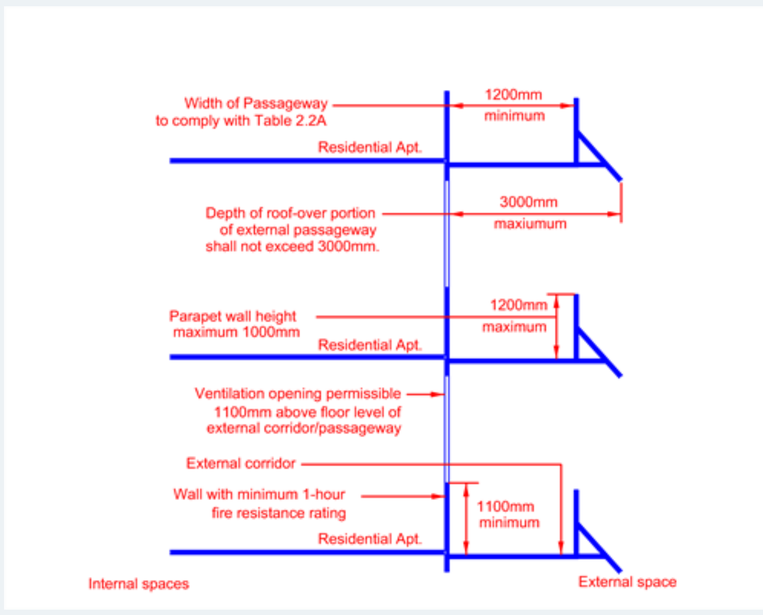
(7) Smoke-free approach to exit staircase

In a block of residential apartments or maisonettes, a smoke-free approach to an exit staircase can be provided by means of an external corridor, complying with Cl.2.3.10.

Rationale

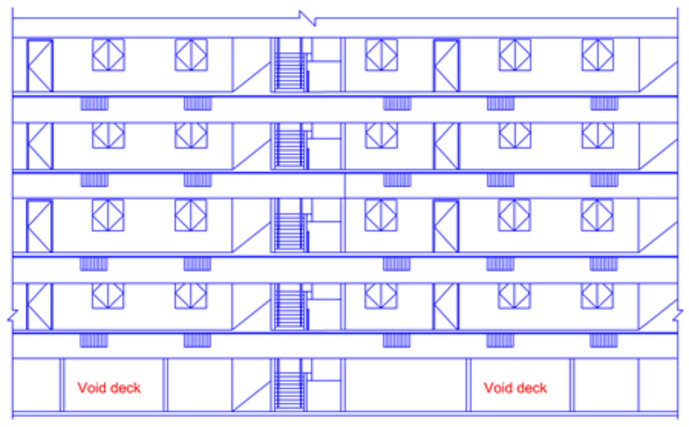
The purpose of providing a smoke-free approach to an exit staircase is to create an effective buffer for venting of smoke and heat so that occupants can access the staircase safely.

Explanation and Illustrations



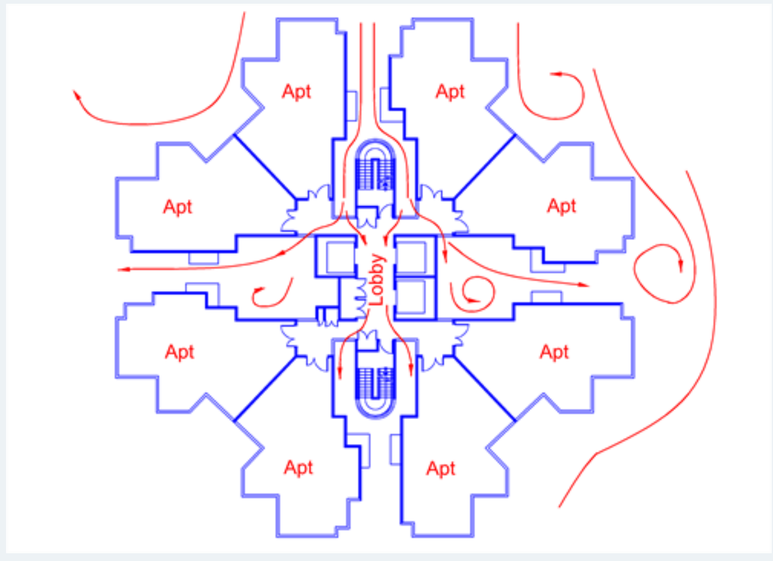
Section

Figure 9.2.1a.(7) – 1 : Part section of residential building with external corridor



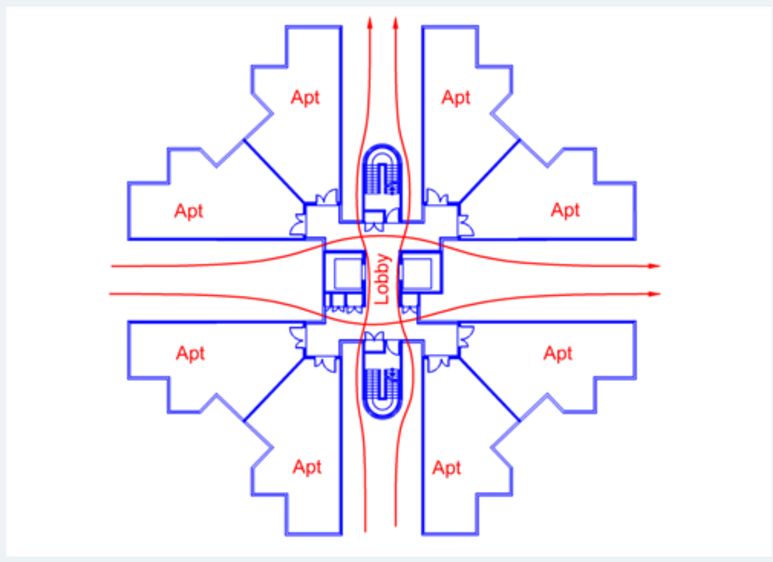
Elevation

Figure 9.2.1a.(7) - 2 : Typical layout of cross-ventilated internal corridor - Exit staircase approached from external corridor



Not Acceptable

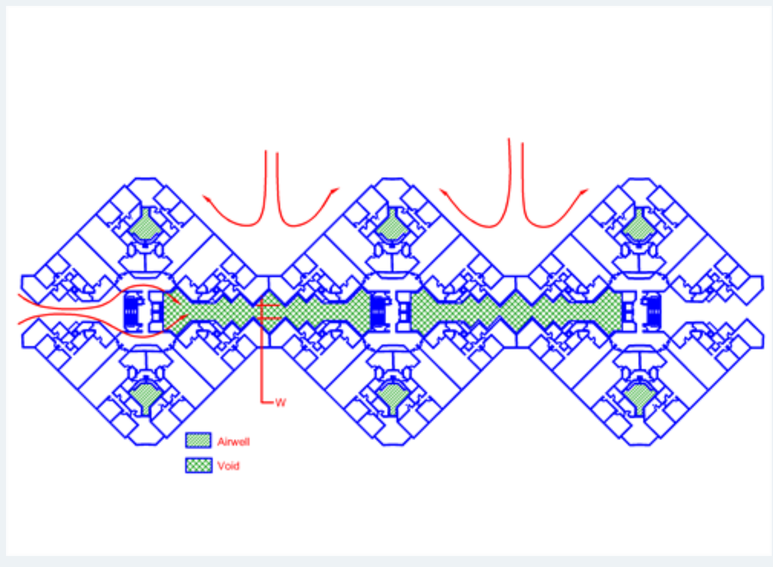
Figure 9.2.1a.(7) - 3



Acceptable

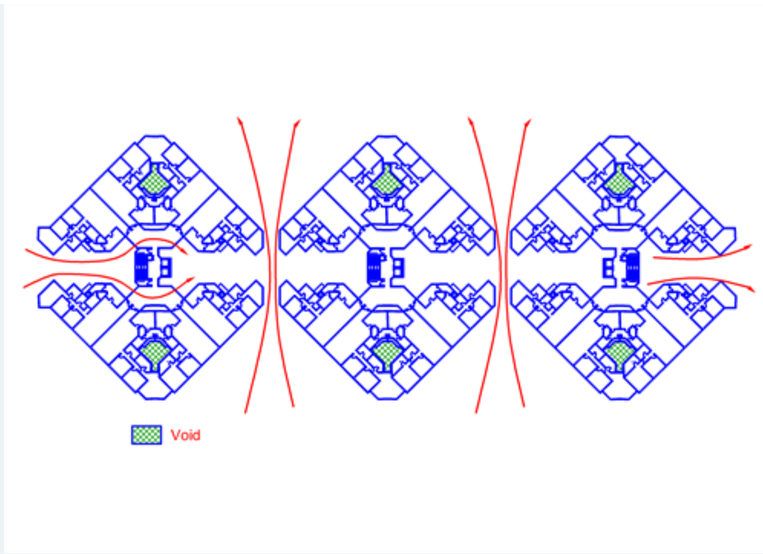
Figure 9.2.1a.(7) - 4

Corridors or lobbies, which are cross-ventilated, serve as smoke-free approach to exit staircases from residential units. For effective cross ventilation and quick smoke dispersal from these areas, particular attention must be given during design stage of buildings, to ensure clear wide open unobstructed paths for the passage of the wind currents as shown in *Figure 9.2.1a.(7) – 4*. Layout in *Figure 9.2.1a.(7) – 3* is not desirable, as the wind path is obstructed, creating a situation whereby smoke build up in the lobby area would be retained for prolonged periods by turbulent eddy wind currents.



Not Acceptable

Figure 9.2.1a.(7) - 5 : Ventilation for smoke-free approach to exit staircases - Example of a 20-storey appartment building



Acceptable

Figure 9.2.1a.(7) - 6

The above design layout (*Figure 9.2.1a.(7) – 5*), is not favourable as ventilation of the corridors and lobbies through the narrow central court or air well, is not effective for such high-rise development. The staircases are sharing ventilation with other areas via the air wells. The central services cores, which also incorporates the exit staircases and lifts, further disrupt or obstruct any possible wind current through that air well space.

For smoke free approach to exit staircases through air well, open vertically to the sky, the air well shall have a minimum width of 6m and a superficial plan area of not less than 93m².

The above layout could be improved by separating the abutting blocks and widening the width of the internal court as shown in *Figure 9.2.1a.(7) - 6*.

(8) Travel distance

(a) One-way travel distance

In a block of residential apartments or maisonettes where the means of escape is through an external corridor, the one-way travel distance measured from the door of the apartment or maisonette to the exit staircase shall not exceed 20m, or 24m if the aggregate one-way travel distance within the unit and along the external corridor does not exceed 40m. The above one-way travel distances along the external corridor shall not apply to residential apartments or maisonettes in a building exceeding 24m permitted under *Cl.9.2.1a.(3)*.

(b) Two-way travel distance

In a block of residential apartments or maisonettes, the two-way travel distance can be extended to 45m if the means of escape is through an external corridor as in *Cl.2.3.10*.

In the case of buildings which are required to be provided with rising mains, the number and distribution of rising mains specified in Chapter 6 shall be complied with.

(c) Travel distance for open-to-sky roof garden

For habitable roof garden that is fully open-to-sky and provided with at least 2 exits, the travel distance can be based on the requirement for sprinkler-protected buildings as specified in *Table 2.2A*.

Explanation and Illustrations

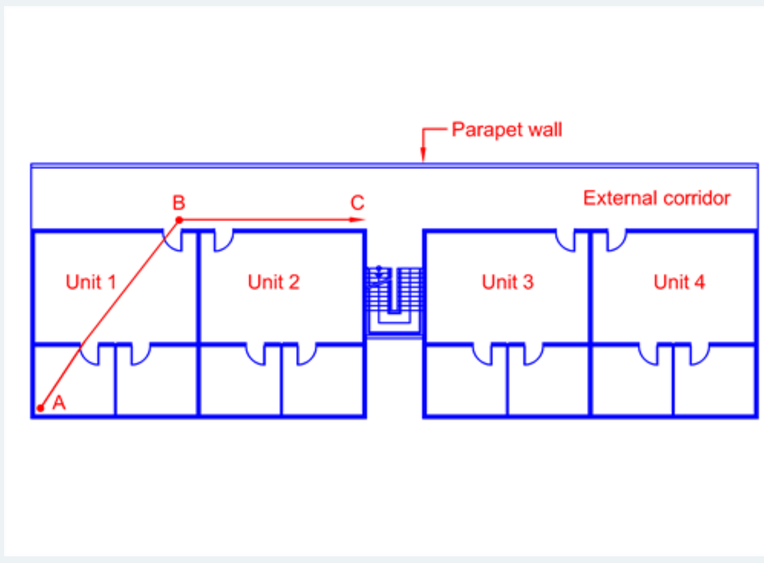


Figure 9.2.1a.(8)(a)

(9) Protection of staircases

The requirements for unprotected openings stipulated under *Cl.2.3.3a.(2)* and *Cl.2.3.3b.(2)* for internal and external exit staircases, respectively need not be complied with for PG II buildings provided:

Explanation and Illustrations

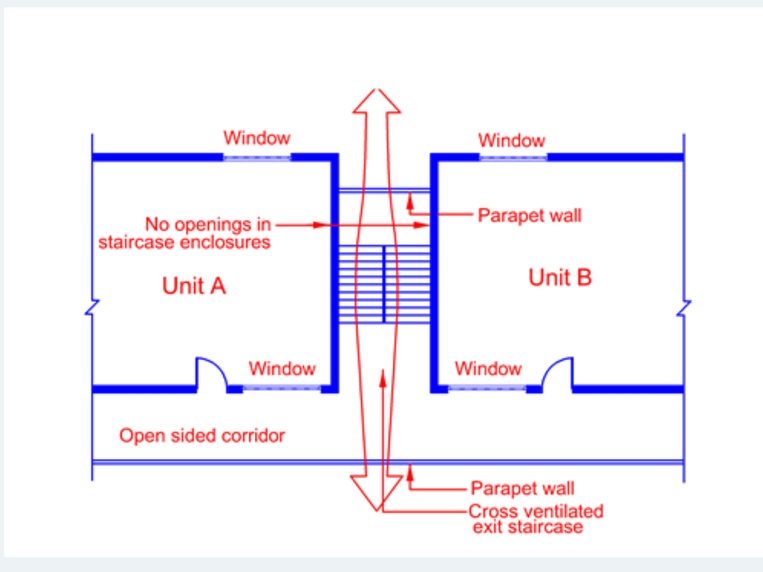


Figure 9.2.1a.(9)

Cross-ventilated exit staircase of residential apartments or maisonettes, shown in above, should be able to prevent any accumulation of smoke and provide the smoke-free condition for occupants to evacuate. The above clause grants a relaxation of the requirement for 3m separation of unprotected openings from exit staircases, required under Cl.2.3.3, and is only applicable to residential buildings.

(a) the exit staircases are cross ventilated and maintained under smoke-free conditions at all times; and

(b) unprotected openings of the apartment or maisonette units are not facing or ventilating into the exit staircase enclosures, as shown in *Diagram 9.2.1a.(9).*

(10) Ventilation

Rationale

Cross ventilation for exit staircases of residential apartments or maisonettes serves to address accumulation of smoke and provide a smoke-free condition for occupants to evacuate.

(a) Exit staircase

All exit staircases shall be naturally ventilated. Where an exit staircase is used as storey shelter, mechanical ventilation is permitted provided there are more than one exit staircase, with the remaining exit staircase(s) being naturally ventilated.

(b) Common internal corridor

Explanation and Illustrations

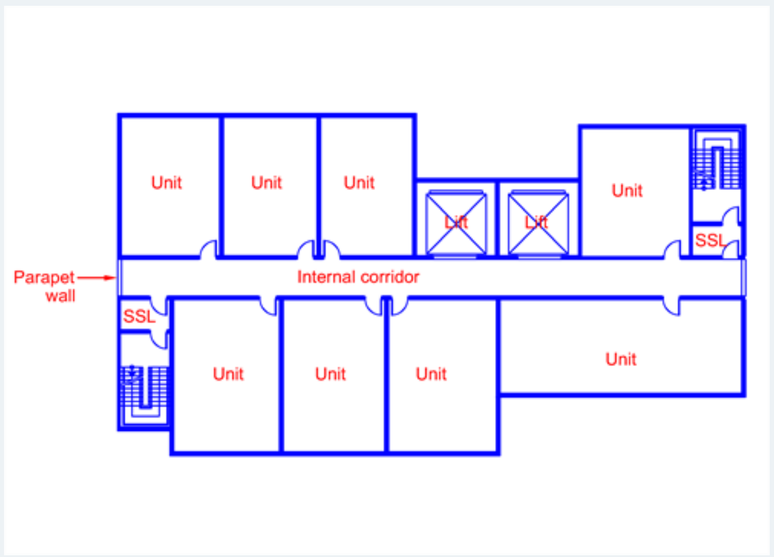


Figure 9.2.1a.(10)(b)

To address smoke-logged situation that may take place in an internal corridor, a suitable means of ventilation shall be provided. In a case of long internal corridor with units entrance fronting, it shall be provided with cross ventilation. Each end of the wall shall not be less than 50% of the superficial area of the end walls.

(i) The internal corridor not forming part of smoke-free approach to exit staircase shall have ventilation openings of not less than 15% of the floor area and located not more than 9m from any part of the common internal corridor.

(ii) Where the common internal corridor is cross ventilated, it shall be in accordance with *Cl.2.2.13b.(7)(c)*.

b. Structural fire precaution

(1) Wall separating residential apartment or maisonette

(a) Each residential dwelling unit shall be compartmented from adjoining units and other parts of the same building by construction having at least 1-hr fire resistance rating and unit's exit access door of ½-hr fire resistance rating, unless otherwise permitted under *Cl.2.3.10d.*.

(b) Any compartment wall separating a residential apartment or maisonette from any other part of the same building, shall separately comply with fire resistance requirements:

(i) the wall forms part of a protected shaft and the minimum period of fire resistance required by the provisions of this Code for the protecting structure is more than one hour, or

(ii) the part of the building from which the wall separates the residential apartment or maisonette is of a different purpose group and the minimum period of fire resistance required by the provisions of this Code for any element of structure in that part is more than one hour.

Explanation and Illustrations

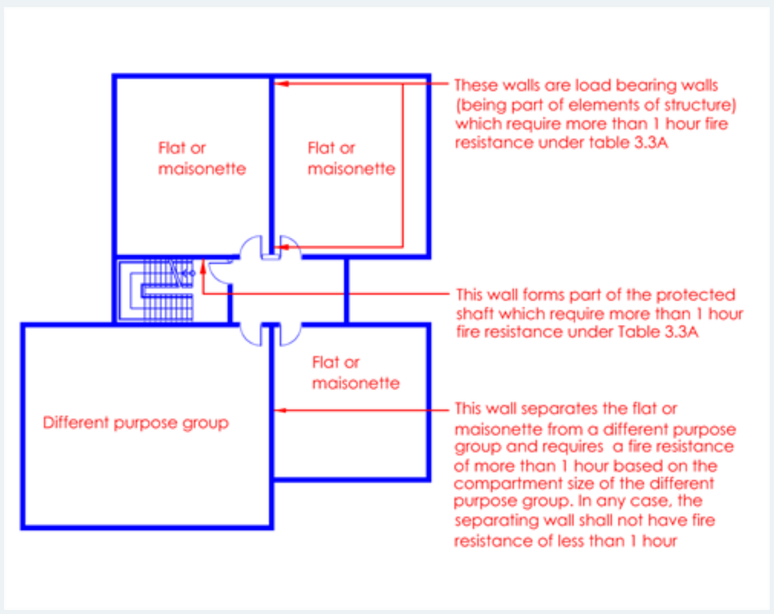


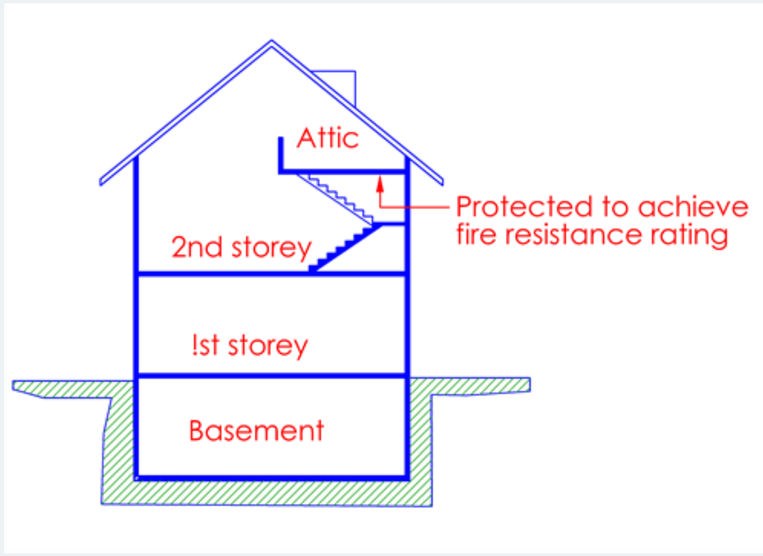
Figure 9.2.1b.(1)(b)

(2) Attic floor

An attic in buildings under PG II can be constructed of timber boarding on timber joists, provided it is protected to achieve the fire resistance rating required of the elements of structure of the building or compartment.

(3) Separation of residential floor facade

Explanation and Illustrations

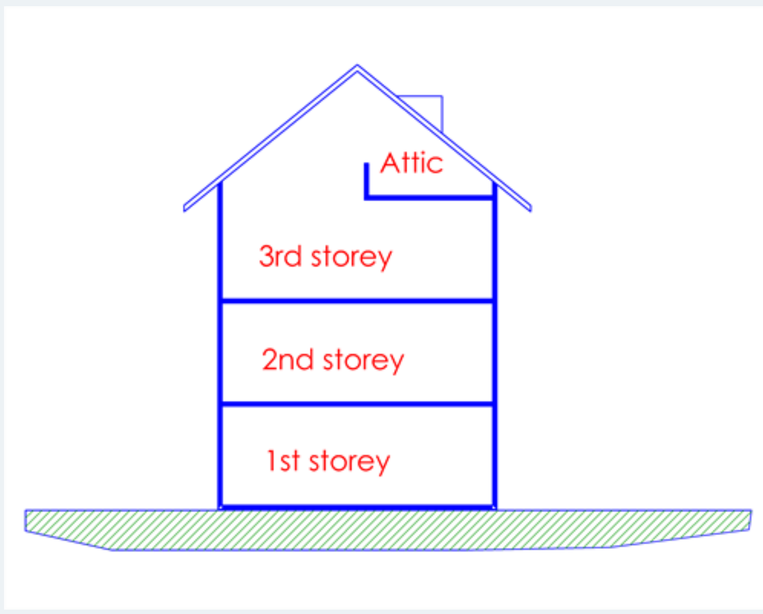


Section

Figure 9.2.1b.(2) - 1

a. An attic can be added to new or existing buildings under PG I, provided the total number of storeys or levels in the building does not exceed 4, inclusive of basement.

b. The attic can be constructed of timber boardings on timber joists, provided that it is protected to achieve the fire resistance rating required of the elements of structure of the building.



Section

Figure 9.2.1b.(2) - 2

The above should be seen as a relaxation as timber floors are only allowed in buildings under conservation. Owing to the need to create additional living space in existing houses for extended family use, etc. many applications were received to have addition of attic. In all the applications affecting existing buildings, timber floor construction was the norm for ease of construction and the need to consider the dead load affecting the existing structures. The SCDF had considered the problems of many old houses, which could not be easily and cheaply modified to receive RC floor construction for attic. Under Cl.3.15.3, impregnation of timber boardings and joists for the construction of attic is acceptable.

For residential buildings exceeding 24m in habitable height, the facade of every unit shall be separated from each other by:

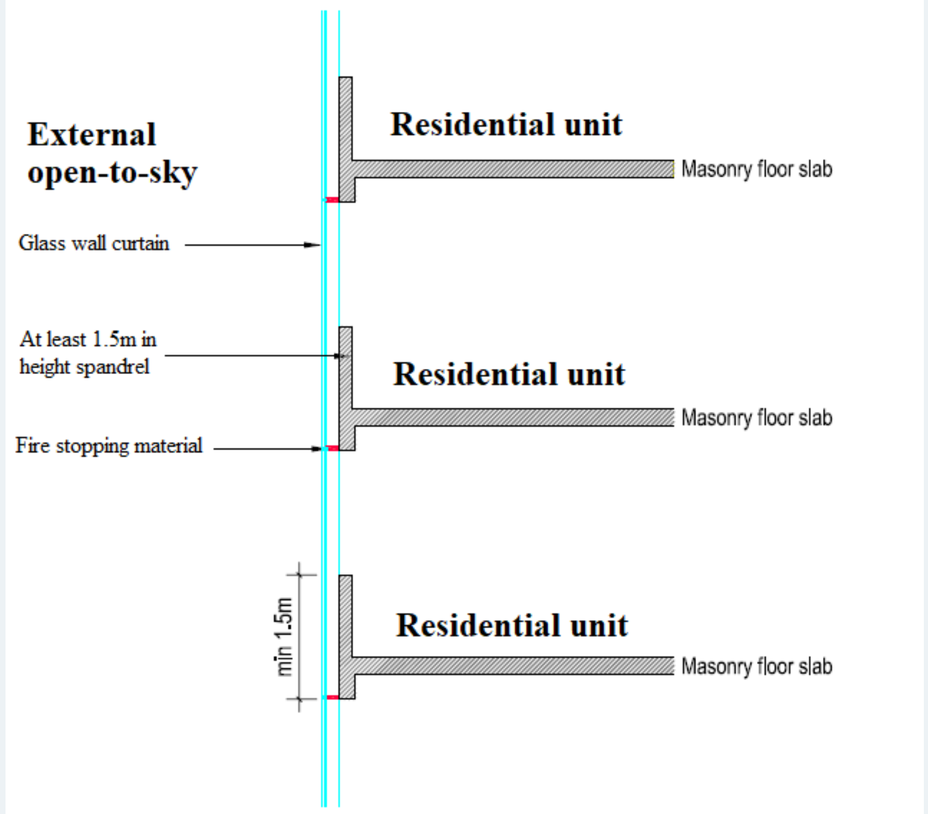
(a) a minimum 1-hr fire-rated spandrel of at least 1.5m in height, or

(b) a minimum 1-hr fire-rated horizontal projection that extends at least 600mm from the building.

Note: Balcony and air-con ledge can be used as part of this horizontal projection if they protrude at least 600mm from the building facade and have at least 1-hr fire-rated construction.

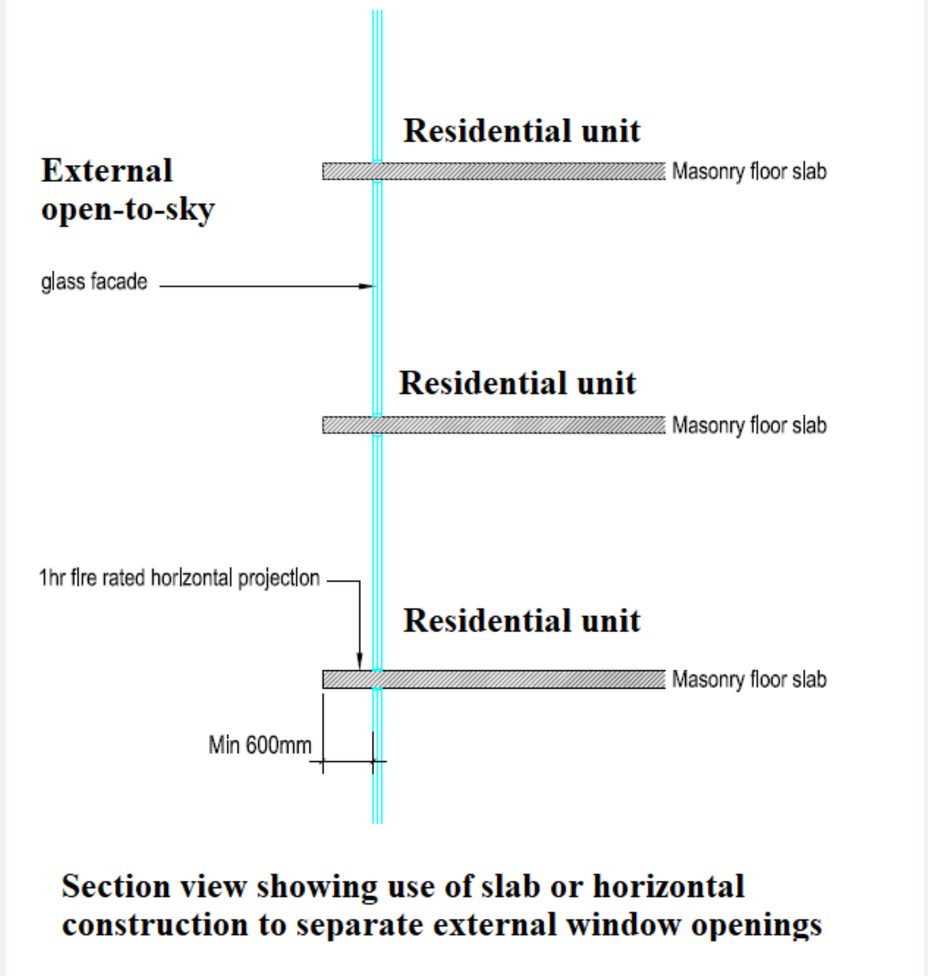
Explanation and Illustrations

Section view showing use of spandrel to separate external window openings



Section view showing separation of external facade window openings in a glass curtain wall

Illustration for Cl 9.2.1b.(3)(a)



Section view showing use of slab or horizontal construction to separate external window openings

Illustration for Cl 9.2.1b.(3)(b)

c. Single household dwelling house classified as cluster housing within PG II development

In a PG II mixed occupancy development, the single household dwelling house classified as cluster housing can adopt the requirements stipulated in *Cl.9.1.1.*

9.2.2 Super high-rise residential building

a. Refuge floor

Super high-rise residential buildings, with or without mixed occupancies, shall be provided with at least one refuge floor at an interval of not more than 20 storeys, i.e., each refuge floor shall not serve more than the 20 storeys immediately above it. The refuge floor shall comply with all of the following requirements:

(1) It shall be of masonry construction having at least 2-hr fire resistance rating.

(2) At least 50% of the accessible floor area of the refuge floor shall be designated as an evacuee holding area. There shall be no residential unit or part of the unit on the refuge floor.

(3) There shall be no commercial activities in the evacuee holding area, however, it can be used as space for physical exercises or a children's playground. All equipment placed within the evacuee holding area shall be made/constructed of non-combustible materials.

(4) The size of the evacuee holding area shall be adequate to accommodate at least the total occupant load of all storeys above the refuge floor, up till the next higher refuge floor, or the remaining floors, based on 0.3m² per person.

(5) The evacuee holding area shall be separated from other areas of the refuge floor by compartment walls having at least 2-hr fire resistance rating. Linking of the evacuee holding area with other occupied rooms/areas shall be via an external corridor, or a smoke-free lobby complying with *Cl.2.2.13a.*.

(6) The evacuee holding area shall be naturally ventilated with permanent openings on at least two sides of the external walls, with total area of at least 25% of the floor area of the evacuee holding area.

(7) The minimum height (measured from the sill to the top) of each opening shall be at least 1.2m.

(8) All parts of the evacuee holding area shall be within 9m of a ventilation opening.

(9) Ventilation openings shall be located at least 1.5m horizontally from and 3m vertically above unprotected openings, except for ventilation openings which total area as specified in *Cl.9.2.2a.(6)* above is at least 50% of the evacuee holding area, the vertical distance from the unprotected openings can be reduced to 1.5m.

(10) A sprinkler system shall be provided for the refuge floor if there is any non-residential room located on the same floor.

(11) Escape routes leading to the evacuee holding area shall be through a smoke-free/ fire lift lobby or external corridor.

(12) Emergency lighting shall be provided to cover all areas of the evacuee holding area. Such lighting shall be connected to a secondary power supply, i.e., generator, battery, etc., and shall be able to provide horizontal luminance at floor level of not less than 5 lux. The delay between the failure of the electrical supply for normal lighting and the energization of the emergency lighting for occupied areas shall not exceed 15 secs.

(13) A sign depicting "EVACUEE HOLDING AREA" shall be displayed inside the exit staircase and on wall immediately outside the exit staircase at the refuge floor. The sign of lettering size of at least 50mm shall be displayed at a height of 1.5m above the landing/ finished floor level.

(b) Provision of fire lift

(1) The fire lift car shall have a clear area/ space of not less than 1.7m (depth) x 1.5m (width).

(2) Two-way emergency voice communication system shall be provided between the fire lift lobby at the refuge floor and the following locations in order of priority:

(a) FCC, or

(b) Main alarm panel, or

(c) Respective fire lift lobby at grade level nearest the fire engine access road.

(3) At least two fire lifts shall be provided for a super high-rise residential building.

Diagram 9.2.1a.(4)(f): Provision of exit staircase for residential building not exceeding 60m in habitable height

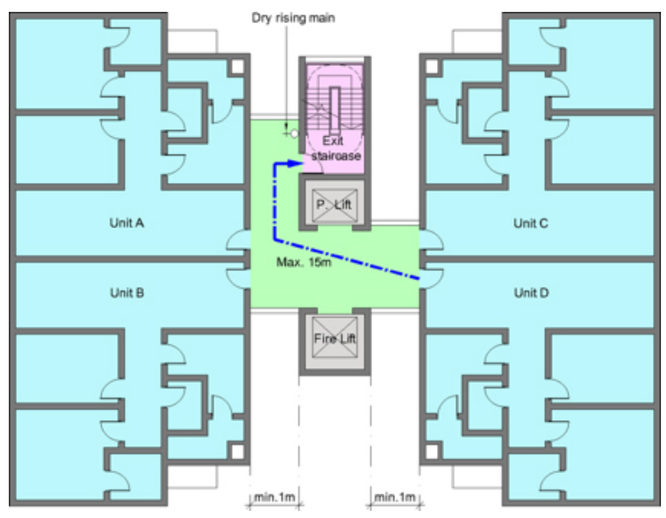


Diagram 9.2.1a.(4)(f): Provision of exit staircase for residential building not exceeding 60m in habitable height

In a block of residential apartments or maisonettes not exceeding 60m in habitable height, one exit staircase only can be provided to every storey.

Diagram 9.2.1a.(5)(a): Provision of exit for apartment unit

Diagram 9.2.1a.(5)(a): Provision of exit for apartment unit

Diagram 9.2.1a.(9): Cross-ventilated exit staircase to residential apartment/ maisonette

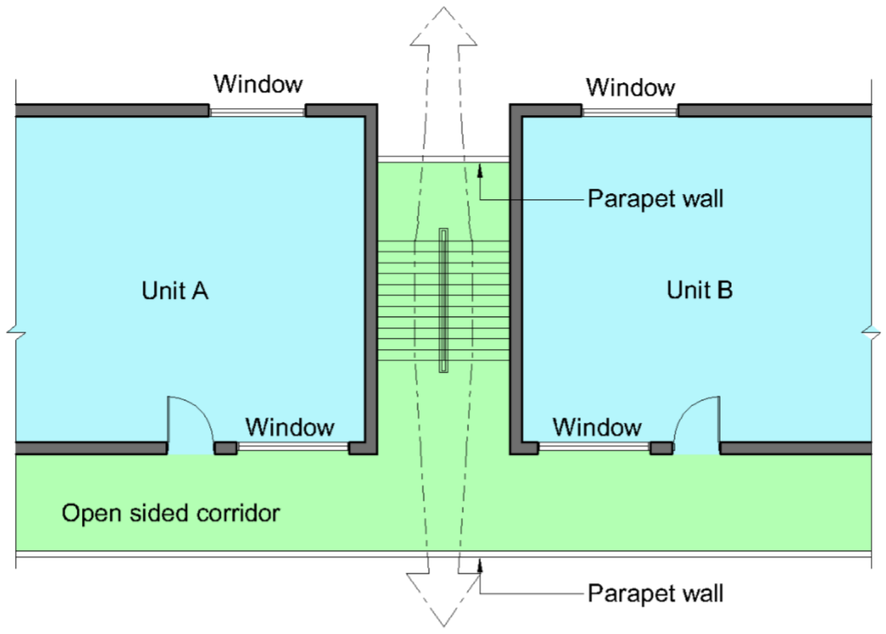


Diagram 9.2.1a.(9): Cross-ventilated exit staircase to residential apartment/ maisonette

Exit staircase is cross-ventilated and maintained under smoke-free condition at all times. Unprotected openings of the apartment/ maisonette units are not facing or ventilating into the exit staircase enclosure.

CLAUSE 9.3 PURPOSE GROUP III OCCUPANCY

9.3.1 General

a. Means of escape

(1) One exit staircase is permitted to serve an aboveground floor used for educational/ training purposes provided:

(a) the habitable height of the floor shall not exceed 15m;

(b) the floor shall not be located above 4th storey;

(c) the AFA of the floor shall not exceed 200m²;

(d) the occupant load of the floor shall not exceed 30 persons; and

(e) the exit staircase/ floor in the building shall not be of timber construction.

9.3.2 Healthcare occupancy

(6) Provision of fire escape bed lifts

Explanation and Illustrations

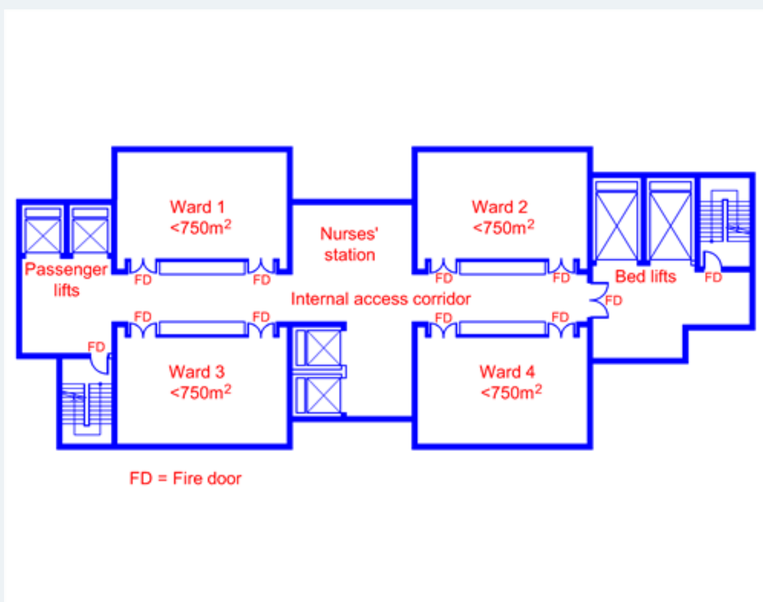


Figure 9.3.2b.(7)

As the internal access corridor is an escape route for all the occupants in Wards 1 to 4, it shall be made protected from the ward areas.

a. General

Sprinkler shall be provided for healthcare occupancy with patient accommodation if:

(1) it comprises more than one storey, or

(2) it is located on an upper storey other than first storey, or

(3) its largest non-compartmented AFA exceeds 750m².

b. Hospital

They shall comply with the following additional requirements:

(1) Basement

Patient accommodation area containing beds shall not be located in basement storeys.

(2) Width of exit

The minimum clear width of an exit door opening shall be not less than 1.2m.

(3) Number of exits per ward

For patient accommodation wards where the occupant load exceeds 50 persons, each ward shall be provided with at least two exits, which shall be remotely located from each other.

(4) Provision of area of refuge

Every upper storey used for the accommodation of patients shall be provided with at least one area of refuge. The size of the area of refuge shall be computed based on *Table 1.4B*. For hospital and nursing home, the area of refuge shall be sized adequately to accommodate the number of beds of minimum dimension 2.55m (length) by 1.1m (width) and computed based on occupant load factor of 2.8m^2/person for the ward served by the area of refuge.

(a) For area of refuge not adjacent to the patient ward, the routes leading to the area of refuge shall be through:

(i) an external corridor complying with *Cl 2.3.10*, or

(ii) a protected lobby separated from the adjoining areas of the building by a wall and door of at least 1-hr fire resistance rating. The protected lobby shall have a minimum size of 4m (length) by 2m (width) and ventilated in accordance with *Cl 2.2.13b.(7)(a)* or *(b)*

(b) For area of refuge immediately adjacent to a patient ward, the routes leading to the area of refuge need not be through an external corridor provided both the area of refuge and the adjacent patient ward are:

(i) fire compartmented from each other by a wall and door of at least 1-hr fire resistance rating;

(ii) provided with engineered smoke control and the design smoke layer height shall be at least 2.5m above the finished floor; and

(iii) provided with minimum of 2 remotely located exit access between them.

(5) Size and compartmentation of patient accommodation area

(a) Each patient accommodation ward shall not exceed a floor area of 750m² and an occupant load of 75 persons, calculated on the basis of Accessible Floor Area (AFA) of 10m² per person.

Explanation and Illustrations

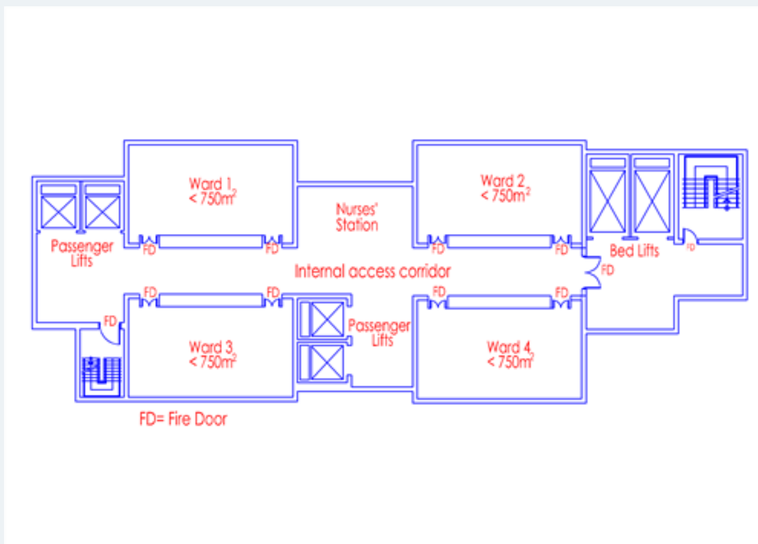


Figure 9.3.2b.(5)

The above figure shows 4 wards that are fire compartmented from the internal corridor by walls and doors having 1-hr and ½-hr fire resistance rating respectively.

(b) For single storey premises not protected by sprinkler, each patient accommodation ward shall be constructed as a compartment having at least 1-hr fire resistance rating and at least ½-hr fire resistance rating door for protection of door openings. It shall be provided with an automatic fire alarm system.

(c) For sprinkler-protected premises, patient accommodation ward area shall not exceed a fire compartment size 2100m² and shall be separated by full-height smoke barrier (up to soffit of the slab) for patient rooms of aggregated area not exceeding 750m² within the ward.

(6) Provision of fire escape bed lifts

(a) At least two fire escape bed lifts shall be provided for premises with more than one storey. They shall be located remotely from each other and sited adjacent to a protected exit staircase. Each area of refuge shall also be served by at least one fire escape bed lift. Fire lift can double-up as a fire escape bed lift provided there is more than one fire lift and at least one shall remain as a dedicated fire lift. Where the fire lift doubles up as fire escape bed lift, its dimension shall be as specified in *Cl.9.3.2b.(6)(c)*.

(b) The fire escape bed lift shall be contained within a protected shaft, constructed to comply with the relevant requirements under Cl.3.8.

(c) The entry into the fire escape bed lift and the protected exit staircase shall be through a common protected lobby. The fire escape bed lift shall have a minimum clear platform size of 2.8m (depth) by 1.8m (width). The protected lobby shall have a minimum size of 5m (length) by 4m (width). In the situation where the protected lobby is also serving as a smoke-free lobby or fire lift lobby, the floor area of the lobby shall be of sufficient size to accommodate both the evacuation of the required number of beds, as well as the passage of other occupants into the protected staircase.

(d) A signage shall be displayed outside the bed lift stating “FIRE ESCAPE BED LIFT”.

Explanation and Illustrations

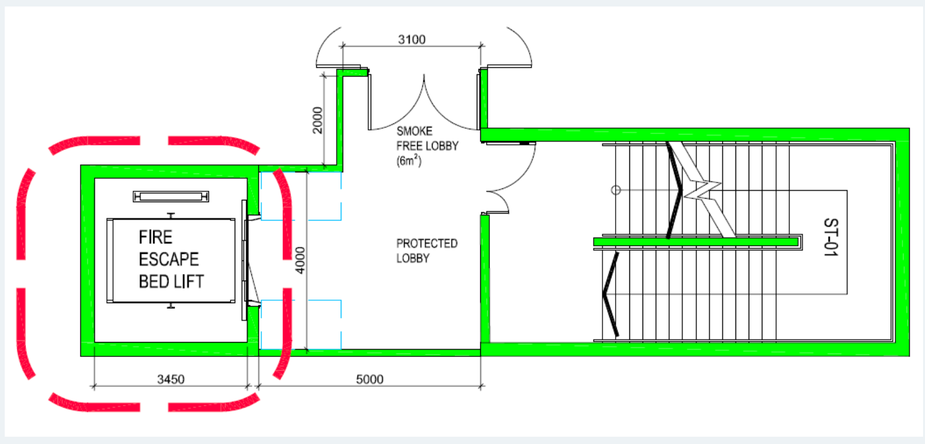


Figure 9.3.2b.(6)(c)

Escape bed lifts are used for the evacuation of patients who are bed-ridden. The escape bed lift shall be provided adjacent to a protected exit staircase. The fire escape bed lift shall have a minimum clear platform size of 2.8m (depth) by 1.8m (width). The protected lobby shall have a minimum size of 5m (length) by 4m (width). In the situation where the protected lobby is also serving as a smoke-free lobby or fire lift lobby, the floor area of the lobby shall be of sufficient size to accommodate both the evacuation of the required number of beds, as well as the passage of other occupants into the protected staircase. A signage shall be posted outside the bed lift, stating “Fire Escape Bed Lift”.

(e) The escape route for the fire escape bed lift at the 1st storey level shall be protected from other occupancy areas by 1-hr fire resistance separation and shall discharge directly into an external space.

Explanation and Illustrations

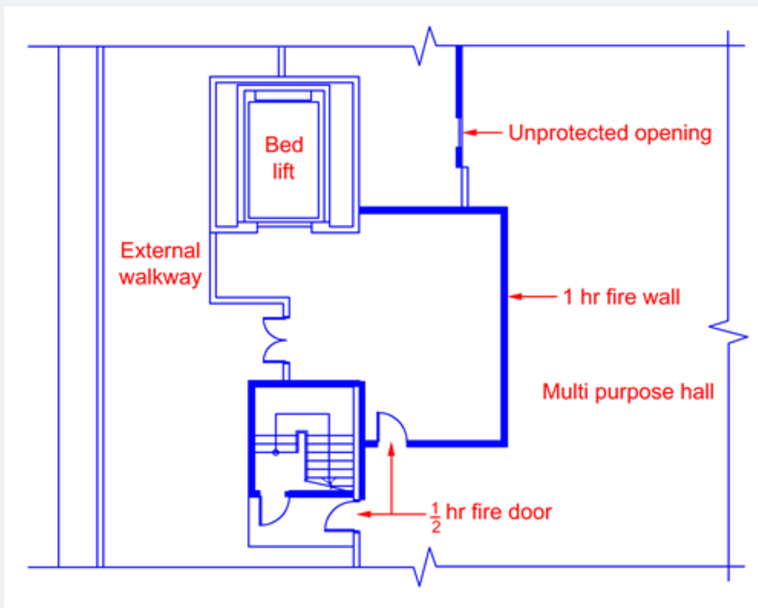


Figure 9.3.2b.(6)(e)

The discharge route for the exit bed lift is to be protected from other occupancy by 1-hr fire-rated wall and ½-hr fire-rated door.

(f) An fire escape bed lift that opens directly into an external corridor and which is sited adjacent to a protected exit staircase does not require a protected lobby, provided there is no unprotected opening within 3m horizontally from the fire escape bed lift door opening. The fire escape bed lift provided in this situation may be treated as a common bed lift that

can serve multiple compartments located on the same floor.

(g) An fire escape bed lift shall be provided with the following features:

Explanation and Illustrations

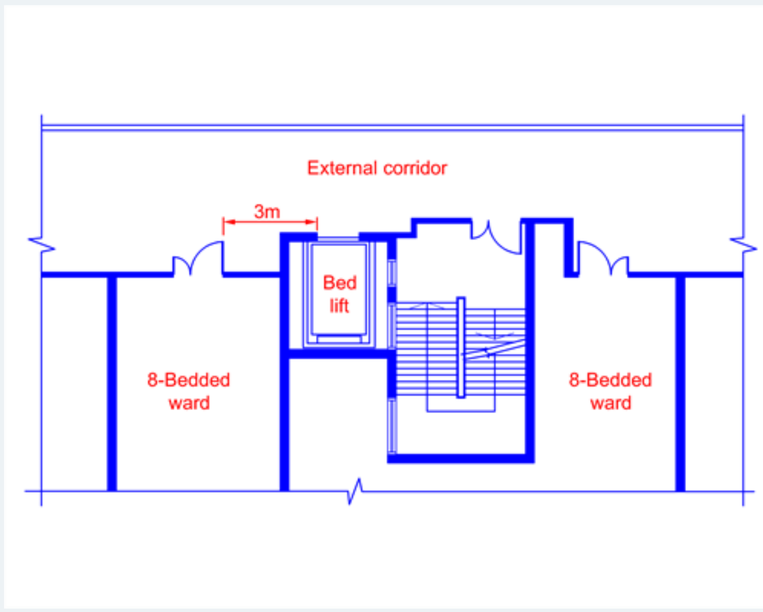


Figure 9.3.2b.(6)(f)

The provision of protected lobby to the bed lift is not required, provided there is no unprotected opening within 3m horizontally from the bed-lift door opening.

(i) a secondary power supply from an emergency generating plant;

(ii) a switch labelled "Fire Escape Bed Lift", situated next to the lift landing door at the final exit storey, which enables an authorised person nominated by the building management to take control of the lift car during an emergency. The operating of the switch shall be similar to fire lift operational features stipulated in *SS 550*. Such a switch is not needed in two-storey buildings;

(iii) a communications system (except in two-storey buildings) shall be installed to allow communication between occupants at each lift landing and the operator in the lift car; and

(iv) the installation of fire escape bed lifts shall be in accordance with *SS 550*.

Rationale

The purpose of providing a secondary power supply from an emergency plant is to ensure that the escape bed lift will stay operational during a fire emergency or a power failure in the building.

(7) Internal access to wards

Explanation and Illustrations

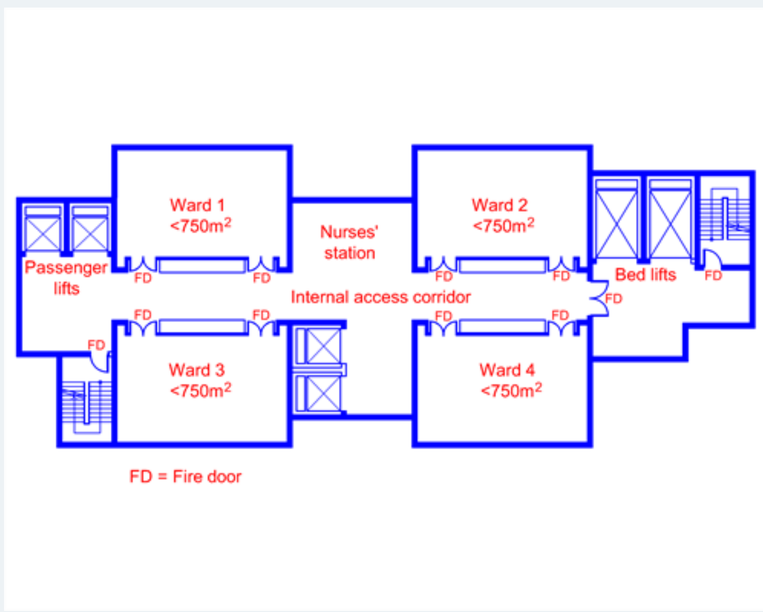


Figure 9.3.2b.(7)

As the internal access corridor is an escape route for all the occupants in Wards 1 to 4, it shall be made protected from the ward areas.

A patient accommodation ward with access through an internal corridor shall comply with the following requirements:

(a) each ward shall be separated from the internal corridor by a wall having at least 1-hr fire resistance rating;

(b) doors opening into an internal corridor shall have at least ½-hr fire resistance rating and be fitted with an automatic self-closing device to comply with the requirements of Cl.3.9.2; or be held open by an electromagnetic or electromechanical device;

(c) requirements on fire compartmentation under *Cl.9.3.2b.(7)(a)* and *Cl.9.3.2b.(7)(b)* can be relaxed up to a size of 2100m² as per *Cl.9.3.2b.(5)(c)*, if the premises is sprinkler-protected;

(d) an internal corridor shall be naturally cross ventilated in accordance with *Cl.2.2.13b.(7)(c)*;

(e) an internal corridor can be provided with mechanical ventilation and pressurisation in lieu of natural ventilation; and

(f) other non-patient accommodation areas or spaces which open into or form part of the internal corridor, and which can jeorpadise the means of escape provision, shall be compartmentalised by 1-hr fire-rated enclosures and ½-hr fire-rated doors unless otherwise allowed under *Cl.9.3.2b.(4)(b)* and *Cl.9.3.2b.(6)(c)*.

(8) External access to wards

External access to a patient accommodation ward shall be through external corridor complying with Cl.2.3.10.

Rationale

External corridor and lobby space facing external space will minimise the possibility of smoke-logged situation to facilitate safe evacuation of occupants in a fire emergency. These dimensions have been validated through a fire engineering study.

Explanation and Illustrations

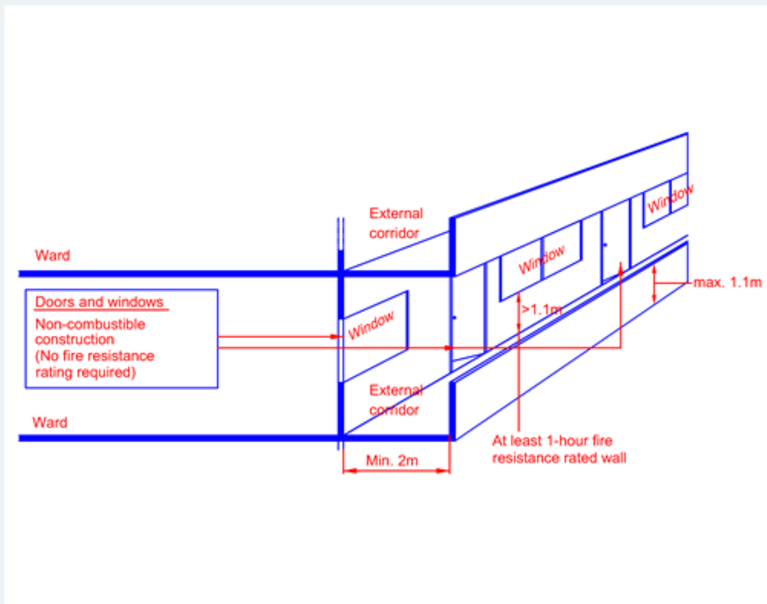


Figure 9.3.2b.(8)

(9) Smoke-free approach to exit staircase

(a) Entry into an exit staircase from any part of a building of more than four storeys above ground level shall comply with the requirements of smoke-free approach to an exit staircase, as stipulated in Cl.2.2.13.

(b) Where a smoke-free lobby is provided to an exit staircase to serve a patient accommodation floor, or any area where patients may need to be evacuated on mattresses or stretchers, the lobby shall have a minimum clear space (unobstructed by door swing) of 6m².

Explanation and Illustrations

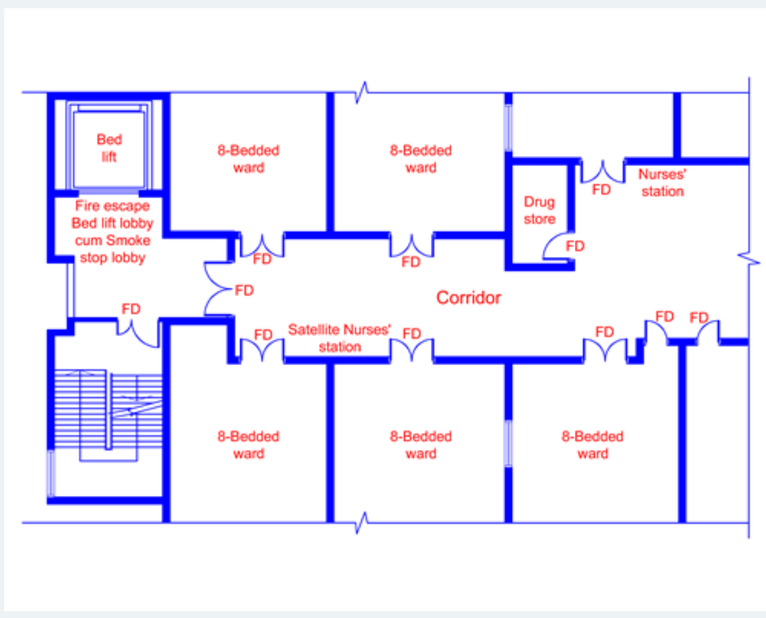


Figure 9.3.2b.(9)

The clear space within a smoke-stop lobby shall not be less than 6m² to accommodate the people in wheelchairs, etc. In the above figure the smoke-stop lobby also performs as a fire escape bed-lift lobby. The floor area shall not be less than 9m² having a depth of minimum 2.5m perpendicular to the lift landing door.

(10) Staircase landing width/depth

(a) Exit staircases that serve a patient accommodation floor to be used by patients in an emergency fire situation shall be designed to allow the evacuation of patients on mattresses or stretchers.

(b) The width of stairs, and staircase landing width and depth shall comply with *Table 9.3A* .

Explanation and Illustrations

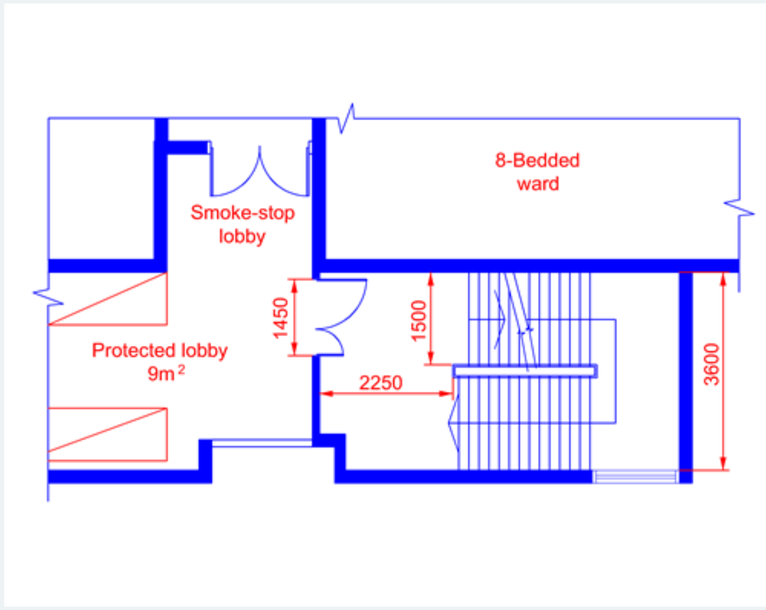


Figure 9.3.2b.(10) – 1

Exit Capacity Calculation

Exit Door width = 1.45m

Unit of width = 2.5

Person per unit width = 30 persons

No of person provided = 30 X 2.5= 75 persons

Stair Landing Depth = 1.6m and clear width of staircase = 1.5m)

Unit of width = 3 (Using clear width of staircase as it is less than 1.6m)

Person per unit width = 15 persons

No. of person provided = 15 persons x 3 = 45 persons

No. of persons provided with means of escape for this staircase = 45 persons.

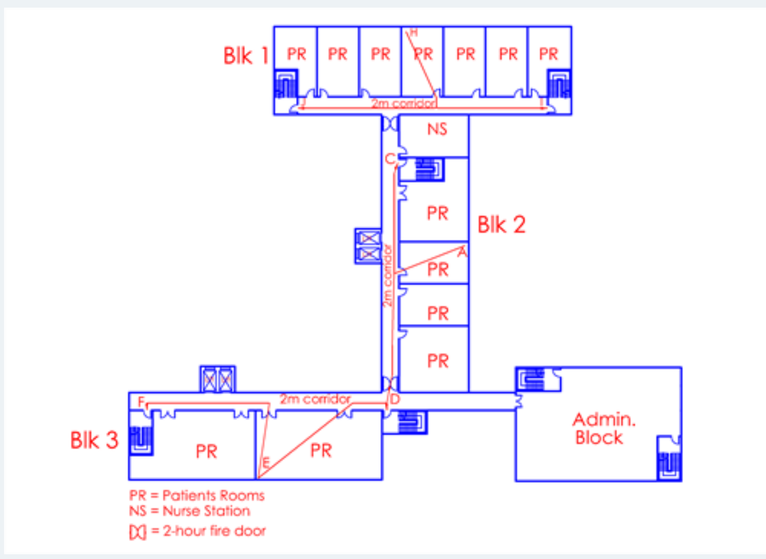


Figure 9.3.2b.(10) – 2

In *Figure 9.3.2b.(10) - 2*, each block is provided with at least 2 exit staircases, except for Blk 2, which is provided with only one exit staircase. This is because blocks 1 and 3 serve as areas of refuge for Blk 2. The holding area in Blk 1 and 3 shall be based on the area of 2.8m²/person. See Cl.9.2 and *Cl.2.2.6e.* for further explanation. Administration block is self-sufficient in the provision of exit staircases

Owing to the design using area of refuge concept, the 2m wide corridors are required to be designed and maintained as open-sided at all times. This will prevent the corridors from being filled with smoke during a fire emergency. The max. 2-way travel distances shall not exceed 30m or 45m if sprinkler-protected. The direct distances for Blk 1 and 3, from point H to I and point E to F respectively shall not exceed ⅔ of 30m or ⅔ of 45m, if sprinkler-protected, for open plan layout. The direct distance for Blk 2 from point A to D, entry point to Blk 3 as area of refuge, shall not exceed ⅔ of 30m or ⅔ of 45m if sprinkler-protected, for open plan layout. Travel distances shall comply with *Table 2.2A* when internal partitioning work is introduced to create patients' rooms etc..

Where the occupant load of any room exceeds 50 persons, the doors to the room shall be made to swing outwards. Care should be taken to ensure that the corridor width is not affected.

(11) Healthcare occupancy above 120m in habitable height

Healthcare occupancies with patient accommodation of habitable height more than 120m shall comply with the following requirements:

(i) Smoke detectors shall be provided for the entire building. Other types of detectors are permitted in special environmental conditions as stated in *SS 645*.

(ii) Sprinkler systems installed shall be equipped with fast-response sprinkler heads.

(iii) Each area of refuge shall be provided with its own dedicated fire escape bed lift.

(iv) Each area of refuge shall have access to at least two separate areas of refuge complying with *Cl.9.3.2b.(4)*.

(v) All fire escape bed lifts in accordance with *Cl.9.3.2b.(6)* shall be designed to operate at a minimum average rated speed of 3.5m/s.

Explanation and Illustrations

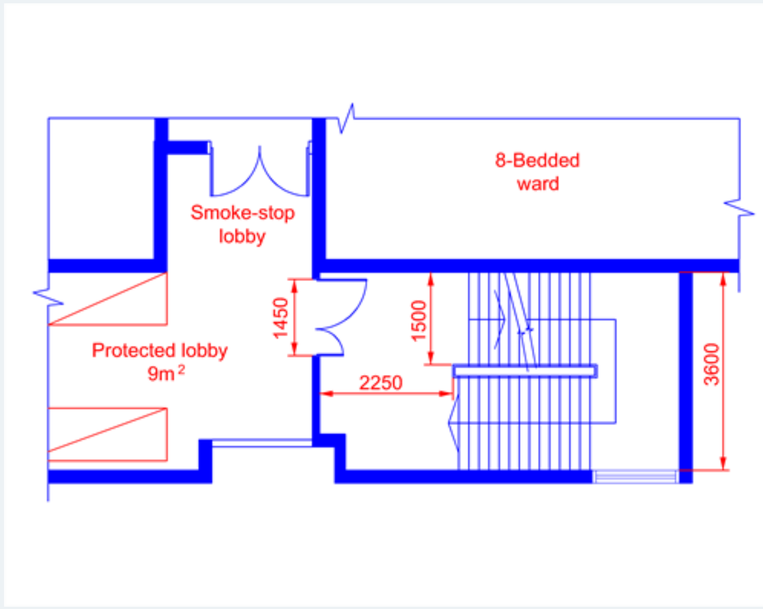


Figure 9.3.2b.(10) – 1

Exit Capacity Calculation

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Unit of width = 2.5

Person per unit width = 30 persons

No of person provided = 30 X 2.5= 75 persons

Stair Landing Depth = 1.6m and clear width of staircase = 1.5m)

Unit of width = 3 (Using clear width of staircase as it is less than 1.6m)

Person per unit width = 15 persons

No. of person provided = 15 persons x 3 = 45 persons

No. of persons provided with means of escape for this staircase = 45 persons.

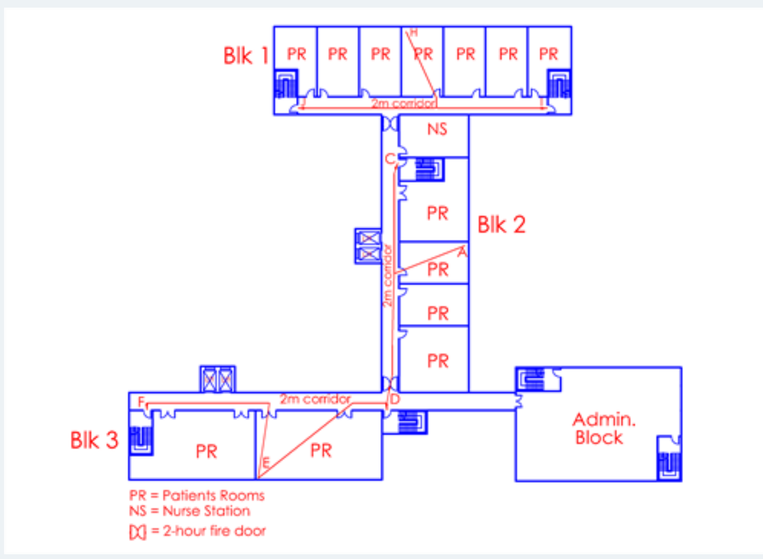


Figure 9.3.2b.(10) – 2

In *Figure 9.3.2b.(10) - 2*, each block is provided with at least 2 exit staircases, except for Blk 2, which is provided with only one exit staircase. This is because blocks 1 and 3 serve as areas of refuge for Blk 2. The holding area in Blk 1 and 3 shall be based on the area of 2.8m²/person. See Cl.9.2 and *Cl.2.2.6e.* for further explanation. Administration block is self-sufficient in the provision of exit staircases

Owing to the design using area of refuge concept, the 2m wide corridors are required to be designed and maintained as open-sided at all times. This will prevent the corridors from being filled with smoke during a fire emergency. The max. 2-way travel distances shall not exceed 30m or 45m if sprinkler-protected. The direct distances for Blk 1 and 3, from point H to I and point E to F respectively shall not exceed ⅔ of 30m or ⅔ of 45m, if sprinkler-protected, for open plan layout. The direct distance for Blk 2 from point A to D, entry point to Blk 3 as area of refuge, shall not exceed ⅔ of 30m or ⅔ of 45m if sprinkler-protected, for open plan layout. Travel distances shall comply with *Table 2.2A* when internal partitioning work is introduced to create patients' rooms etc..

Where the occupant load of any room exceeds 50 persons, the doors to the room shall be made to swing outwards. Care should be taken to ensure that the corridor width is not affected.

c. Nursing home, convalescent home, home for the aged and hospice

They shall comply with the full requirements stated under *Cl.9.3.2a.* and *b.* for hospital.

Explanation and Illustrations

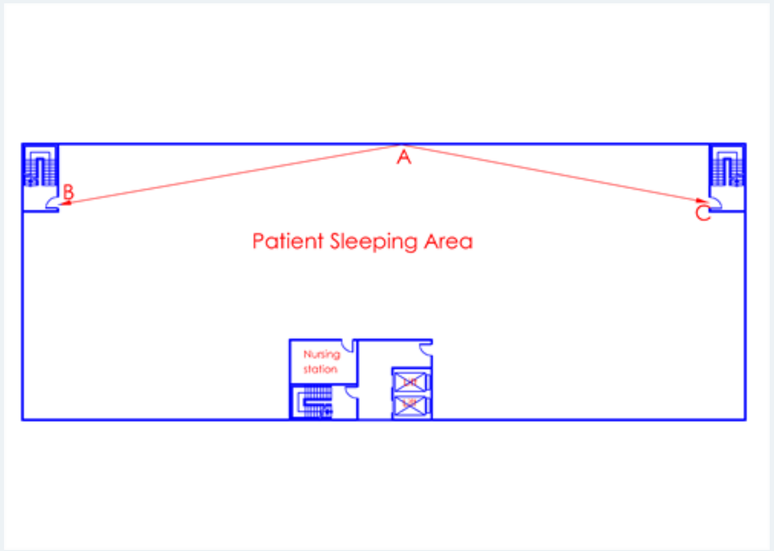


Figure 9.3.2c. - 1

Nursing home shall also include hospices. Each floor of the patient sleeping area shall be provided with at least 2 exit staircases. Most of the occupants of nursing homes are considered as non-ambulatory or bedridden and incapable of self-preservation. As such, the homes shall be manned on a 24-hr basis by trained staff who knows how to evacuate the patients during a fire emergency.

In the above *Figure 9.3.2c. - 1*, which shows an open plan layout, the direct distance requirements i.e. ⅔ of travel distance shall be used to ensure that actual travel distances would comply with *Table 2.2A* when internal partitioning work is introduced to create patients' rooms etc.. The direct distance from points A to B and A to C shall not exceed ⅔ of 30m or ⅔ of 45m if sprinkler-protected.

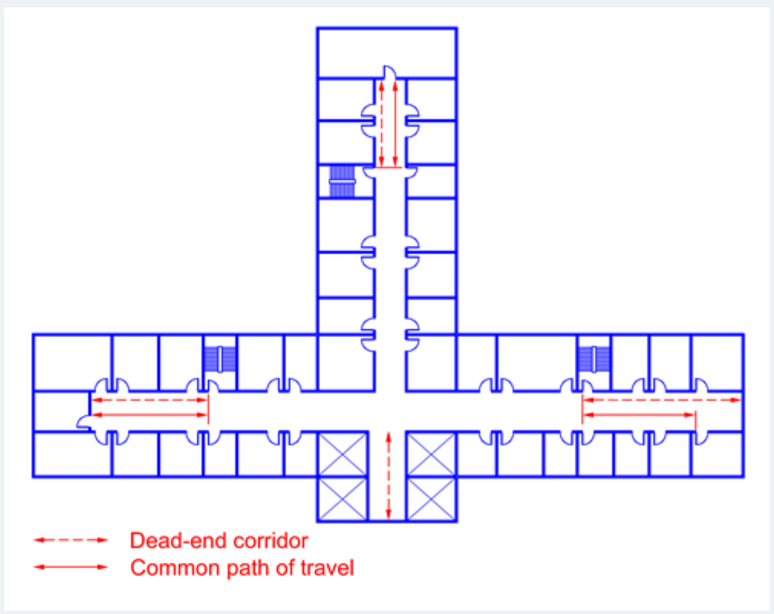


Figure 9.3.2c. - 2 : Path of travel and dead-end corridors in a nursing home

d. Custodian care facility

It shall comply with the following additional requirements:

(1) where such facilities are located within a building of mixed use, they shall be compartmentalised from other spaces and occupancies by walls and doors having at least 1-hr fire resistance rating. The requirement on the provision of fire compartmentation will not apply if the building is sprinkler-protected. In addition, the following requirements shall be complied with:

Explanation and Illustrations

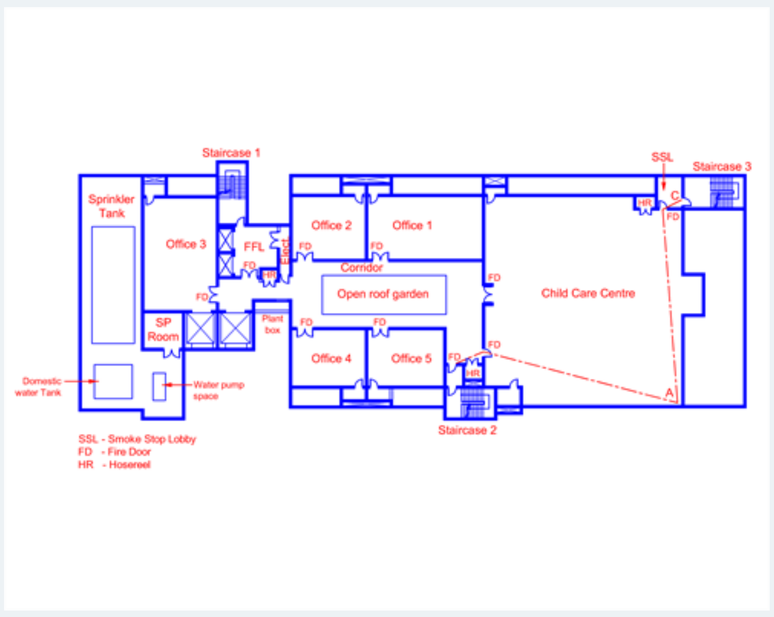


Figure 9.3.2d.

In the above figure, a child care centre or nursery is located in one part of the office building. The child care centre shall be provided with direct access to at least 2 exit staircases. Routes leading to exit staircases outside the child care centre shall be made protected.

Occupants of custodian-care facilities are generally capable of movement with limited assistance. They do not require to be evacuated in beds or stretchers, or bedsheets.

Institutions for mentally retarded patients would have locked exit doors, windows with security bars to confine and protect them. QPs shall consult the SCDF regarding the fire safety features in the security control system before submission of building plan. The maximum 2-way travel distances shall not exceed 30m or 45m, if sprinkler-protected. The direct distance from point A to B shall not exceed of ⅔ of 30m or ⅔ of 45m if sprinkler-protected for open floor plan layout.

(a) where such facilities are located on the 1st storey, they shall be provided with direct access to the exterior of the building;

(b) where located on upper storeys, they shall be sited adjacent to an exit staircase with direct access through a smoke-free lobby to the staircase (minimum one exit staircase); and

(c) where there is no fire lift lobby or smoke-free lobby, there shall be at least one direct access to the exit staircase.

(2) Institutions for the mentally disabled shall be designed with each storey having an area of refuge in accordance with Cl.1.4.9 and *Table 1.4B*. Fire safety requirements under *Cl.9.3.2b.* - Hospital, shall be fully complied with, except *Cl.9.3.2b.(6)* on provision of escape bed lift and *Cl.9.3.2b.(10)* on staircase landing width/depth.

e. Supervisory care facility

It shall comply with *Cl.9.3.2a.* and *b.*, except *Cl.9.3.2b.(6)* on provision of fire escape bed lift and *Cl.9.3.2b.(10)* on staircase landing width/depth.

Explanation and Illustrations

(No illustration)

Supervisory care facility used for housing for 4 or more mental health patients would require security measures such as locked exit doors, windows with security bars etc.. It must be recognised that such measures, which contravenes the Code would be necessary to restrain the patients and for their own safety.

The facility would be manned by trained staff on a 24 hours basis. QPs shall consult the SCDF on the provision of locking devices to exit doors and how such doors would be released in times of emergency to allow orderly evacuation of patients before making building plan submission.

f. Ambulatory healthcare centre

It shall comply with the following additional requirements:

(1) if located within a building of mixed use, shall be compartmentalised from other tenants and occupancies by walls and doors having at least 1-hr fire resistance rating;

(2) shall be provided with its own means of escape to at least one exit staircase; and

(3) shall fully comply with *Cl.9.3.2a.* and *b.*, except *Cl.9.3.2b.(4)* on provision of area of refuge for horizontal evacuation, *Cl.9.3.2b.(6)* on provision of fire escape bed-lift and *Cl.9.3.2b.(10)* on staircase landing/depth.

Explanation and Illustrations

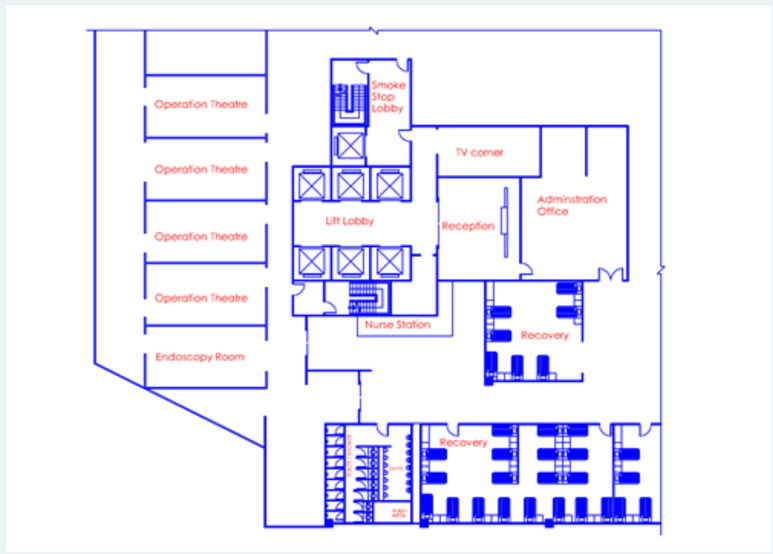


Figure 9.3.2f.

In an ambulatory healthcare centre, some of the patients are not capable of perceiving threats and taking appropriate action for self-preservation under emergency conditions without assistance from others, such as hemaedialysis units or freestanding emergency medical units.

Staff shall be trained to carry out evacuation procedures during a fire emergency. The building or part of the building used as an ambulatory healthcare centre shall be provided with at least 2 exit staircases.

g. Other outpatient clinics

Outpatient clinics shall be categorised as PG V occupancy and shall comply with all relevant requirements for such premises/ usage.

9.3.3 Workers' dormitory

Workers' dormitories shall comply with the following additional requirements:

a. Size

Each dormitory bedroom shall not exceed 120m^2.

b. Occupant load

The occupant load shall be based on 4.2m² per person in accordance with *Table 1.4B*.

c. Number of exit staircases or exits per storey

There shall be at least two independent exit staircases or other exits from every storey of a workers' dormitory.

d. Maximum travel distance

The travel distance, measured from the most remote point of the dormitory bedroom to the nearest exit staircase or other storey exit, shall not exceed the maximum travel distance permitted under *Table 2.2A*.

e. Internal corridor to dormitory bedrooms

Dormitory bedrooms with access through an internal corridor shall comply with the following requirements:

Rationale

The minimum size of ventilation openings along the internal dormitory corridors minimises the risk of a smoke-logged situation. These dimensions have been validated through a fire engineering study.

(1) dormitory bedrooms shall be separated from the internal corridor by a wall having at least 1-hr fire resistance;

(2) doors opening into internal corridors shall have at least ½-hr fire resistance and be fitted with an automatic self-closing device to comply with the requirements of Cl.3.9.2; and

Explanation and Illustrations

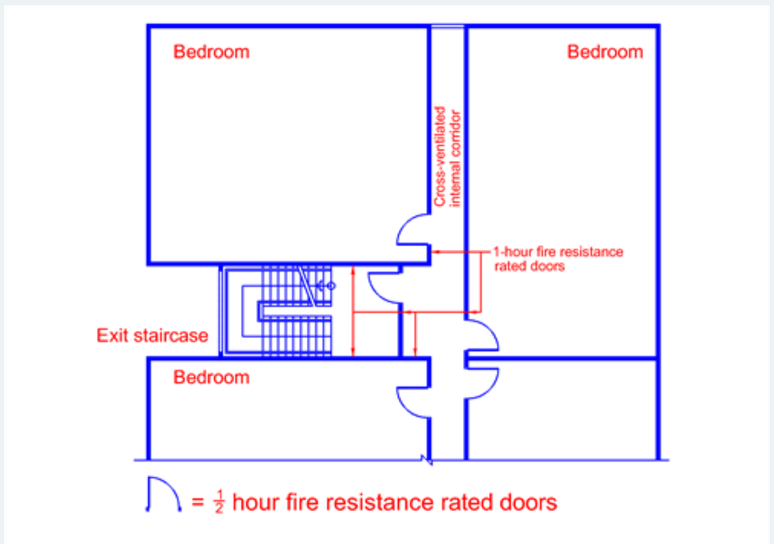


Figure 9.3.3e.(1) & (2)

(3) an internal corridor shall be naturally cross ventilated in accordance with *Cl.2.2.13b.(7)(c)*;

(4) pressurisation of internal corridors in lieu of natural ventilation is not permitted; and

Rationale

Natural ventilation is a permanent and more reliable method for ventilating internal corridor in workers' dormitory. It ensures effective smoke dispersal and unlike mechanical ventilation and pressurisation systems which may fail during an fire emergency if they are not properly maintained.

Explanation and Illustrations

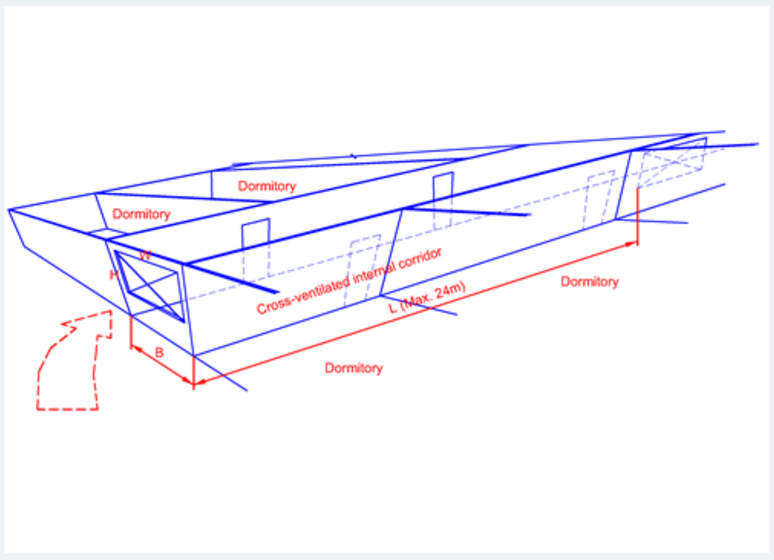


Figure 9.3.3e.(3) to (5) - 1

Area of each external opening = W x H

= min. 1.75m²

Area of external opening = 2(W x H)

Percentage of external openings = 2(W x H) x 100
over internal corridor L x B

= Min. 15%

Internal corridor shall either be cross-ventilated as illustrated above or provided with natural ventilation as illustrated in *Figure 9.3.3e.(3) to (5) – 2*. Pressurisation of internal corridor is not allowed.

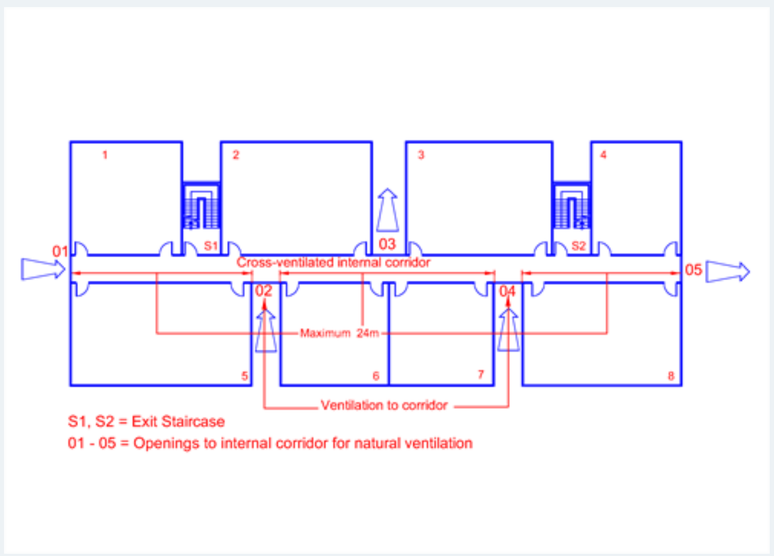


Figure 9.3.3e.(3) to (5) - 2 : Ventilation of corridors to workers' dormitory

Ventilation breaks (02, 03 & 04) as illustrated above are provided to cross ventilate the internal corridor.

(5) other rooms or spaces which open into or form part of the bedroom corridor and which can jeopardise the means of escape shall be compartmented by enclosures with at least 1-hr fire-resistance rating and doors with at least ½-fire resistance rating.

Explanation and Illustrations

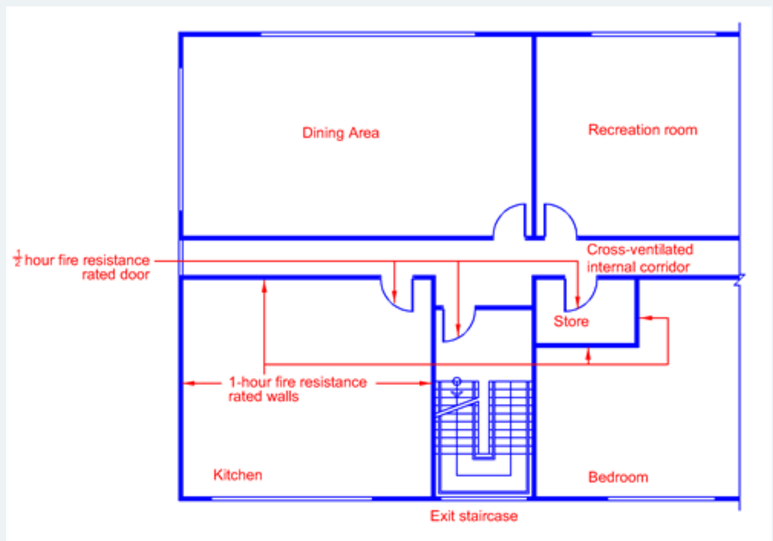


Figure 9.3.3e.(7)

Store shall be fire compartmented as it opens into the designated internal escape corridor.

f. External access to dormitory bedrooms

External access to dormitory bedrooms shall be through an external corridor complying with Cl.2.3.10.

Explanation and Illustrations

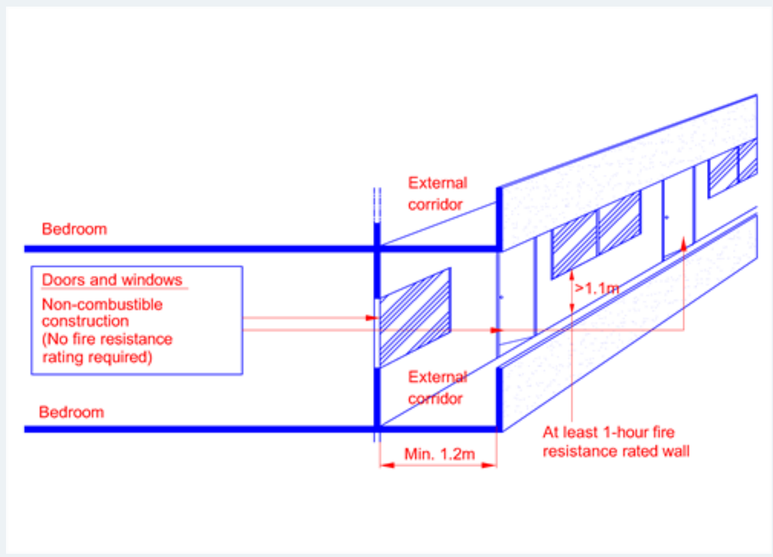


Figure 9.3.3f.

g. Smoke-free approach to exit staircase

Entry into an exit staircase from any part of a building of more than four storeys above ground level shall comply with requirements of Cl.2.2.13 - requirements of smoke-free approach to exit staircase. Pressurisation of a staircase in lieu of the provision of smoke-free lobby is not permitted.

Explanation and Illustrations

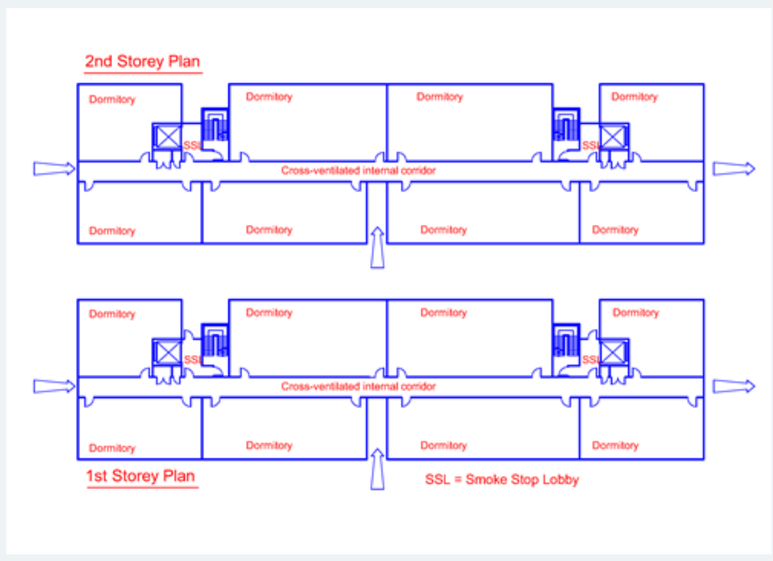


Figure 9.3.3g.

Under *Cl.2.2.13c.*, exit staircases to buildings under PG III will not be allowed to omit the smoke-stop lobby.

h. Bedroom compartmentation

(1) Each dormitory bedroom shall be compartmented from adjoining rooms and other parts of the same building by construction having at least 1-hr fire resistance rating, unless otherwise permitted under *Cl.9.3.3f.* for the provision of window openings between the bedroom and external corridor; and

(2) Dormitory bedrooms and other rooms or spaces which open into or form part of the dormitory bedroom corridor shall be separated from the corridor to comply with *Cl.9.3.3e.* and *Cl.9.3.3f.*.

Explanation and Illustrations

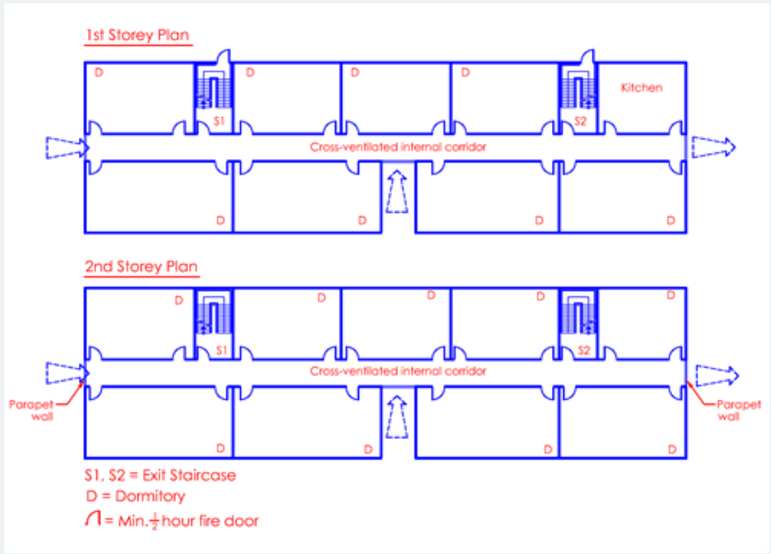


Figure 9.3.3h. - 1

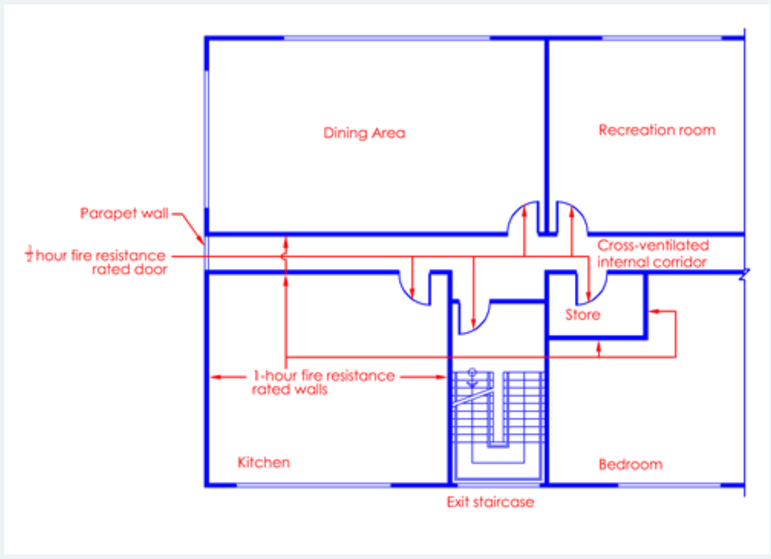


Figure 9.3.3h. - 2

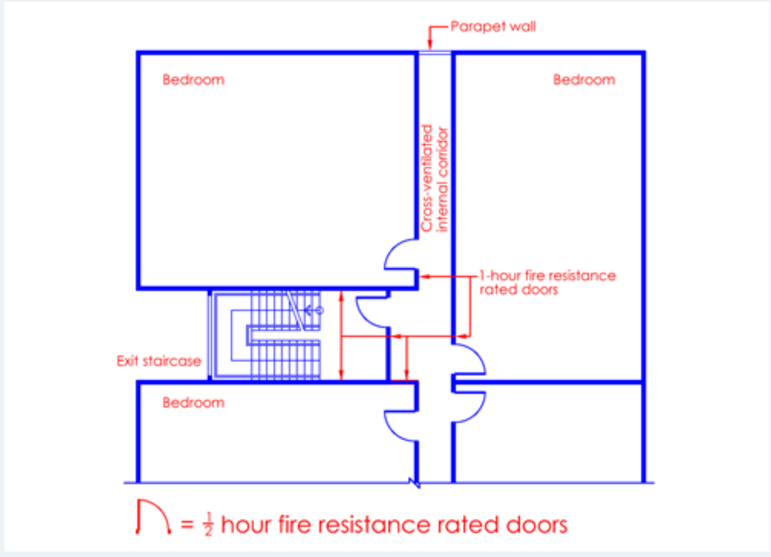


Figure 9.3.3h. - 3

i. Kitchen compartmentation

A kitchen with open-flame cooking activity shall be enclosed with at least 1-hr fire-rated compartment wall and ½-hr fire-rated door. The kitchen shall not be located within the dormitory unit.

Rationale

Dormitory bedrooms are meant for resting and sleeping. Hence, cooking activity, which normally involves the use of open flame, shall not be allowed in the bedrooms. This will help to reduce the risk of fire occurring in workers' dormitory.

9.3.4 Temporary workers' quarter in uncompleted permanent buildings on construction sites

a. General

(1) The temporary workers' quarters shall not be located higher than 10m above the fire engine access road level of the uncompleted building and shall not be lower than first basement level.

(2) The temporary workers' quarters shall only be used for housing workers working within the construction site.

(3) Hot work is not allowed in the basement(s) where the temporary workers' quarters are located.

b. Means of escape

(1) For above ground levels, provision of only one exit staircase is permitted provided that the one-way travel distance is complied with *Table 2.2A* and the occupant load does not exceed 20 persons on any storey. The exit staircase shall discharge directly to exterior open space.

(2) At least two independent exit staircases shall be provided for the temporary workers' quarters located in basement levels or when the occupant load exceeds 20 persons on any aboveground storey.

(3) Every storey shall be provided with exit facilities for its occupant load. Only those exits designated for escape of the workers shall be included in the exit capacity calculations.

c. Compartmentation

(1) Cooking is only allowed at a designated kitchen area, including basement(s). Such kitchen, shall be enclosed with at least 1-hr fire-rated compartment wall and at least ½-hr fire-rated door and shall not be located within the dormitory unit.

(2) Office and storage are allowed in the basement(s) where the temporary workers' quarters are located. They shall be compartmented from the accommodation areas with at least 1-hr fire-rated compartment wall and at least ½-hr fire-rated door.

(3) Only non-combustible materials shall be used for the construction of temporary workers' quarters.

(4) The floor area of each worker bedroom or the total floor area of a group of small worker bedrooms shall not exceed 120m^2. Compartment wall of having fire resistance rating of at least 1-hr shall be provided to separate the bedrooms so as to limit each compartment size to a maximum of 120m^2.

(5) Notwithstanding subclause (4), the worker bedrooms shall be separated from any internal corridor by a wall having fire resistance rating of at least 1-hr. Doors opening into the internal corridor shall have fire resistance rating of at least half an hour.

(6) The worker bedrooms shall be separated from any external corridor by a wall having fire resistance rating of at least 1-hr, except that ventilation openings of non-combustible construction can be fixed at or above a level of 1.1m, measured from the finished floor level of the external corridor to the sill height of the opening. Doors opening into the external corridor are not required to have fire resistance rating.

d. Fire engine access

(1) Provision of fire engine access road shall be provided in accordance with the requirements for the development. Only the portion of the fire engine access road serving the temporary workers' quarters shall be made available.

(2) Every part of the required fire engine access road shall be within an unobstructed distance of 50m from the nearest working fire hydrant. Where the remotest temporary workers' quarter is located not more than 100m away from the site entrance at the public road, provision of working private fire hydrant is exempted.

(3) A temporary "dry" fire hydrant is allowed. The "dry" fire hydrant shall be connected to a 150mm diameter pipe, which shall be connected the other end to a 4-way breeching inlet. This breeching inlet shall be within 18m from any fire engine accessway or fire engine access road having minimum 4m width and within 50m from any wet fire hydrant.

e. Emergency power supply

(1) Emergency power supply lasting at least 2-hr shall be provided for all firefighting systems serving the temporary workers' quarters.

(2) The location, arrangement, control and installation of electrical wiring of the secondary source of power supply, be it in the form of battery, standby generator, inverter or other accepted equipment, shall be in accordance with Chapter 5.

f. Firefighting systems

(1) Where dry riser system is required for the main development, they shall be commissioned and made operable for the storeys housing the temporary workers' quarters during the accommodation period.

(2) Provision of automatic sprinkler system and smoke control system is exempted for basement provided the basement is effectively cross ventilated as follows:

(a) no point within the basement(s) is more than 12m from any vertical opening or void for spaces that are in between two openings or voids;

(b) no point shall be more than 6m from any opening or void for spaces that are ventilated by such opening or void on only one side;

(c) all ventilation openings shall be at least 1000 x 600mm; and

(d) the total aggregate area of these voids and vertical openings shall be at least 20% of the total basement floor area.

(3) An automatic fire alarm system shall be provided if provision of automatic fire sprinkler system is exempted for the temporary workers' quarters located in the basement(s).

(4) For temporary workers' quarters located above ground level, fire alarm system shall be provided as stipulated under *Table 6.3A*.

(5) Connection of fire protection systems to the approved alarm monitoring company is not required.

(6) Standby fire hoses can be installed in lieu of the dry riser system, on condition that the temporary workers' quarters are adequately covered by fire hose reel(s).

(7) Provision of fire extinguishers shall be in accordance withCl.6.1.

(8) Provision of fire hose reels shall be in accordance withCl.6.2.8.

g. Engineered smoke control system

Engineered smoke control and sprinkler systems shall be required for the basement levels where the workers' quarters are located, if the provision of cross ventilation stipulated in *Cl.9.3.4.f.* cannot be fulfilled.

h. Storage of hazardous materials

(1) All stores of highly flammable substances shall be sited in open space at a minimum distance of 5m away from the building where the temporary workers' quarters are located and shall comply with the relevant standards.

(2) All LPG cylinder installations serving the temporary workers' quarters shall be in accordance with *Cl.10.1.*

i. Occupant load

The occupant load shall be based on the floor area of the temporary workers' quarters on the basis of 4.2m^2 per person, excluding non-simultaneous areas such as toilets, kitchens etc., or the actual number of occupants for which each occupied space of the floor is designed as shown on the plan, whichever is greater.

j. Emergency lighting and exit signs

Emergency lightings and exit signs serving the temporary workers' quarters shall be in accordance with Cl.8.1.

TABLE 9.3A STAIRCASE LANDING WIDTH/DEPTH

Stair Width	Minimum Landing width	Minimum Landing Depth	
1	2.8	1.9	Allows mattress or stretcher evacuation only (i.e. no pedestrian passing)
1.25	2.8	1.9	Allows mattress or stretcher evacuation and restricted ambulant passing
1.5	3.2	1.55	
1.75	3.6	1.35*	Allows mattress or stretcher evacuation and ambulant passing.
2	4	1.25*	

Note:
* = Clear landing depth, instead of the clear stair width, shall be taken for the purpose of calculating the exit capacity of the staircase.

CLAUSE 9.4 PURPOSE GROUP IV OCCUPANCY

9.4.1 General

a. Means of escape

(1) Aboveground office floors

One exit staircase is permitted to serve an aboveground office floor provided:

(a) the habitable height of the floor shall not exceed 15m;

(b) the floor shall not be located above 4th storey; and

Explanation and Illustrations

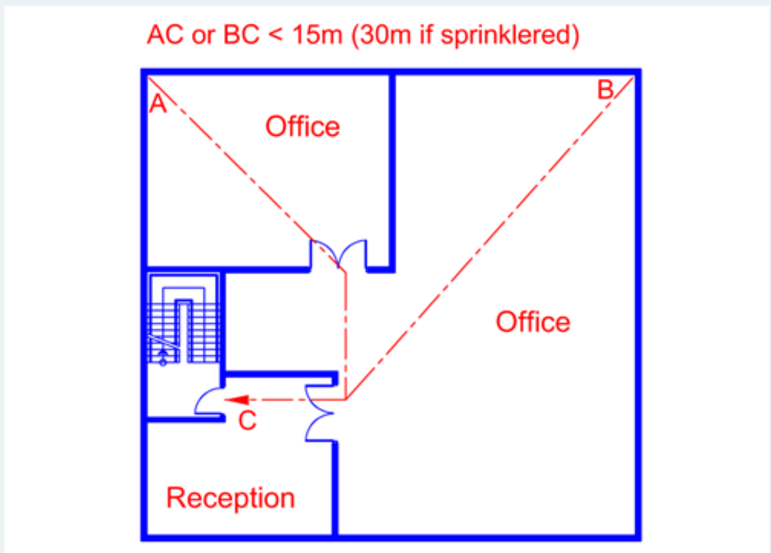


Figure 9.4.1a.(1)

- OL < 50 persons (or 10* persons)
- One-way travel distance AC or BC < 15m; or 30m (if sprinkler-protected) or < 10m or 20m respectively*
- Floor area < 200m²
- Storey height < 4 storeys or habitable height of building < 15m whichever is lower.

*For high hazard building if allowed by the SCDF

(c) the AFA of the floor shall not exceed 200m².

(2) Underground office floors

One exit staircase is permitted to serve an office basement provided:

(a) the building is of non-combustible construction;

(b) the depth of basement storey shall not exceed 9m below the average ground level;

(c) compartment below ground shall not comprise more than one storey; and

(d) the AFA of each basement storey, including service ducts, lift shafts, toilets, staircase, etc., shall not exceed 200m^2.

b. Structural fire precautions

(Not in use)

CLAUSE 9.5 PURPOSE GROUP V OCCUPANCY

9.5.1 General

a. Means of escape

(1) Aboveground shop floors

One exit staircase is permitted to serve an aboveground shop floor provided:

(a) the habitable height of the floor shall not exceed 15m;

(b) the floor shall not be located above 4th storey; and

(c) the AFA of the floor shall not exceed 200m².

Explanation and Illustrations

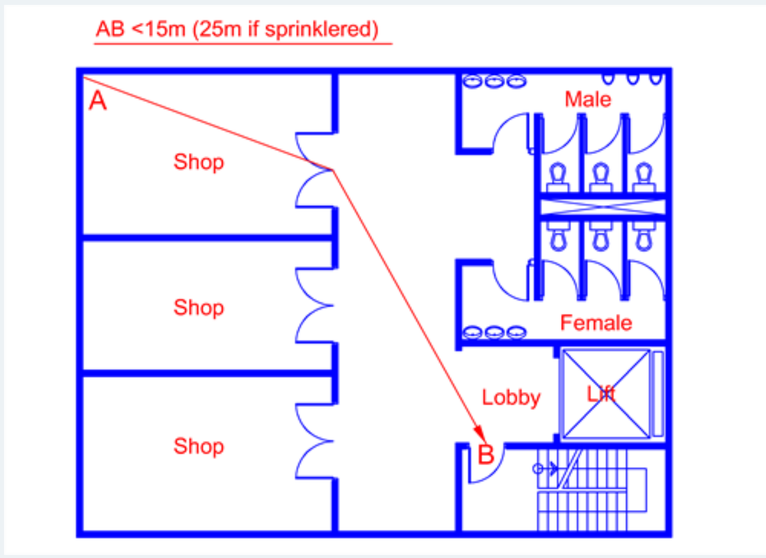


Figure 9.5.1a.(1)

- Occupant Load < 50 persons
- One-way travel distance AB, < 15m or 25m (if sprinkler-protected)
- Floor area < 200 m^2 (not applicable to office)
- Accessible floor area includes service ducts, lift shafts, toilets and staircases.
- Building shall not exceed 4 storeys or habitable height of 15m whichever is lower.

(2) Underground shop floors

One exit staircase is permitted to serve a shop basement provided:

(a) the building is of non-combustible construction;

(b) the depth of basement storey shall not exceed 9m below the average ground level;

(c) compartment below ground shall not comprise more than one storey; and

(d) the AFA of each basement storey, including service ducts, lift shafts, toilets, staircase, etc., shall not exceed 200m^2.

b. Structural fire precautions

(Not in use)

9.5.2 Outdoor Display Areas (ODAs)

a. General

This set of fire safety requirements shall be applicable to the following four types of Outdoor Display Areas (ODAs).

(1) Non-roofed-over ODAs detached from building

This refers to the ODAs where goods are displayed at the outdoors without any roofing. An example of this type of ODAs is the outdoor flea market.

Note

Application for approval of fire safety plans for ODAs complying fully with *Cl.9.5.2b.(1)* is not required.

Explanation and Illustrations

Figure 9.5.2a.(1) : Non-roofed-over ODAs detached from building

(2) Roofed-over ODAs detached from building

This refers to the ODAs where goods are displayed at the outdoors with roofing. An example of this type of ODAs is the outdoor kiosk.

Note

For ODAs complying fully with *Cl.9.5.2b.(2)*, the owner/operator of the ODAs can apply for Temporary Permit if the intended period of occupation of the ODA is not exceeding two months.

When the intended period for the display of goods is more than two months, the owner/operator of the ODAs shall engage a QP to submit fire safety plans to SCDF for approval. A Registered Inspector(s) of relevant discipline shall also be engaged by the owner/operator to inspect the completed fire safety works.

Explanation and Illustrations

Figure 9.5.2a.(2) : Roofed-over ODAs detached from building

(3) ODAs along covered walkway

This refers to the ODA where goods are displayed along the common walkway in front of a shop unit.

Note

Application for approval of fire safety plans for ODAs complying fully with *Cl.9.5.2b.(3)* is not required except when drop-down screen is used at the ODAs for protecting merchandises from the weather elements (see *Cl.9.5.2b.(3)(c)*). For the installation of drop-down screen, the owner/operator of the ODAs shall engage a QP to prepare and lodge the fire safety plans with SCDF under the Lodgement Scheme for minor addition/alternation works.

Explanation and Illustrations

Figure 9.5.2a.(3) : ODAs along covered walkway

(4) ODAs with extended awning/ canopy

This refers to the ODAs where goods are displayed underneath the awning/ canopy from a shop front.

Note

Application for approval of fire safety plans for ODAs complying fully with *Cl.9.5.2b.(4)* is not required except when:

a. drop-down screen is used at the ODAs for protecting merchandises from the weather elements (*Cl.9.5.2b.(4)(f)*); or

b. the building sprinkler system is extended to cover the ODAs (*Cl.9.5.2b.(4)(h)*).

For the installation of drop-down screen, the owner/operator of the ODAs shall engage a QP to prepare and lodge the fire safety plans with SCDF under the Lodgement Scheme for minor addition/alternation works. For the extension of building sprinkler system to cover the ODAs, a Registered Inspector(s) of relevant discipline, in addition to the QP, shall also be engaged by the owner/operator to inspect the completed fire safety works.

Explanation and Illustrations

Figure 9.5.2a.(4) : ODAs with extended awning/canopy

b. Fire Safety Requirements for Outdoor Display Areas (ODAs)

(1) Non roofed-over ODAs detached from building

(a) The goods display area shall be located at least 3m from the roof eaves and/or boundaries of the neighbouring buildings.

(b) There is no control on the size/height of the ODAs and the materials used for displaying goods at the ODAs.

(See *Diagram 9.5.2b.(1)*)

(2) Roofed-over ODAs detached from building

(a) The goods display area shall be located at least 3m from the roof eaves and/ or boundaries of the neighbouring buildings.

(b) The maximum total length of stalls shall not exceed 6m. A separation distance of at least 3m shall be provided between stalls if the total length exceeds 6m. However, the continuous length of stalls can exceed 6m if hose reel is provided to cover these stalls.

(c) There is no control on the size/ height of the ODAs and the materials used for displaying goods at the ODAs.

(See *Diagram 9.5.2b.(2)*)

(3) ODAs along covered walkway

(a) A clear width of not less than 1.2m shall be maintained along the covered walkway at the shop front.

(b) Racks for displaying goods shall not exceed 3m in length. There shall be a minimum 1m wide clear path between rows of racks. Goods shall not be stacked higher than 2m above floor level.

(c) There shall not be any drop-down screen at the ODAs for protecting merchandises from weather elements, except the retractable type approved by the SCDF. The retractable screen shall retract upon activation of smoke detectors or during a power failure.

(d) Goods shall not be placed within 3m from the discharge points of exit staircases. However, if there is more than one exit staircase or there is a rear escape at the 1st storey for single exit staircase, the distance can be reduced to 1.5m.

(e) Goods, shelves or racks shall not be left overnight at the ODAs outside the shop after operating hours.

(f) Hose reel shall be provided to cover the ODAs if the total area of shop and ODAs per unit exceeds 150m^2 or if the unit above the shop is used for non-residential purposes. The hose reel shall be located not more than 5m from exit.

(See *Diagram 9.5.2b.(3)*)

(4) ODAs with extended awning/canopy

(a) The depth of awning/canopy shall not exceed 2.4m. There is no restriction on the use of material for the awning/canopy.

(b) The awning/canopy shall be set back at least 3m from the discharge points of exit staircases. However, if there is more than one exit staircase or there is a rear escape at the first storey for single exit staircase, the distance can be reduced to 1.5m.

(c) Goods, shelves or racks shall not be left overnight at the ODAs outside the shop after operating hours.

(d) A clear width of at least 1.2m shall be maintained along the covered walkway at the shop front.

(e) Racks for displaying goods shall not exceed 3m in length. There shall be a minimum 1m wide clear path between rows of racks. Goods shall not be stacked higher than 2m before floor level.

(f) There shall not be any drop-down screen at the ODAs for protecting merchandises from the weather elements, except the retractable type approved by the SCDF. The retractable screen shall retract upon activation of smoke detectors or during a power failure.

(g) Hose reel shall be provided to cover the ODAs if the total area of shop and ODAs per unit exceeds 150m^2 or if the unit above the shop is used for non-residential purposes. The hose reel shall be located not more than 5m from exit.

(h) For sprinkler-protected buildings, the sprinkler system shall be extended to cover the ODAs. The sprinkler shall not be obstructed by the stacked merchandises and a minimum vertical clearance of 500mm shall be maintained between the goods and the sprinkler heads.

(See *Diagram 9.5.2b.(4)*)

(5) Other fire safety requirements applicable to all ODAs

(a) There shall be no open-flame activities at the ODAs.

(b) The ODAs shall not encroach onto any fire engine accessway/ fire engine access road.

(c) Fire extinguisher(s) shall be provided to cover the ODAs so that no person needs to travel more than 15m to reach an extinguisher. For roofed-over ODAs detached from building, fire extinguisher shall be provided for each stall.

Diagram 9.5.2b.(1) : Non-roofed-over ODAs detached from building

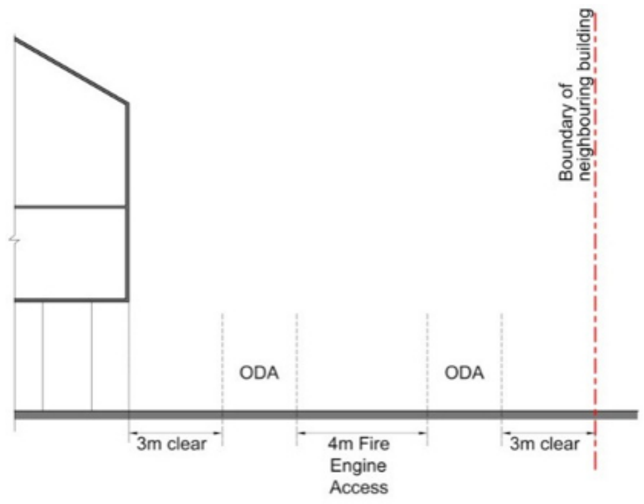


Diagram 9.5.2b.(1) : Non-roofed-over ODAs detached from building

The goods display area shall be located at least 3m from the roof eaves and/or boundaries of the neighbouring buildings.

Diagram 9.5.2b.(2) : Roofed-over ODAs detached from building

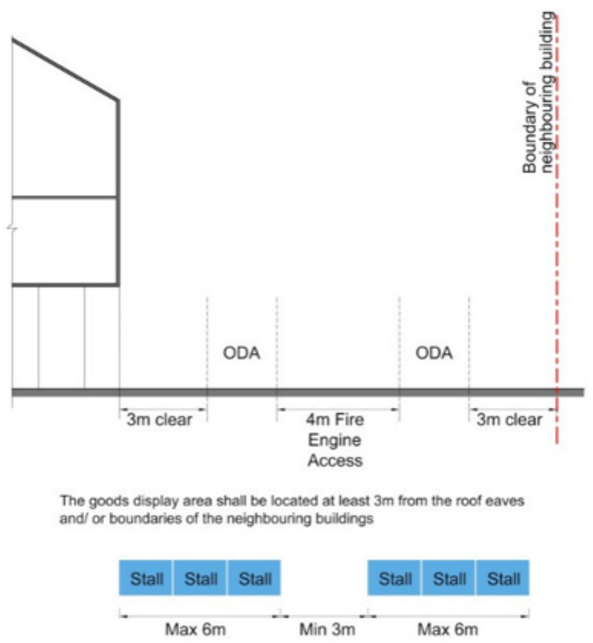


Diagram 9.5.2b.(2) : Roofed-over ODAs detached from building

The goods display area shall be located at least 3m from the roof eaves and/or boundaries of the neighbouring buildings.

The maximum total length of stalls shall not exceed 6m. A separation distance of at least 3m shall be provided between stalls if the total length exceeds 6m. However, the continuous length of stalls can exceed 6m if hose reel is provided to cover these stalls.

Diagram 9.5.2b.(3) : ODAs along covered walkway

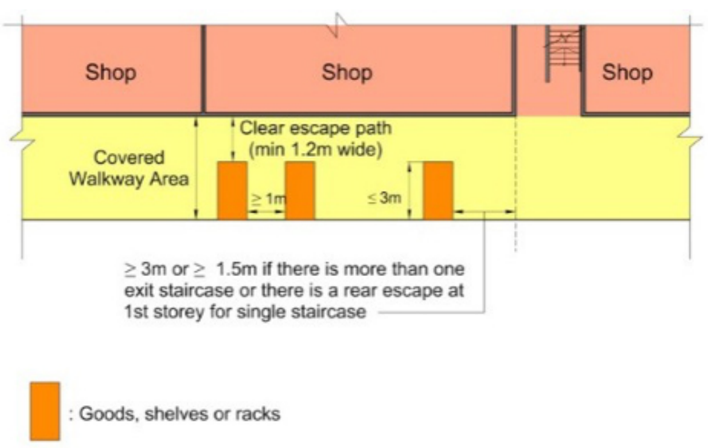


Diagram 9.5.2b.(3) : ODAs along covered walkway

Diagram 9.5.2b.(4) : ODAs underneath extended awning/canopy

Diagram 9.5.2b.(4) : ODAs underneath extended awning/canopy

CLAUSE 9.6 PURPOSE GROUP VI OCCUPANCY

9.6.1 General

a. Means of escape

(1) Aboveground factory floors

One exit staircase is permitted to serve an aboveground factory floor provided:

(a) the habitable height of the floor shall not exceed 15m;

(b) the floor shall not be located above 4th storey; and

Explanation and Illustrations

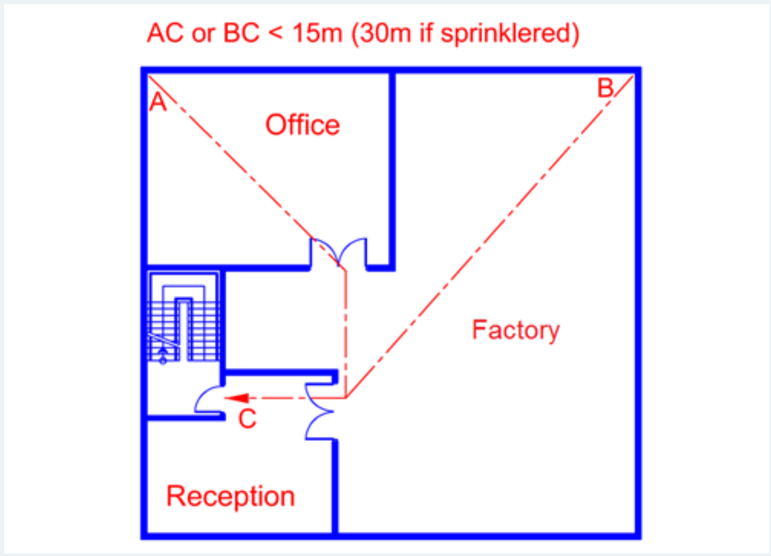


Figure 9.6.1a(1)

• OL < 50 persons (or 10* persons)

• One-way travel distance AC or BC < 15m; or 30m (if sprinkler-protected) or < 10m or 20m respectively

• Floor area < 200m²

• Storey height < 4 storeys or habitable height of building < 15m whichever is lower.

* For high hazard building if allowed by the SCDF

(c) the AFA of the floor shall not exceed 200m².

(2) Mezzanine floor

One open staircase is allowed to serve a mezzanine floor(s) within an aboveground factory floor provided:

(a) the aggregate AFA of the mezzanine floor(s) per factory unit shall not exceed 60m²;

(b) the open staircase has a width of at least 1m and be constructed of non-combustible materials;

(c) the maximum travel distance measured from remote point on the mezzanine floor(s) to the exits complies with *Table 2.2A*;

(d) the elements of structure of the mezzanine floor(s) are of at least 1-hr fire resistance rating construction;

(e) the habitable height of mezzanine floor shall not exceed 24m; and

(f) the mezzanine floor is only be used for store and/or ancillary office.

Explanation and Illustrations

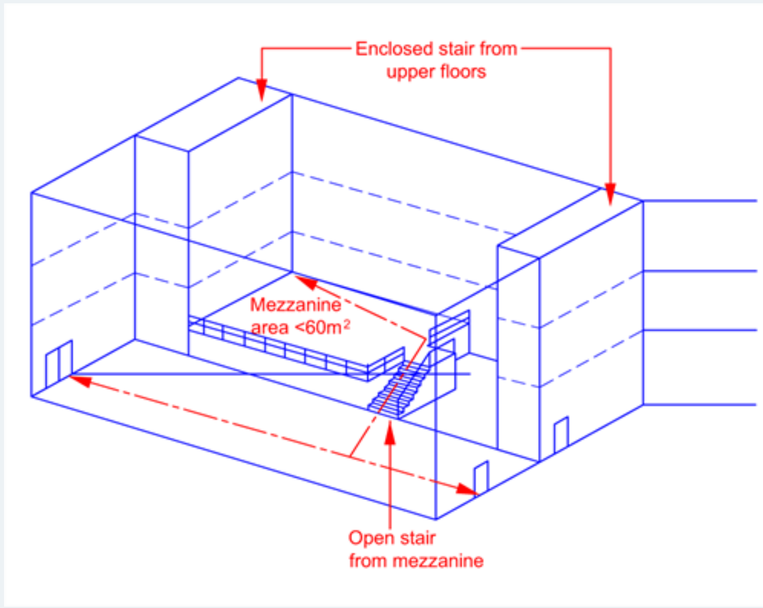


Figure 9.6.1a(2) – 1: Mezzanine egress through main factory floor

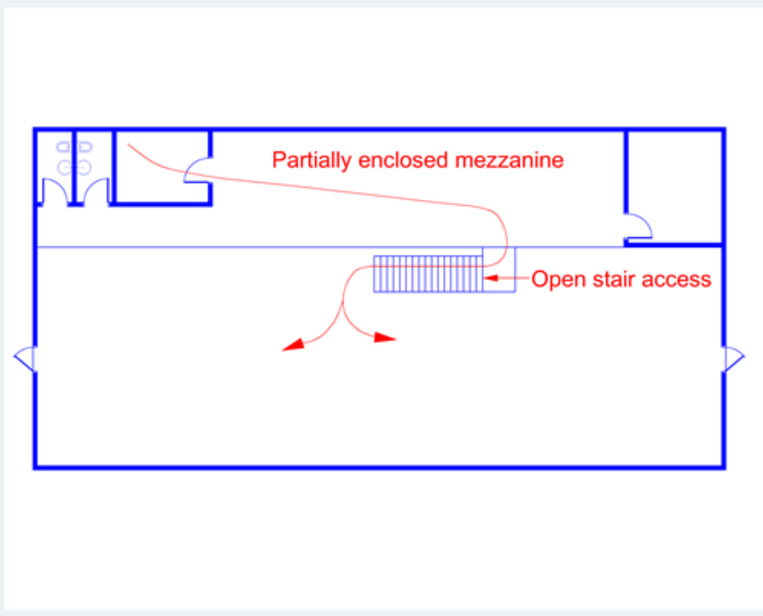


Figure 9.6.1a(2) – 2

The mezzanine floor and open staircase shall be fire resistant construction, similar to the compartment floor.

Figure 9.6.1a(2) – 3

The allowable common path of travel were exceeded, the mezzanine would require a second remote exit access.

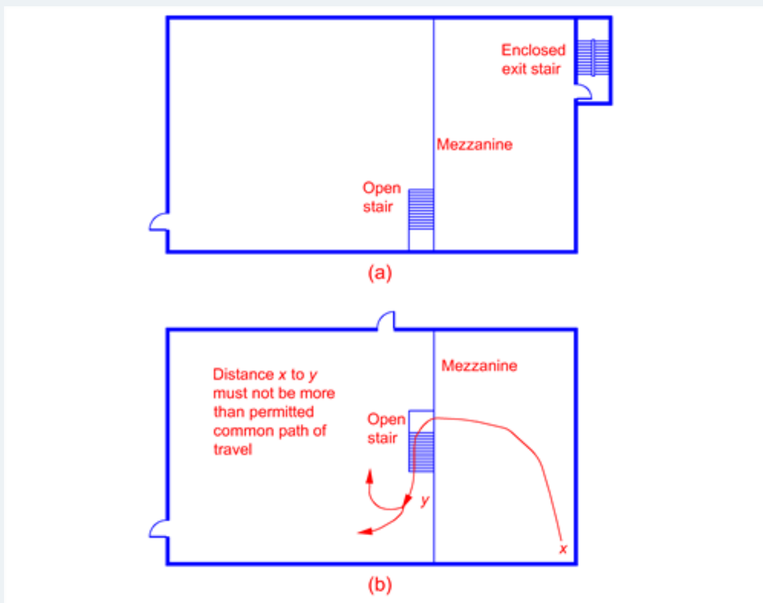


Figure 9.6.1a(2) – 4

b. Structural fire precautions

Fire compartmentation between individual tenancy units within a terraced or flatted factory building shall be provided. The entire enclosure of each of these units shall be fire compartmented with walls and floors of at least 1-hr fire resistance rating.

Explanation and Illustrations

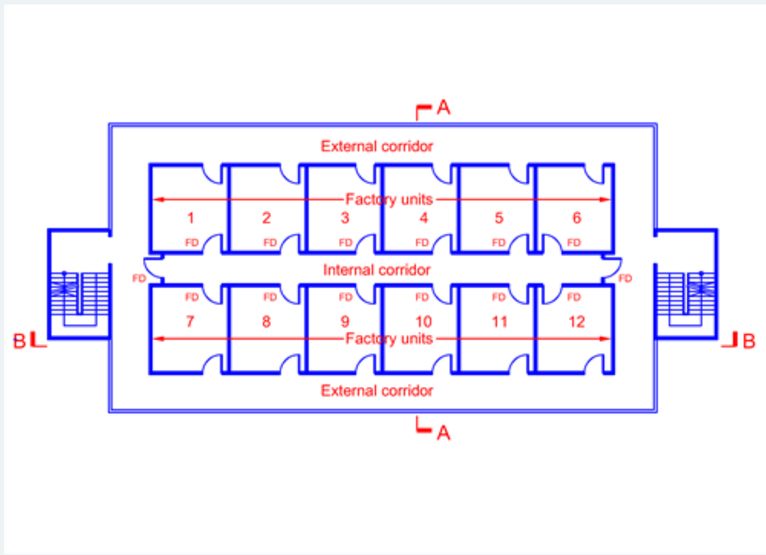


Figure 9.6.1b. -1

Enclosing walls and doors to internal corridor are required to be constructed of non-combustible materials having the necessary fire resistance rating. Walls and doors facing the external corridor are not required to be fire-rated.

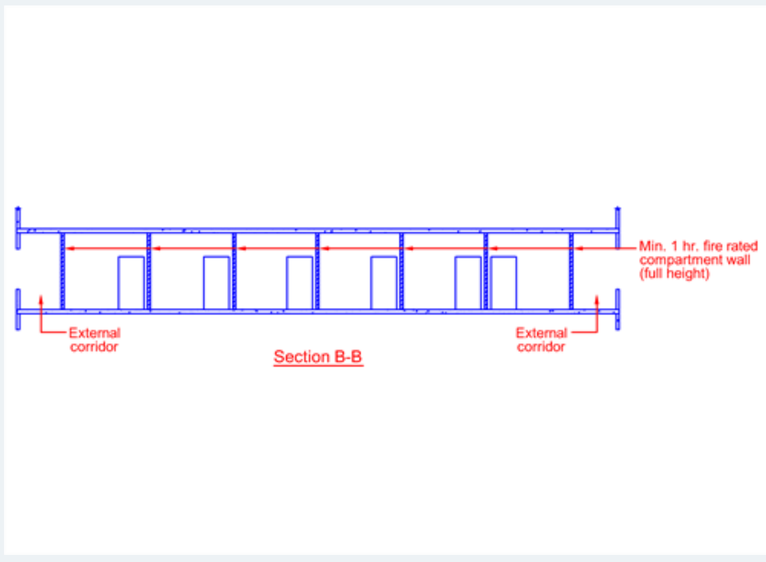


Figure 9.6.1b. - 2

Compartment wall between units are required to be constructed of non-combustible materials having minimum 1-hr fire resistance rating.

c. Storage within PG VI premises

(1) In a non-sprinkler-protected factory with storage areas/ spaces:

(a) Where the aggregate storage areas/ spaces (including transient) within a factory unit exceeded 100m^2, the entire factory unit shall comply with general warehouse requirements under PG VIII buildings, or

(b) Where the aggregate storage areas/ spaces (including transient) within a factory unit exceed 100m2, they shall be compartmented from the factory such that the areas/spaces of storage within the factory do not exceed 100m^2.

(2) The area stipulated in *Cl.9.6.1c.(1)* can be increased to 700m^2 if the factory is protected by an automatic sprinkler system.

9.6.2 Petroleum service stations

a. General

(1) Any site chosen shall be sufficiently spacious for it to be designed to minimise unauthorised access, i.e., it shall be away from areas of high human traffic and the entrances/exits of other buildings.

(2) The boundary line of petroleum service stations shall be at least 50m from any residential building, or 90m from any place of public assembly.

(3) The route for tank vehicles leading to petroleum service stations shall not pass through or be near to places of public assembly, as stated in *Cl.9.6.2a.(2)*.

(4) A service station shall be stand-alone, and dispensing of petrol shall be restricted to the ground level only (see *Diagram 9.6.2a.(4)*).

(5) Convenience stores integrated with the petroleum service station shall be at most 150m^2.

b. Storage and tank requirements

(1) Tanks for all classes of petroleum in a petroleum service station shall be installed underground.

(2) All underground tanks shall have a water capacity of not more than 30kl each.

c. Tank requirements

The tank shall be designed, constructed, installed and tested to meet any of the following:

(1) *BS 2594*: Carbon Steel Welded Horizontal Cylindrical Storage Tanks, or

(2) Underwriters Laboratories (*UL 58*): Steel Underground Tanks for Flammable and Combustible Liquids, or

(3) Standards Association of Australia (1962): Steel Tanks for the Storage of Flammable and Combustible Liquids, or

(4) *NFPA 30*, Flammable and Combustible Liquids Code, or

(5) other equivalent standards.

d. Underground tanks and access pits

All underground tanks installations shall comply with the following requirements:

(1) the road surface above the underground tanks shall be of reinforced concrete of the thickness necessary to support itself and any superimposed loads, but not less than 150mm;

(2) the depth from the road surface to the top of the tank shall be not less than 450mm; and

(3) each access pit shall be fitted with a cover that is watertight or raised above the level of the surrounding ground to prevent the entry of surface water, and be strong enough to withstand any superimposed loads. The strength of such a cover shall not be inferior to those of 5mm low carbon steel.

e. Separation from property boundaries and building foundations

The distance of the underground tank to any property boundaries and foundations shall be not less than 2.5m and 1m respectively (see *Diagram 9.6.2a.(4)*).

f. Corrosion protection

Any underground tank and its associated piping shall be protected from corrosion by one or more of the following methods:

(1) protective coating or wrappings, or

(2) cathodic protection, or

(3) corrosion-resistant materials of construction.

g. Venting

Each tank shall incorporate a vent to atmosphere for the vapour space above the liquid to allow vapours to vent to the atmosphere.

h. Vent capacity

The size of any vent shall be such that pressure or vacuums resulting from filling, emptying or atmospheric temperature change, will not cause stresses in excess of the maximum design stress for the tank. The vent shall have a minimum internal diameter of 38mm.

i. Vent piping

Any vent piping between the tank vent connection and the discharge point shall comply with the following requirements (see *Diagram 9.6.2i*):

(1) the vent pipes shall fall consistently back to the tank at a slope not less than 1 in 40;

(2) a vent pipe shall not pass through building foundations, but can be embedded in concrete, which is part of other types of building construction. A vent shall not be run within a cavity wall but can pass through a cavity wall or through masonry which incorporates cavities, provided that it is in a sleeve which will prevent vapour gaining access to the cavities; and

(3) a vent pipe can be either embedded in a concrete slab or laid in the earth. If the vent pipe is laid in the earth, it shall be:

(a) located not less than 300mm below ground level;

(b) surrounded by clean washed sand, or provided with equivalent corrosion protection;

(c) suitably protected if the area is subject to vehicular traffic;

(d) the vent pipe and its terminal shall be located or protected so that they are not liable to damage resulting from normal activities;

(e) the vent pipe shall be vapour-tight throughout its length; and

(f) all underground tanks or compartments in a tank shall have a separate individual vent pipe.

j. Vent outlet location

The discharge point of a vent shall comply with the following requirements:

(1) the location, direction and velocity of discharge shall be such that venting vapour will not cause danger to the surroundings;

(2) the vent discharge point shall be not less than 2m from any boundary or opening of a building, e.g. windows, doors, ventilators, air conditioners and forced air intakes (see *Diagram 9.6.2a.(4)*); and

(3) the vent shall discharge into open air and vent discharge point shall be located not less than 4m above ground level (see *Diagram 9.6.2i*).

k. Vent terminal

(1) The discharge end of a vent shall be protected from the ingress of foreign material by a protective cage of fitting and shall discharge only vertically upward in order to disperse vapours.

(2) A vent provision shall be connected to a vapour recovery or collection system, as similarly provided for at the filling mentioned in *Cl.9.6.2l*.

l. Filling connection

The filling connection to a storage tank, which is filled from a tank vehicle, shall incorporate a vapour-tight connection. A cap or cover with lock shall be provided for the filling point. A vapour recovery system shall be provided to prevent accumulation or abnormal discharge of vapour during refilling.

m. Location of filling point

The location of the filling point for any storage tank intended to be filled from a tank vehicle shall comply with the following requirements (see *Diagram 9.6.2a.(4)*):

(1) the length of any hose required to connect a tank vehicle to the filling point shall not exceed 5m;

(2) the filling point shall be protected from accidental or physical damage. Guardrails or any necessary measures shall be installed to prevent damage by collision;

(3) the filling point for any tank containing Class I, Class II or Class III petroleum shall be in open air at least 3m from any building opening or boundary. If a distance of 3m cannot be complied with, a vapour barrier made of material of at least 2-hr fire resistance rating shall be installed and shall not be less than 500mm above the centre of the filling point inlet. The vapour barrier shall be at least 1m from the boundary line. The distance measured in a horizontal plane around the end of any vapour barrier shall be 3m from the centre of the outermost filling point inlet to the building and boundary (See *Diagram 9.6.2a.(4)* for details);

(4) the edge of the tank vehicle designated parking area for refilling shall be at least 3m from any building opening or boundary; and

(5) the filling point for the underground tank shall be located in such a way that tank vehicles have unobstructed entry and egress from the service station.

n. Piping design suitability

The design, fabrication, assembly, test and inspection of piping shall be suitable for the expected working pressure temperatures and structural stresses and shall comply with relevant local (where available) or international standards.

o. Piping material suitability

Any material used in the construction or installation of piping shall be suitable for the conditions of use, and in particular:

(1) it shall be compatible with the particular petroleum or any other component with which it may be in contact;

(2) it shall be resistant to any heat (during operations) to which it may be exposed; and

(3) it shall be corrosion-resistant.

p. Piping flexible tube

Flexible tubing, piping or hose can be used only on condition that:

(1) the use of such tubing is unavoidable because of the need to provide for movement or to reduce the effect of vibration; and

(2) the tubing is of flexible metallic, metal-reinforced, armoured or other construction suitable for the working pressure, temperature and the liquid being handled.

q. Piping design and construction

The following general design considerations shall be taken into account when designing or installing any piping:

(1) the layout shall take into account the needs for all operating accesses and shall ensure that fire engine accessways are not impeded;

(2) supports and fitting of the pipework shall be secure and the piping shall be not unduly exposed to mechanical damage;

(3) wherever necessary, provision shall be made for the expansion or contraction of the piping and its contents;

(4) any buried piping shall be protected from superimposed loads, ground settlement, etc.;

(5) any necessary electrical bonding and earthing shall be provided; and

(6) piping shall be painted and/or marked in a manner sufficient to facilitate identification of its contents.

r. Pump drive

Any motor or engine that drives a pump for use with any classes of petroleum shall be of the type specifically approved for such use.

s. Fuel dispensing system

(1) Dispensing units at a service station shall be located in the open air where they will be adequately ventilated. These shall be located such that all parts of the vehicle being served will be on the premises of the service station, and shall be sited not less than 6m away from any building, public roadway or boundary (see *Diagram 9.6.2a.(4)*).

(2) A clearly identified and easily accessible switch or circuit breaker (a centralised Emergency Shut-Off Device) shall be provided at a location remote from the dispensing devices, including remote pumping systems, to shut off the power to all dispensing devices in the event of an emergency, and shall not be less than 6m or more than 15m from the dispenser. A sign incorporating the wordings "EMERGENCY CUT-OFF" shall be provided in the vicinity of the cut-off switch (see *Diagram 9.6.2s.(2)*). A similar device shall be provided in close vicinity to the console area/cashier as stipulated in *Cl.9.6.2u.(1)*.

(3) Petroleum shall be transferred from underground tanks by means of fixed pumps designed and equipped to allow control of the flow and to prevent leakage or accidental discharge.

(4) A control shall be provided such that the pump will operate only when a dispensing nozzle is removed from its bracket or normal position with respect to the dispensing unit and the lever on this dispensing unit is manually activated. This control shall also stop the pump when all nozzles have been returned, either to their bracket or to the normal non-dispensing position.

(5) The dispensing unit and its piping shall be mounted on a concrete island. Each island shall rise not less than 150mm above the surrounding ground level and shall extend not less than 300mm on both sides of the dispensing units and at least 500mm from the dispensing unit to the edge of the base measured longitudinally (see *Diagram 9.6.2s.(2)*).

(6) The length of hose at each service station shall not exceed 5m. When not in use the hose shall be secured so as to protect it from damage.

(7) The nozzle through which fuel is dispensed to a vehicle shall be designed to automatically close when the fuel tanks of the vehicles are full.

(8) Individual dispensing units shall be provided with an emergency shut-off device.

(9) A rigidly anchored emergency shutoff valve, incorporating a fusible link or other thermally activated device, designed to close automatically in the event of a severe impact or fire exposure, shall be properly installed in the supply line at the base or inlet of each dispenser. The automatic closing feature of this valve shall be checked at the time of initial installation, and at least once a year thereafter by manually tripping the hold-open linkage.

t. Remote pumping systems

For systems where petroleum is transferred from storage to individual or multiple dispensing units by pumps located other than at the dispensing units, the following requirements shall apply:

(1) pumps shall be designed or equipped so that no part of the system will be subjected to pressure above its allowable working pressure;

(2) pumps installed above grade level shall be located not less than 3m from the boundary or building opening, and shall be substantially anchored and protected against physical damage; and

(3) pit lids or covers for subsurface pumps or piping manifolds of submersible pumps shall be in accordance with *Cl.9.6.2d.(3)*.

u. Attended self-service stations

(1) The dispensing area at all times shall be in clear view of the console area/ cashier (area having control of the emergency shut-off devices for all and individual dispensing units, including remote pumping systems).

(2) The console/cashier operator shall at all times be able to communicate with persons at the dispensing area. This can be by means of a voice communication system.

(3) Sufficient close circuit cameras are to be installed at the petroleum service station to cover the forecourt, backcourt, dispensing areas and other critical areas of the petroleum service station.

(4) Provisions must be made for bollards and chains to be installed at the exit and the entrance of the petroleum service station during refilling by the tank vehicle to be utilised during high alert situations.

(5) The setback distance from the edge of the roof of the dispensing area to any boundary line must be in accordance to the requirements of Cl.3.5.3, or 3m, whichever greater. (See *Diagram 9.6.2a.(4)*)

v. Electrical equipment and area classification

(1) General

All electrical wiring and equipment shall be of a type suitable for the location, in accordance with NFPA 70 or IEC 60079.

(2) Electric Vehicle (EV) Charging Station

(a) EV charging station located within a petrol station shall be in the following order of priority:

(i) Open-to-sky areas.

(ii) Forecourt.

(b) Main isolation shut-off switches shall be provided as follows:

(i) An emergency main isolation shut-off switch for an EV charging station must be located so that a person does not have to travel more than 15m from the EV charging station and its associated parking lot to reach the switch.

(ii) If there is more than one EV charging station, one or more than one emergency main isolation shut-off switch may be shared between EV charging stations within the same storey. The switch or switches must be located so that a person does not have to travel more than 15m from any EV charging station and its associated parking lot to reach the switch.

(iii) Every emergency main isolation shut-off switch for an EV charging station must be located on the same storey as the EV charging station, so that there is a safe means of isolating the main electrical power supply to the entire electric vehicle charging system on the same storey upon activation of any one of those switches. Those switches must be capable of being activated manually without the use of a key or tool, or any special knowledge or effort.

(iv) Subject to Cl.9.6.2v.(2)(b)(v), the nearest edge of an emergency main isolation shut-off switch must be located at least 3m away from an EV charging station and its associated parking lot.

(v) An emergency main isolation shut-off switch may be located less than 3m away from an EV charging station and its associated parking lot, if there is at least another emergency main isolation shut-off switch located at least 3m away but within 15m of that EV charging station and its associated parking lot.

(vi) An emergency main isolation shut-off switch must be located between 800mm and 1.2m (inclusive of both measurements) above the finished floor level.

(vii) An emergency main isolation shut-off switch must be in a clearly visible and easily accessible location, and be clearly labelled.

(viii) There must be clear instructions (however indicated) on how an emergency main isolation shut-off switch may be operated.

(ix) There must be one or more than one signage, on which any letter must bear a height of at least 50mm and that is displayed in a prominent location from the emergency main isolation shut-off switch, directing a person on how the switch is to be operated.

(x) Where an emergency main isolation shut-off switch cannot be seen clearly from, or is not within the line of sight of, an EV charging station and its associated parking lot, any number of additional signages as may be necessary must be displayed for the purpose of directing persons to the emergency main isolation shut-off switch.

(c) There shall be at least 12m separation distance between the EV charging station and the refilling points and vent pipes.

(d) There shall be at least 6m separation distance between the EV charging station and the designated oil tanker parking area.

(e) There shall be at least 8m distance separation distance from the EV charging station to any fuel dispensing unit.

(f) No electrical connection within EV charger shall be located within 500mm from the finished floor level of the forecourt.

(g) EV charging station shall be fully enclosed unless such openings are located at least 1m above the finished floor level of the forecourt.

(3) Battery Swap Station (BSS)

(a) BSS unit located within a petrol station shall be sited in the following order of priority:

(i) Open-to-sky areas.

(ii) Forecourt.

(b) Aggregate stored energy capacity of each BSS unit shall not exceed 20kWh. Where more than 1 BSS unit is installed, a minimum separation distance of 3m between BSS units shall be provided and the total aggregate stored energy capacity of all BSS units shall not exceed 40kWh.

(c) Separation distance

(i) BSS unit shall be placed at least 6m away from any exit access door.

(ii) BSS unit shall be located at least 1m away from parking lots (excluding the lots used for swapping of batteries).

(iii) Separation distance specified under *Cl.9.6.2v.*(2)(c) to (g) for EV charging stations shall be applicable to BSS units.

(d) Approved types of fire extinguishers of at least 2 numbers of 55A shall be provided.

(e) Emergency isolation switch shall be provided for each BSS unit.

w. Caution labelling

An emergency information panel shall be provided at the filling point.

x. Warning signs

(1) Warning signs shall be conspicuously displayed at the individual dispensing area incorporating the following wordings: “WARNING - NO SMOKING, NO NAKED LIGHTS, STOP ENGINE”. The lettering shall be at least 50mm high.

(2) The signs shall be displayed not less than 1.8m and not more than 2.5m above the ground level.

y. Firefighting and prevention

(1) Fire extinguishers

Approved types of fire extinguishers of rating not less than 70B (9kg) or 34B (2 x 4.5kg) shall be provided at the individual dispensing units and protected from the weather.

(2) Hose reels

(a) Sufficient hose reel coverage shall be provided such that the service station usable/accessible area is within 6m of a nozzle attached to a 30m hose.

(b) Hose reels shall comply with the requirements of *SS 575*.

(3) Absorbents

A small quantity of absorbent material or sand (as a guide, one full bucket minimum of 40 litres) shall be provided at the service station to mop up any spillage. These absorbent materials shall be kept in a container with a close fitting lid and shall be installed in an accessible place.

(4) Fire hydrant

Fire hydrants shall be within 50m from any part of the fire engine access road. The actual travel distance from the edge of the fire engine access road to the most remote point of the petroleum service station usable/ accessible space shall not be more than 50m.

9.6.3 High containment facilities

a. General

The purpose of this section of the Code is to stipulate fire safety requirements for high containment facilities and laboratories that handle biological agents or toxins, which are designed to meet the requirements of WHO and the authority having jurisdiction for Bio-Safety Level 3 (BSL-3) or higher.

b. General requirements

(1) A BSL-3 or BSL-4 containment laboratory shall be located at the ground floor and shall be separated from areas that are open to unrestricted traffic flow within the building. They shall be designed and constructed to comply with the requirements listed herein.

(2) The word "BSL-3" or "BSL-4" shall be stated clearly in the project title and printed on the top-right corner (lettering shall be bold, in red colour and at least 15mm in size) of all the fire safety plans of the high containment facility.

c. Fire compartment

(1) In a sprinkler-protected building, the high containment facility (including interstitial space, waste treatment areas, anterooms, etc.) shall be fire compartmented from adjoining spaces with at least 1-hr fire-rated walls, floor and ceiling. For a non-sprinkler-protected building, the fire rating shall be at least 2 hours.

(2) The protecting structure shall be constructed of masonry or drywall. If drywall construction is used, it shall be in accordance with *Cl.3.8.7b*.

d. Firefighter staging lobby

For high containment facilities, an additional (on top of the usual requirement to have a fire lift lobby next to exit staircases) firefighter staging lobby shall be provided to comply with the following requirements:

(1) it shall be located at every entrance of the facility;

(2) it shall be fire-compartmented with at least 1-hr fire resistance rating;

(3) in the absence of (1), an anteroom with the same fire resistance rating shall be provided to serve this function;

(4) it shall have at least 6m^2 free working space;

(5) it shall comply fully with *Cl.2.2.13b.(1)* to *(6)*, *(7)(a)* and *(b)*; and

(6) it shall be installed with designated main landing valve, standby fire hose and fire hose reel.

e. Two-way emergency communication system

For a biomedical facility or building provided with a two-way emergency voice communication system, the two-way emergency communication system shall be extended to the firefighter staging lobby.

f. Fire detection and suppression systems

All high containment facilities shall be protected with sprinkler systems. High containment facilities without sprinkler protection shall comply with the following:

(1) smoke detectors shall be installed along the exterior of the periphery walls of the high containment facility;

(2) the fire protection circuit for BSL-3 or BSL-4 shall be grouped in a different fire zone for ease of identification;

(3) the fire protection systems shall be linked to the building fire alarm system and shall be connected to the SCDF Operations Centre through an approved alarm monitoring company; and

(4) if water discharge within the high containment facility is undesirable or unacceptable, the sprinkler system can be replaced by an approved fire extinguishing system.

g. Label and sign

(1) Caution labels shall be provided at all the laboratory entrances and exits in accordance with *SS 586*. In addition, a label indicating the information as shown in *Diagram 9.6.3g.(1)* shall be also provided.

(2) A sign shall be displayed at all entrances to the high containment facility, with the following wording: "In the event of fire or any water discharge, please notify the authority having jurisdiction for control of contaminated water runoff."

Diagram 9.6.2a.(4) : Typical petroleum service station

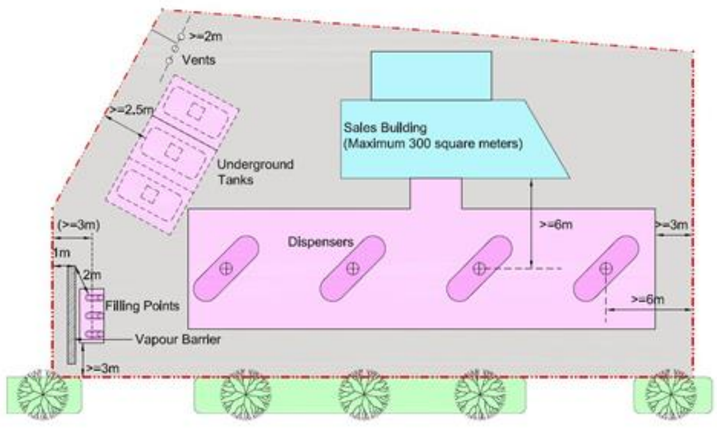


Diagram 9.6.2a(4) : Typical petroleum service station

Diagram 9.6.2i : Vent

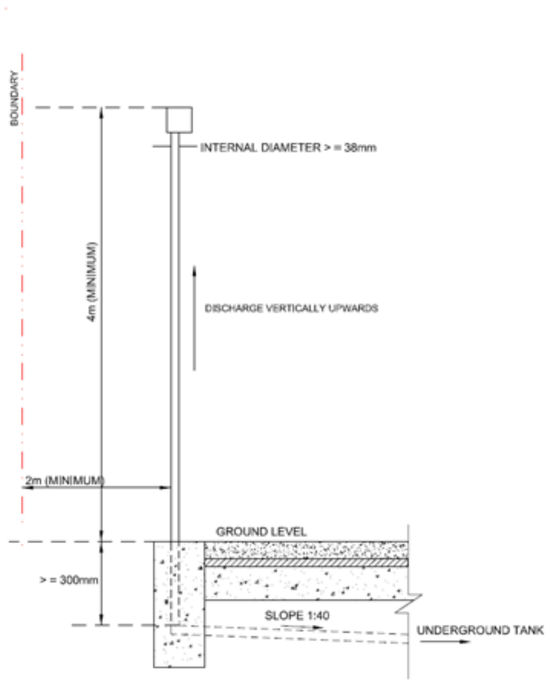


Diagram 9.6.2i: Vent

Diagram 9.6.2s.(2) : Pump island

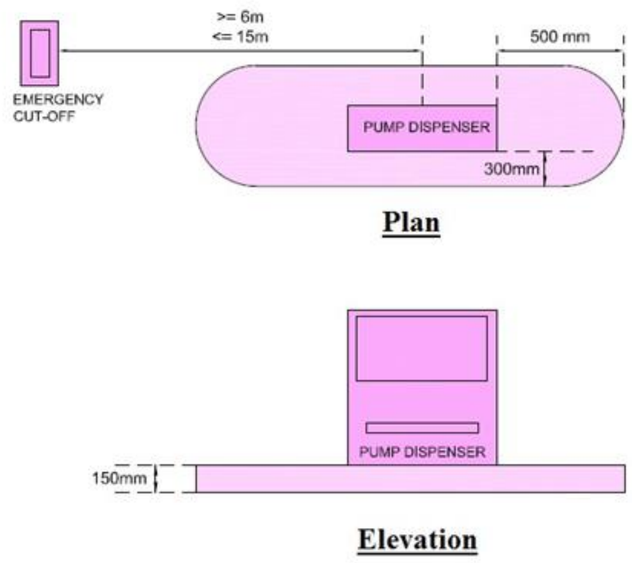


Diagram 9.6.2s.(2) : Pump island

Diagram 9.6.3g.(1) : Biohazard caution label

Diagram 9.6.3g.(1) : Biohazard caution label

9.6.4 Farm buildings

a. General

This set of fire safety requirements shall be applicable to farm buildings that meet the following criteria:

(1) the habitable height of the building shall not be more than 10m;

(2) the building shall be used for the sole purpose of farming (e.g. growing of crops, fish harvesting and egg production) and not involve activities such as packaging, storage and retail;

(3) other usages such as packaging, storage, retail, office and non-farming related production can be co-located within the building, provided they are compartmented and comply fully with the respective requirements stipulated in this Code; and

(4) the total computed Fire Load Energy Density (FLED) within the compartment that is used solely for farming shall not exceed 200 MJ/m^2.

b. Fire Safety Requirements

(1) Occupant Load

The occupant load shall be based on the accessible floor area, excluding designated farming areas, on the basis of 30m2 per person.

(2) Width of corridor

Where the building is exempted from barrier-free accessibility compliance by the authority having jurisdiction, the clear width of corridor shall be at least 1m.

(3) Travel distance

The one-way and two-way travel distances shall not exceed 25m and 60m respectively.

(4) Fire engine accessibility

A fire engine accessway is not required, however a fire engine access road for access by firefighting appliances shall be provided to within a travel distance of 60m of every point on the project plan area of the building.

(5) Compartment size

The compartment size limitations given in Table 3.2A is not applicable. The maximum AFA per compartment shall not exceed 8000m^2 and the maximum cubical extent per compartment shall not exceed 30000m^3. The full height of the compartment shall be used for computing the cubical extent.

(6) Sprinkler system

An automatic sprinkler system shall be provided where the AFA of any compartment that is used for farming purpose, exceeds the compartment size limit stated under *Cl.9.6.4b.(5)*.

(7) Smoke control system

An engineered smoke control system as specified in Cl.7.4.5shall be provided where the AFA of any compartment that is used for farming purpose, exceeds size limit of 8000m^2.

(8) Setback distance due to unprotected openings

The requirements on setback of unprotected openings from building/notional boundary stipulated under Cl.3.5.3 shall be complied with and in accordance with Table 1 of Annex 3B. However, the height of the unprotected openings for greenhouses, used for the computation of the setback requirement, shall be in accordance with Table 9.6.4b.(8).

(9) Emergency voice communication system and Fire Command Centre (FCC) are exempted.

(10) External wall construction

The requirements of *Cl.3.5.1a.(1)* for non-combustibility of external walls need not apply for greenhouse buildings. Where plastic glazing materials are used as screens or shades for a greenhouse, the material shall comply with Table 3.15G.

Table 9.6.4b.(8)	
Height of building	Height of unprotected openings
≤ 6m	Building's height
> 6m	6m or height of racking system (whichever is higher)

Explanation and Illustrations

Fire Load Energy Density (FLED)

Any materials not able to comply with the non-combustible material as stated in Clause 1.4.71.

The total computed FLED is the sum of all the energy available for release when the combustible materials are burned, divided by the total floor area of the compartment.

Equation:

FLED(MJ/m2)= Calorific value[1](MJ/KG) of combustible material (e.g. XXX) X Weight(KG) / Area of compartment[2]

Total FLED = FLED of combustible material X + FLED of combustible material Y + ...

How to compute the total FLED (MJ/m²) within a compartment

1. Determine the Weight of the combustible materials in the compartment for which you wish to calculate fire load.
2. Determine the Calorific Value of these materials.
3. Determine the Area of the compartment.
4. Multiply the Weight by the Calorific Value and divide the total by the Area to obtain the (MJ/KG)

Below show the tabulation of the total computed FLED (MJ/m2) of the combustible materials within a compartment having an area of 1000 m²

S/no	Material	Calorific value / Heat of combustion (MJ/KG)	Total weight (KG)	Fire Load (MJ)	FLED (MJ/m²)
1	X	22.3	1500	22.3MJ/KG x 1500KG= 33,450 MJ	33,450MJ/1000 m²= 33.45
2	Y	17.1	2000	34,200	34.2
				Total FLED	**67.65**

1. Calorific value can be found in product datasheet from the supplier, otherwise QP may refer to international references e.g. SFPE handbook
2. Area of compartment refers to individual fire compartment where the combustible material is stored.

9.6.5 Fuel dispensing system

a. General

This set of fire safety requirements shall be applicable to premises installed with fuel dispensing system other than petrol service station stipulated under *Cl.9.6.2.* Approval for the installation of fuel dispensing system shall be obtained from the relevant authority having jurisdiction.

b. Fuel storage tank

Fuel storage tank shall be installed in accordance with *SS 532*.

c. Fuel dispensing system

Fuel dispensing system shall be installed in accordance with *Cl.9.6.2s.*.

9.6.6 Waste management and recycling premises involved in processing of flammable liquid waste

a. General

This set of fire safety requirements shall be applicable to waste management and recycling premises with any of the following processes:

(1) reconditioning of empty storage container that is used to store flammable liquid;

(2) disposal of flammable liquid waste; and

(3) recovery of flammable liquid waste.

b. General requirements

(1) Classification

(a) All recycling processes shall be classified under high hazard occupancy and shall only be located at grade level.

(b) For disposal and recovery processes stipulated under *Cl.9.6.6a.(2)* and *(3)*, they shall comply with *Cl.9.8.4*.

(2) Spillage control

(a) Spillage control in accordance with *SS 532* shall be provided to all areas where flammable liquid waste is located.

(b) For reconditioning process, each untreated container will shall be assumed to contain a remnant capacity of 10% volume of the container or the actual declared content, whichever is larger, to determine the spillage control stipulated in *Cl.9.6.6b.(2)(a)*.

(3) Electrical wiring and equipment

All electrical wiring and equipment used within the processing areas shall be spark-proof and intrinsically safe in accordance with *IEC 60079*.

(4) Ventilation

Mechanical ventilation system in accordance with Cl.7.1.14shall be provided for disposal and recovery processes.

(5) External processing area (open-to-sky)

(a) For external area, requirements stipulated in *SS 532*, e.g. separation distance, provision of fire engine access road, hydrant, etc., shall be complied with.

(b) Where separation distance is not able to comply with requirements stipulated in *SS 532*, use of 4-hr fire resistance rating masonry wall is allowed provided all of the following are complied with:

(i) The fire-rated wall shall be at least 1m above the stockpile and shall also intersect the direct line between the on-sites facilities and top of the stockpile. (see *Diagram 9.6.6b.(5)(c)(i)*).

(ii) The fire-rated wall shall be at least 2m beyond the outermost edge of the stockpile. (see *Diagram 9.6.6b.(5)(c)(ii)*).

(iii) When fire-rated wall is used, at least one façade shall remain open for firefighting accessibility.

Diagram 9.6.6b.5)(c)(i) - Use of fire-rated separating wall between processing area/storage to on-sites facilities

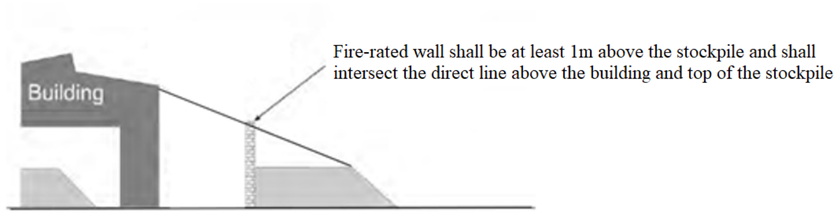


Diagram 9.6.6b.(5)(b)(i) **- Use of fire-rated separating wall between processing area/ storage to on-sites facilities**

Diagram 9.6.6b.5)(c)(ii) - Use of fire-rated separating wall between processing area/storage

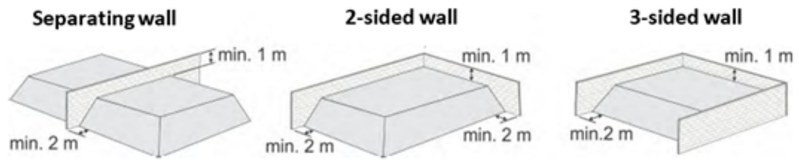


Diagram 9.6.6b.(5)(b)(ii)**: Use of fire-rated separating wall between processing area/ storage**

9.6.7 Electrical transformer room in underground structures

a. Scope

This set of fire safety requirements is applicable to electrical distribution transformer room located within underground structures e.g. consumer or power grid substation.

b. General requirements

(1) Compartment size and depth limits

(a) The AFA of each transformer room shall not exceed 250m^2.

(b) The depth of the transformer room shall not exceed 9m below the average grade level and not more than one level below grade level.

(2) The transformer oil shall be tested to ASTM D 92 or ISO 2592 standard and with the fire point exceeding 300°C.

(3) The underground structure housing the transformer shall not be sited within 15m travel distance measured between the nearest edges of the transformer door and exit staircase shaft.

(4) Provision to contain spillage of transformer insulating liquid shall be provided.

(5) Firefighting systems

(a) Automatic fire alarm system

(i) An automatic fire alarm system shall be provided for the electrical transformer room.

(ii) The fire alarm system for the underground transformer room shall be a dedicated zone, linked to the building fire alarm system. A summary fire alarm status (alarm/ fault) shall be provided to the main fire alarm panel in the building development.

(b) Fire suppression system

Automatic fire suppression system such as automatic sprinklers, foam-water sprinklers or water mist shall be provided for the electrical transformer room.

9.6.8 Sea-based buildings

a. General

This set of fire safety requirements shall be applicable to sea-based buildings that meet the following criteria:

(1) the building is more than one storey (including attic and mezzanine); or s

(2) any usage or part thereof used for Purpose Group V or VII.

b. Fire safety requirements

(1) Evacuee holding area

Evacuee holding area(s) on the basis of 0.3m^2/person shall be provided. The designated evacuee holding area shall be open-to-sky and located not less than 3m from any unprotected openings. In lieu of the separation distance, a 1-hr fire-rated wall of at least 1.8m high shall be provided to separate between the unprotected openings and the evacuee holding area. The evacuee holding area shall be located at first storey.

(2) Means of escape

One-way and two-way travel distance shall not exceed 15m or 30m, respectively as per *Table 2.2A*.

(a) Single storey structure

The travel distance shall be measured from the most remote point in any room or space to an open-to-sky space.

(b) Multi-storey structure

The travel distance shall be measured from the most remote point in any room or space to an exit staircase. An internal and/ or external exit staircase which serves as the required exit shall comply with the requirements stipulated in Cl.2.3.3;

(i) For mezzanine floors (excluding stay-in facility), one open staircase is permitted in accordance with *Cl.9.6.1a(2);* and

(ii) Where there are stay-in facilities provided at the upper floor(s), at least two exit staircases shall be provided.

(3) Structural fire precaution

(a) Single storey structure

The element of structure (excluding the floor) shall be constructed of non-combustible material.

(b) Multi-storey structure

(i) The flooring immediately above the sea level need not be constructed of fire-rated or non-combustible material. For other parts of the building, element of structure shall be constructed of fire-rated and non-combustible materials, in accordance with Cl.3.3 and *Table 3.3A*, respectively.

(ii) Where wooden stilts are used for construction of sea-based building (e.g. Kelong), the part that is above the sea level shall be constructed of fire-rated and non-combustible material.

(4) Marine fire vessel accessibility

(a) To facilitate SCDF's marine firefighting and rescue operations, there shall be unobstructed access to the evacuee holding area.

(b) A minimal 3m depth is required for berthing of SCDF's marine firefighting vessels all-around the building.

(5) Fire protection systems

(a) Hydraulic hose reel(s) conforming to the requirements in *SS 575* shall be provided to every storey of the building.

(b) Fire extinguishers complying with Cl.6.1 shall be provided to every storey of the building.

(c) Every part of the sea-based building shall be installed with a fire alarm system in accordance with *Table 6.3A*.

(6) Exit signs and emergency lightings

(a) Exit and exit directional signs shall be provided in accordance with Cl.8.1.7; and

(b) Emergency lightings shall be provided in accordance with Cl.8.1.3 and Cl.8.1.4, respectively.

(7) Solar Photo-Voltaic (PV) installation

Roof-mounted modules shall comply with Cl.10.2 in terms of:

(a) means of access;

(b) fire performance of PV modules;

(c) design and installation criteria; and

(d) emergency disconnection.

(8) Storage of flammable liquids

Storage of flammable liquids shall be located at the first storey. For the maximum capacity of flammable liquids, it shall be in accordance with *SS 532 Table 1* - Minor Storage.

CLAUSE 9.7 PURPOSE GROUP VII OCCUPANCY

9.7.1 General

a. Means of escape

(1) One exit staircase is permitted to serve an aboveground floor used as places of public resort except for public accommodation purposes, provided:

(a) the habitable height of the floor shall not exceed 15m;

(b) the floor shall not be located above 4th storey;

(c) the AFA of the floor shall not exceed 200m²;

(d) the occupant load of the floor shall not exceed 30 persons; and

(e) the exit staircase/ floor in the building shall not be of timber construction.

9.7.2 Hotels, boarding houses, serviced apartments, hostels, backpacker hotels & capsule hotels & staff quarters

a. Access through an internal corridor

Guestrooms or accommodation units with access through an internal corridor shall comply with all of the following requirements:

(1) Each guestroom or accommodation unit shall be compartmented from adjoining rooms and other parts of the same building, including the internal corridor, by construction having fire resistance rating of at least 1 hour.

(2) Doors opening into internal corridors shall have fire resistance of at least half an hour and fitted with automatic self-closing device to comply with the requirements of *Cl.3.9.2.*

Rationale

In the event of fire within a guestroom, the compartmentation provided to each room will help to contain the fire and prevent it from spreading to other rooms. It will also safeguard the internal common corridor for occupants to access to protected exit staircases.

Explanation and Illustrations

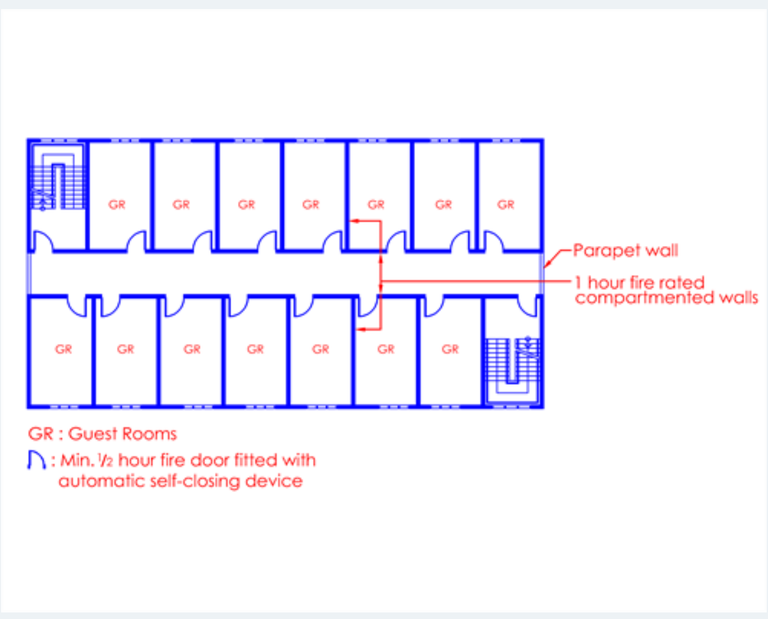


Figure 9.7.2a(1) & (2)

Each guestroom is treated as a fire compartment. Walls facing the corridor and between guestrooms can be constructed of fire-rated materials other than masonry. They shall be of full height carried right-up to the underside of the soffit of the floor slab above or to an imperforate fire-rated ceiling or to the roof coverings.

(3) The common internal corridor can be naturally or cross ventilated. A naturally ventilated corridor shall have ventilation openings of not less than 15% of the floor area and located not more than 9m from any part of the common internal corridor. Where a corridor is cross ventilated, it shall comply with *Cl.2.2.13b.(7)(c)*. Internal corridors which cannot be naturally or cross ventilated shall be pressurised to comply with the requirements in *Chapter 7*.

Explanation and Illustrations

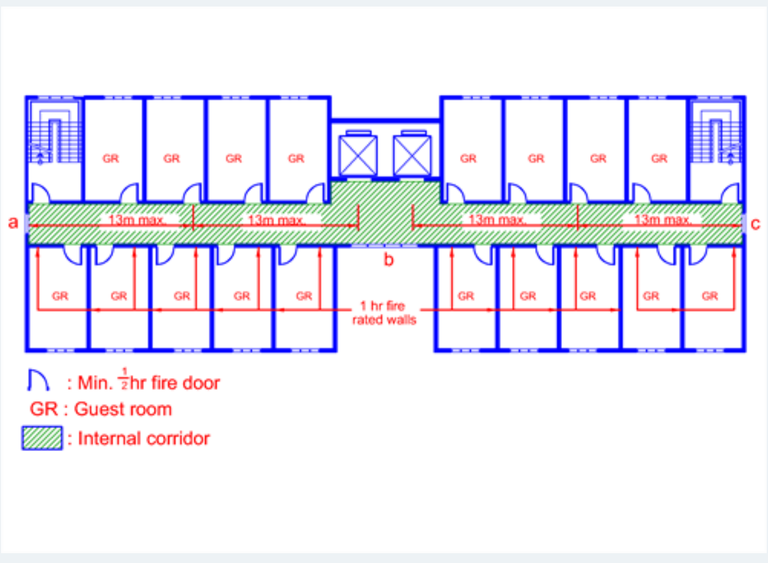


Figure 9.7.2a(3)

For natural ventilation to the internal corridor, the total fixed openings (a + b + c) shall not be less than 15% of the area of the internal corridor. Alternatively, internal corridor can be provided with mechanical ventilation and pressurised to comply with the requirements in Chapter 7. No part of the corridor shall be at a distance of more than 12m from any ventilation openings.

(4) Other rooms or spaces which open into or form part of the guestroom or accommodation unit corridor which can jeopardise the means of escape shall be required to be compartmented to the same extent as the guestroom or accommodation unit.

Explanation and Illustrations

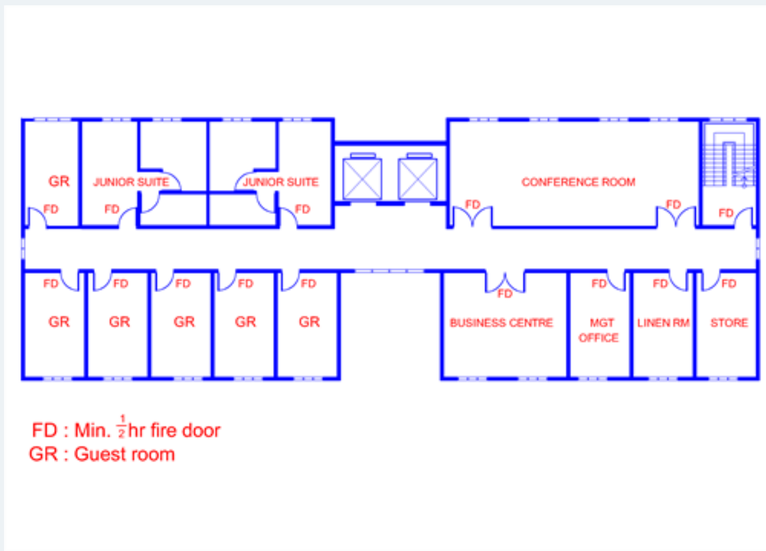


Figure 9.7.2a(4)

Other rooms or spaces include linen room, which required to be fire compartmented with 1-hr fire-rated enclosure and ½-hr fire door respectively. Lounge area, business centre etc. should be treated as guestroom. Therefore, compartmentation is required.

b. Access through an external corridor

Guestrooms or accommodation units with access through an external corridor shall comply with all of the following requirements:

(1) Each guestroom or accommodation unit shall be compartmented from adjoining rooms and other parts of the same building by construction having fire resistance rating of at least 1 hour, unless otherwise permitted under Cl.2.3.10 for the provision of window openings between the guestroom or accommodation unit and external corridor.

(2) Doors opening into the external corridor need not have fire resistance rating.

Explanation and Illustrations

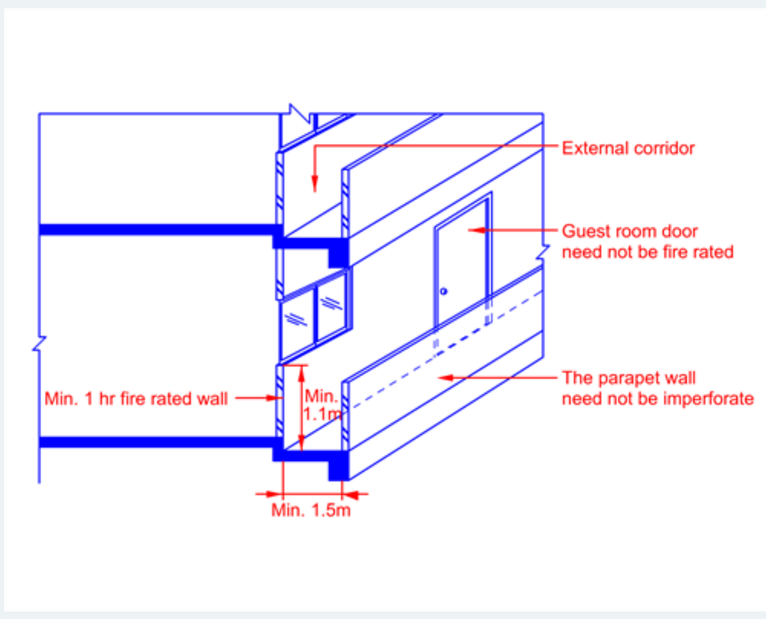


Figure 9.7.2b

The depth of the roof protection over the corridor shall not exceed 3m. The open side of the corridor shall not be installed with glazing, blinds, etc.. The external corridor refers to corridor which opens to the external and not to atrium.

(3) The external corridor shall comply with Cl.2.3.10.

c. Measurement of travel distance

The travel distance shall be measured from the most remote point of a guestroom or accommodation unit or suite to the exit door of an exit staircase, exit passageway or external space.

Explanation and Illustrations

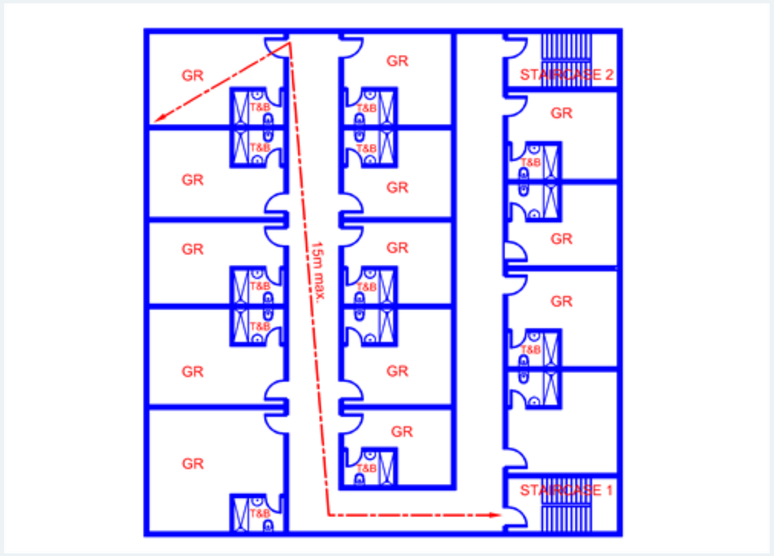


Figure 9.7.2c. - 1

Non-sprinkler-protected building

One-way travel distance from most remote point of guestroom to exit staircase is 15m.

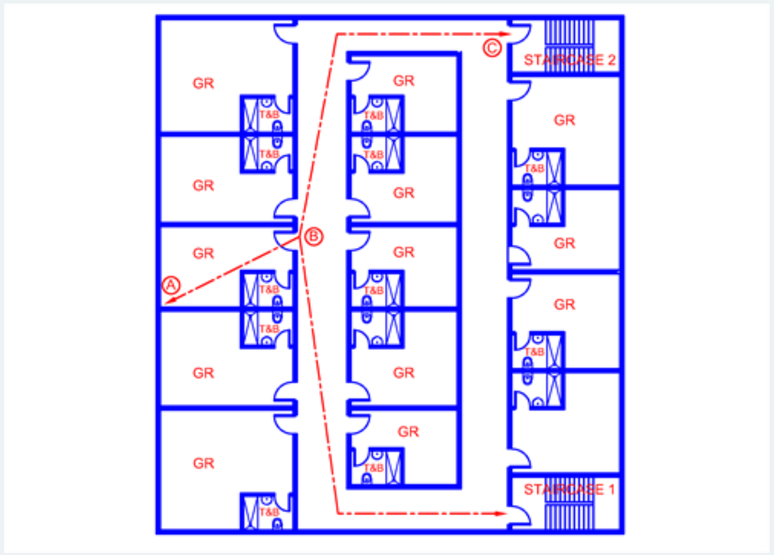


Figure 9.7.2c. - 2

Travel distance for Non-sprinkler-protected building

A to B is considered as one-way travel distance and it shall be not more than 15m. In computing the two-way travel distance, the escape route from point A to C (via B) shall not exceed 30m.

Travel distance for sprinkler-protected building

A to B is considered as one-way travel distance and it shall not be more than 20m. In computing the two-way travel distance, the escape route from point A to C (via B) shall not exceed 60m.

d. Spacing of smoke barrier

(1) Internal corridors which are not naturally-ventilated shall be subdivided by smoke barriers into the following lengths:

(a) Building protected by sprinkler system - 45m, or

(b) Building not protected by sprinkler system - 30m

(2) Smoke barriers shall comply with all of the following requirements:

(a) The smoke barriers shall consist of non-combustible partitions containing smoke check doors. The smoke barriers, including the enclosing walls to the corridor, shall be constructed to full height, carried right up to form a close joint with the soffit of the floor slab above, or an imperforate non-combustible ceiling or the roof coverings.

(b) The smoke barriers shall be sited at suitable locations across the corridor to create multiple sections, with each having free and direct access to an exit or exit staircase, exit passageway or exit ramp.

(c) Smoke-check doors excluding glass doors, shall be provided with clear glass vision panels having at least 25% of the surface area of each door leaf.

(d) Smoke-check doors shall be of the self-closing, swinging type. Double swing type is permitted provided that the door opening is closed completely with such clearance as is reasonably necessary for proper operation. The doors shall be closely fitted around their edges and the bottom clearance gap between such doors and the floor shall not exceed 4mm.

Explanation and Illustrations

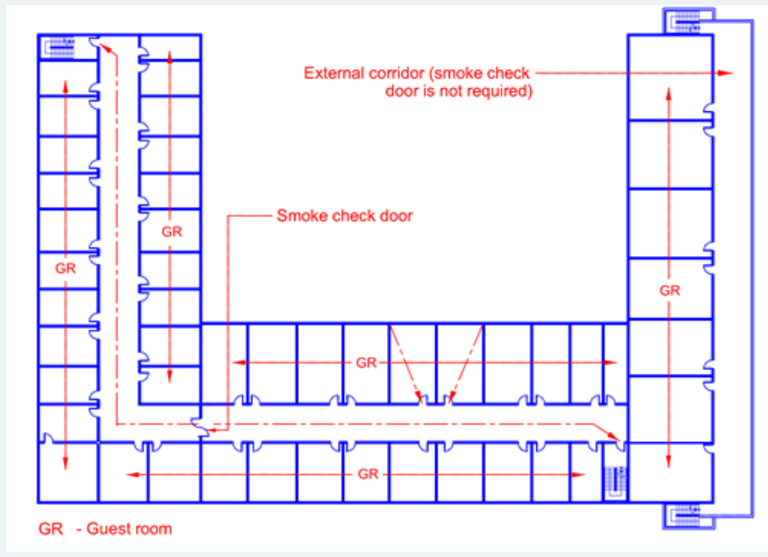


Figure 9.7.2d – 1

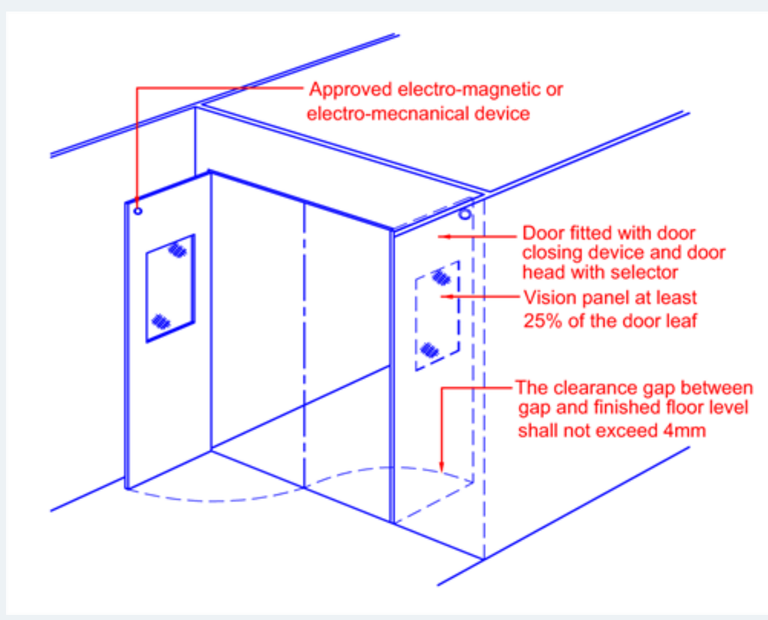


Figure 9.7.2d - 2

The above requirement applies to internal corridors in hotel floors, which are not naturally ventilated. The smoke barriers shall consist of non-combustible partitions containing smoke check doors. The smoke barriers, including the enclosing walls to the corridor, shall be constructed of full height, carried right up to form a close joint with the soffit of the floor slab above, or an imperforate non-combustible ceiling or the roof coverings.

With long internal corridors being subdivided by smoke barriers and smoke-check doors into multiple sections, there is no need to provide separate pressurisation system to each of the subdivided sections.

The smoke barriers shall be situated at suitable locations across the corridor to create multiple sections, with each having free and direct access to an exit or exit staircase, exit passageway or exit ramps.

Smoke-check door if it is not a glass doors, shall be provided with a clear glass panels having at least 25% of the surface area of the door leaf. Smoke-check doors shall be self-closing, the swinging type and may be double swinging but shall close the opening completely. The doors shall be closely fitted around their edge and the bottom clearance gap between door and finished floor level shall not exceed 4mm. The door is not required to have fire resistance rating.

Smoke-check doors shall normally be in the closed position. However, they may be left open if they are arranged to close automatically by an approved electromagnetic or electromechanical device which can be activated by the presence of smoke and/or the building fire alarm system.

(e) Smoke-check doors shall normally be in the closed position. However, they can be left open if they are arranged to close automatically by an approved electromagnetic or electromechanical device which can be activated by the presence of smoke and/or the building fire alarm system.

e. Visual alarm system

At least 10% of the guestrooms or accommodation units shall be provided with visual alarms. In the case of staff quarters accommodation units, this requirement need not be complied with.

Rationale

The main function of smoke-check door is to prevent the whole internal corridor being filled with smoke very quickly should there be migration of smoke from any of the guestroom to the corridor. Hence, it would act as a physical barrier dividing the corridor into separate zones against smoke migration.

f. Additional requirements for capsule hotels

(1) Capsule designs

(a) All capsules shall have a clear access opening of at least 800mm (width) x 600mm (height) or equivalent area of at least 0.5m^2 opening space. If the access opening comes with a door/hatch, it shall have an emergency access from outside of the capsule.

(b) The number of tiers of capsules stacked on top of one another shall be limited to a maximum of 2.

(2) Compartmentation

The capsules shall be located within individual guestroom which complies with the following requirements:

(a) Compartmented in accordance with Cl.9.7.2;

(b) Maximum AFA of not exceeding 60m^2; and

(c) Occupant load not exceeding 20 persons.

(3) Construction materials

(a) Capsules that are constructed of plastics shall comply with the acceptance criteria listed in Table 3.15B.

(b) Capsules that are constructed of combustible materials shall comply with flame spread rating of Class 1 under BS 476 Part 7, or Class B or Class C under EN 13501-1.

(4) Fire protection systems

(a) Sprinkler protection shall be provided in the entire building where the capsule hotel occupied in whole or in part. Inside each capsule, at least one sprinkler shall be provided and the minimum pressure and flow rate for this sprinkler shall be at least 50 kPa and 56 L/min respectively.

(b) The sprinkler system for capsule hotel shall be designed to meet requirements for Ordinary Hazard Group 1 occupancy.

(c) A minimum clearance of 500mm shall be kept between the top surface of the capsule enclosure to the deflector of the room ceiling sprinklers.

(d) K factor for the ceiling sprinkler shall be 11.5.

(e) Hydraulic calculation shall be performed to verify that water supply for the sprinkler system can meet the flow and pressure demands for all the ceiling sprinklers within a single compartmented guestroom plus 6 numbers of in capsule sprinklers to operate for a minimum duration of 60 mins.

(f) The capsule sprinkler shall be protected against tampering by occupant in the capsule.

(g) As an alternative, water-mist system in compliance with NFPA 750 is acceptable. The proposed water mist system shall be type tested and listed for ordinary hazard protection and is capable to handle fire risk similar to that of a capsule fire.

(h) In addition, smoke/heat detector shall be provided within each capsule and when activated fire alarm signal shall be sent to the building's main fire alarm panel to activate all fire alarm sounders and visual alarms in the building, not only to those in the capsule hotel.

(i) Each capsule shall be provided with a sensor to detect the presence and motion of the occupant within the unit. This shall facilitate the conduct of search and rescue operations during a fire emergency. A display panel indicating the occupancy and motion status of the occupant within each capsule shall be co-located with the main fire alarm panel.

9.7.3 Assembly occupancy

a. General

Number and minimum width of exits for assembly occupancies shall comply with the provisions tabulated as follows:

Explanation and Illustrations

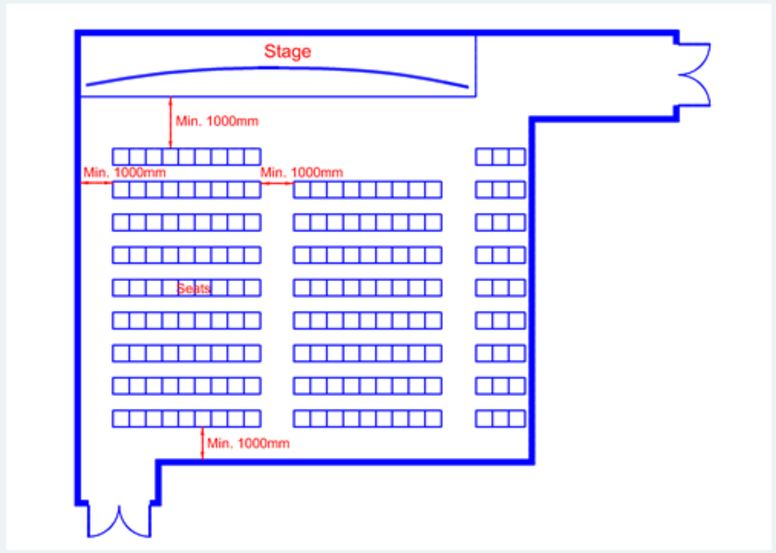


Figure 9.7.3a

The total number of occupant load of the above auditorium is more than 50 persons, but not exceeding 200 persons. The clear width of each exit door shall be sufficient to receive at least half the occupant of the floor space. The clear width of the aisles or gangways shall not be less than 1200mm. The exit doors shall be sited remote from each other to comply with *Cl.2.3.12.*

TABLE 9.7.3a. : MINIMUM WIDTH OF EXITS FOR ASSEMBLY OCCUPANICIES

No. of Occupants	Min No. of Doors	Min width of corridors
51 - 200	2	1.20m
201 - 500	2	1.25m
501 - 1000	3	1.25m
exceeding 1000	4	1.25m

b. Assembly occupancy with fixed seating (Performance theatres, Cinemas, Auditoriums, Concert Halls, etc.)

(1) Aisles and gangways

(a) clear aisles or gangways of not less than the minimum width of corridors shall be provided around the auditorium, stalls and balconies leading to doors or exit doors;

Explanation and Illustrations

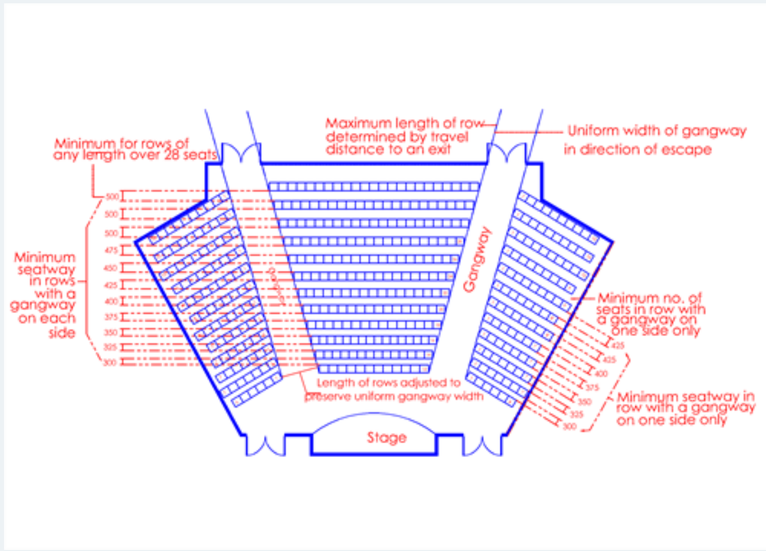


Figure 9.73b.(1)(a) - 1

The above figure illustrates uniform width of gangway in the direction of escape, where escape in opposite directions are available in the auditorium.

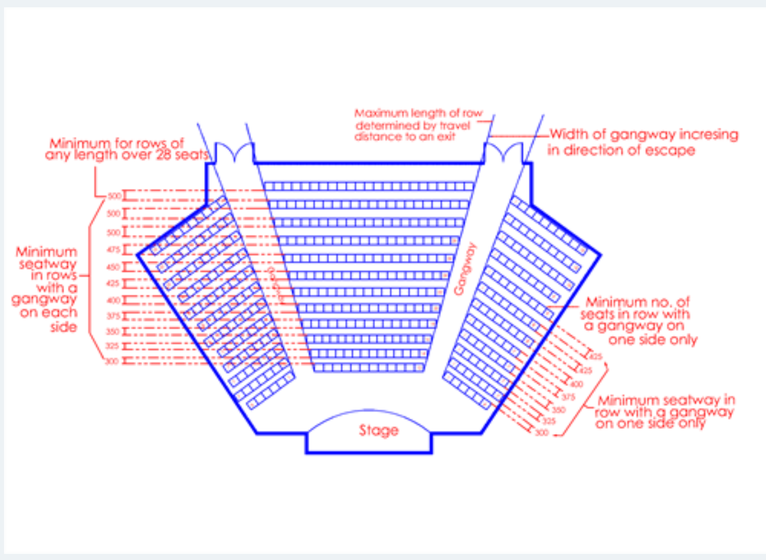


Figure 9.7.3b.(1)(a) - 2

Prior consultation with the SCDF is required if any row has more than 30 seats, as there could be concern on congestion along the gangways and at the exits.

The seating materials, in all cinemas, theatres, concert halls , auditorium, etc. are required to be type tested by a recognised testing laboratory and shall be listed by a recognised certification body.

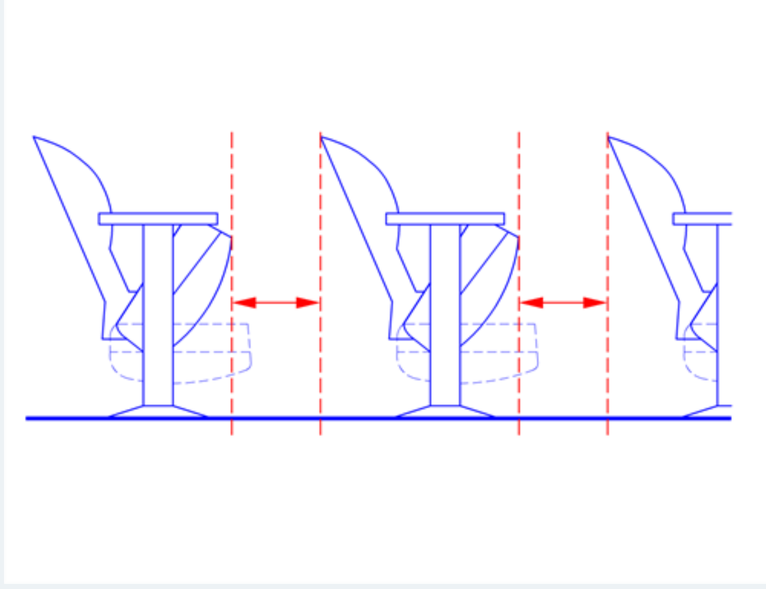


Figure 9.7.3b.(1)(a) - 3

Determination of seatway width

Seatway width shall not be less than the tabulated seatway width in Table 9.7.3b.(1)(b) and shall be constant throughout the length of the row.

Measurement of width of aisle accessway formed by rows of chairs.

Access and egress routes shall be maintained to facilitate easy movement towards the gangway(s) thus allowing faster evacuation of occupants.

(b) aisles or gangways shall be provided with intersecting rows of seating and the number of seats in a row shall be in accordance with the provisions tabulated as follows:

Rationale

The seatway provides the initial part of an escape route and hence it needs to be of sufficient width, depending on the number of seat it serves, to enable easy movement towards the gangway(s).

TABLE 9.7.3b.(1)(b) : NUMBER OF SEATS IN A ROW

Seatway width mm	Maximum no. of seats in a row	
	Gangway on one side	Gangway on two sides
300 - 324	7	14
325 - 349	8	16
350 - 374	9	18

375 - 399	10	20
400 - 424	11	22
425 - 449	12	24
450 - 474	12	26
475 - 499	12	28
500 or more	12	Limited by the travel distance

The seatway shall be the minimum clear width between rows, which shall not be less than 300mm, measured as the clear horizontal distance from the back of the row ahead (including seats that tip up automatically) and the nearest projection of the row behind when the seats are in upright position. The seatway widths shall be constant throughout the length of the row. (See *Diagram 9.7.3b.(1)(b) - 1* and *2*)

(c) for changes of level, steps shall not be used to overcome differences in level in aisles or gangways unless the slope of such gangways exceeds 1 in 10;

Explanation and Illustrations

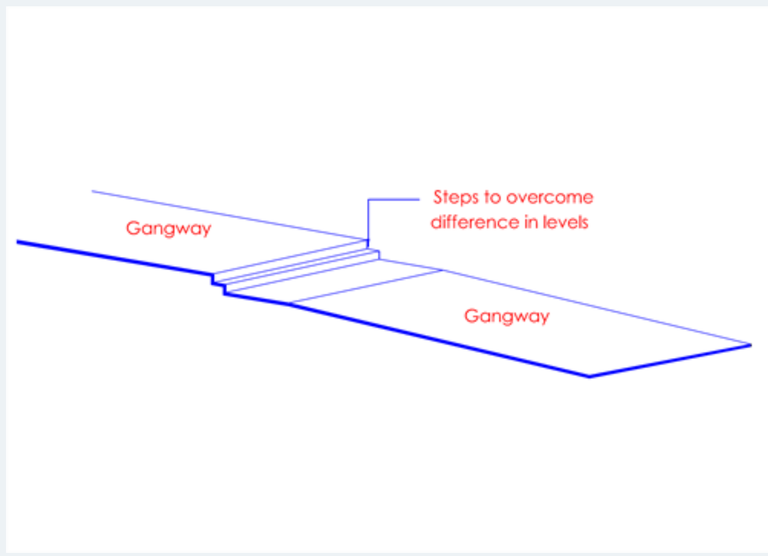


Figure 9.7.3b.(1)(c)

Steps (min. 2 numbers) may be used when gradient of slope of gangways exceeds 1 in 10. The dimensions of treads and risers shall comply with *Cl.2.3.3d.(4)*.

(d) handrails shall be provided, where steps of a pitch exceeding 30° or ramps of a slope exceeding 1 in 10 are provided in aisles or gangways flanking the seating;

(e) flooring for the surface of steps and ramps forming the aisles or gangways shall be finished using non-slip materials; and

Explanation and Illustrations

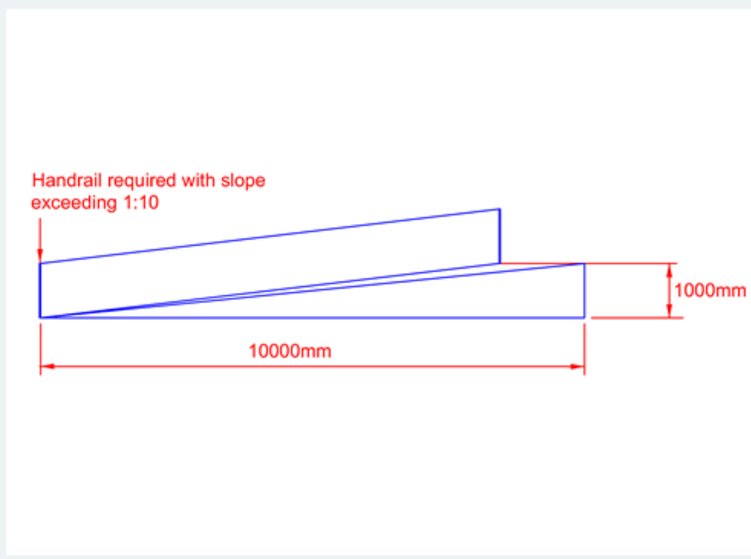


Figure 9.7.3b.(1)(d) - 1

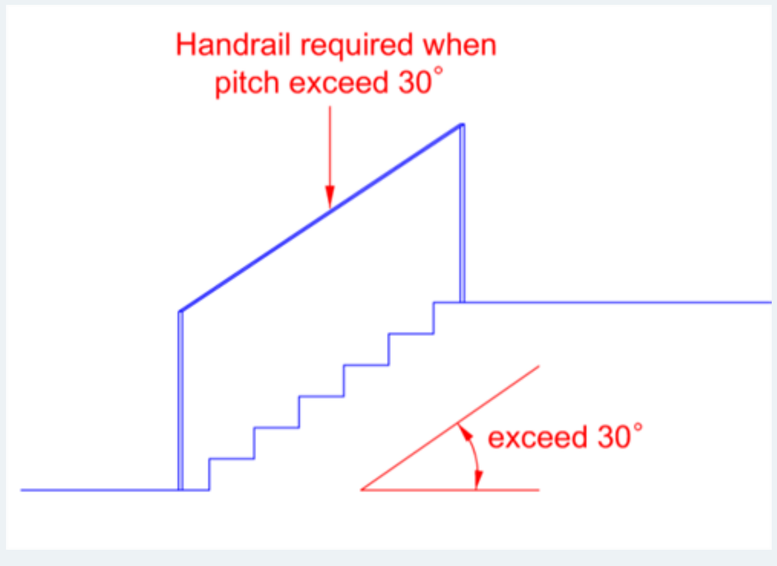


Figure 9.7.3b.(1)(d) - 2

(f) illumination of steps shall be such that each step is clearly visible in the event of emergency.

(g) Combustible seats for cinemas, theatre, auditorium, etc.

The construction of combustible upholstered seats in cinema, theatre, auditorium, etc. shall comply with BS 5852 in respect of the following testing standard:

(i) Smouldering Ignition Source;

(ii) Flaming Ignition Source 1; and

(iii) Crib Ignition Source 5.

Rationale

Emergency lighting will light up the escape route to alert the public of the presence of steps. Such arrangement will help to prevent tripping.

Explanation and Illustrations

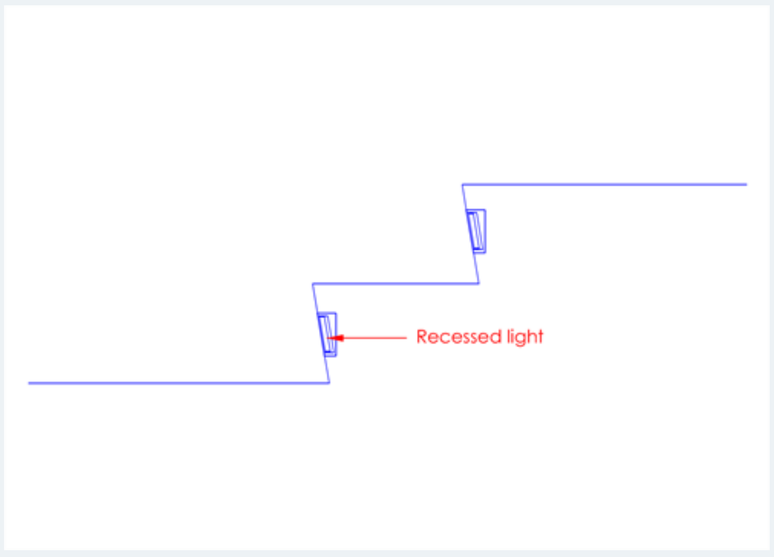


Figure 9.7.3b.(1)(f)

The rationale of illuminating the steps is intended to alert the public of the presence of steps. Such arrangement will help to prevent tripping. Where the emergency lighting of the hall or auditorium is able to provide sufficient lighting to the steps, separate emergency power supply to illuminate the steps would not be required.

(2) Exits from a theatre, cinema or a concert hall

Explanation and Illustrations

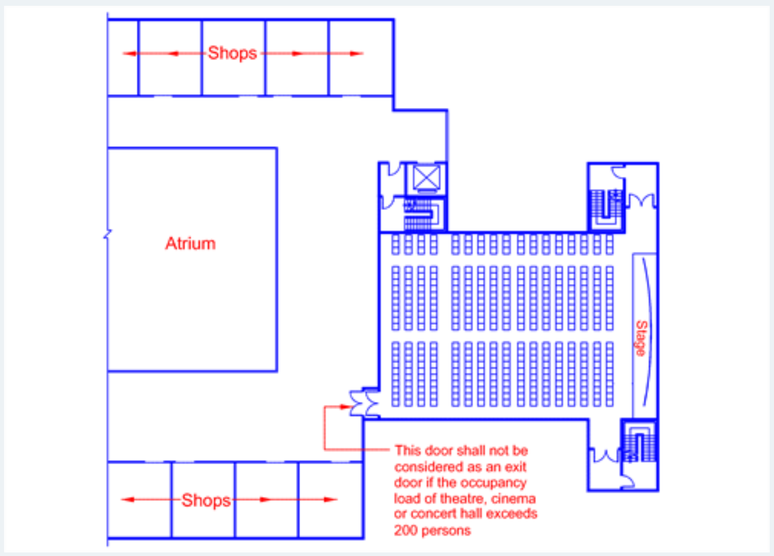


Figure 9.7.3b.(2)

A theatre, cinema or concert hall is considered a compartment by itself. It should be self-sufficient in the provision of the exits for the occupants. Sharing of exit facilities with other part of the building under different occupancy is not permitted unless the occupant load of the theatre, cinema or concert hall is less than 200 persons.

(a) The number and capacity of exits from an enclosed space in an assembly occupancy used or intended for use as cinema, concert hall, auditorium, performance theatre that is not normally provided with natural ventilation and lighting, shall be provided its own means of escape without having to take into account exits provided for its adjoining parts of the same building in which it is housed. Exception can be permitted where the occupancy load does not exceed 200 persons, in which case at least half the capacity of exits shall be provided within the compartment.

(b) Where a building or part of a building is designed as a cineplex to house multiple mini-cinemas, the means of escape to be provided can be shared by all the mini-cinemas. Each cineplex shall be treated as a single big cinema for the purpose of determining the exit requirements under Cl.9.7.3b.(2).

Rationale

The occupants getting out of the theatre during an emergency are likely to be disorientated. The spillage of occupants outside the theatre should be within very close distance, if not immediately adjacent to it, so as to serve its purpose.

(c) The exits adjacent or attached to cinema, theatre or concert hall and the like can be shared as exits with the other parts of the building, provided the exits are accessible from the common circulation areas. The occupancy load of the cinema, theatre, concert hall and the like does not exceed 200 persons.

Rationale

With the positioning of exit next to the small size cinema, theatre etc., it would help to maintain effective evacuation even with the sharing of the staircase with evacuees from the other occupancy areas on the same storey.

(3) Separation of theatre, cinema or concert hall from other parts of the building

A theatre, cinema or concert hall shall be separated from other parts of the same building, which is of a different purpose group, by compartment walls and floors having a fire resistance rating of at least 2 hours. If the building is protected by an automatic sprinkler system, the fire resistance rating of the compartment walls or floors can be reduced to 1 hour. Where openings are provided for access between the theatre, cinema or concert hall and any other part of the same building of a different purpose group, the openings shall either be protected by fire doors having the necessary fire resistance rating as the enclosing walls or floors, or be provided with lobby which complies with the following requirements:

(a) The lobby is enclosed by walls having fire resistance rating of at least 1 hour, is naturally ventilated complying with the requirements for ventilation of smoke-free lobbies, or mechanically ventilated to comply with the requirements in Chapter 7; and

(b) All doors to the lobby shall each have fire resistance rating of at least ½ hour and fitted with an automatic self-closing device.

Explanation and Illustrations

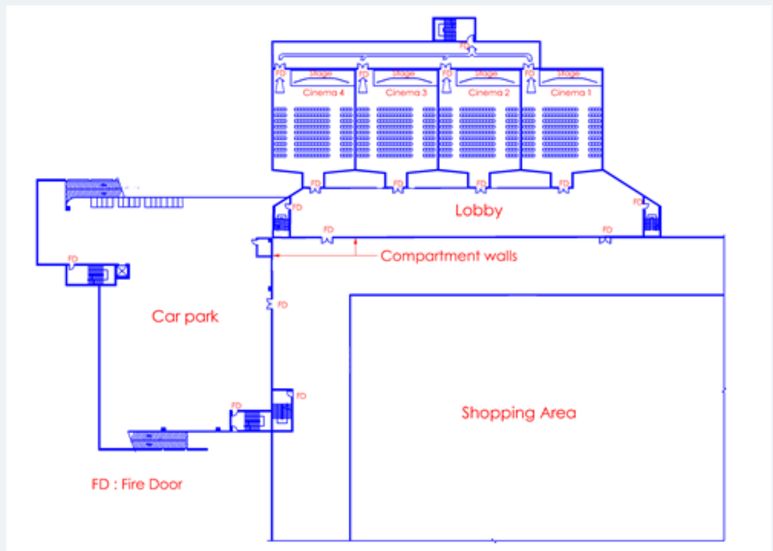


Figure 9.7.3b(3)

(4) Separation by proscenium wall in theatres or concert halls

(a) In a place of public resort, such as theatres, and concert halls, capable of seating more than 500 persons and in which fly tower is used for stage scenery or when extensive stage scenery is installed on the stage side, the stage shall be separated from the seating area by a proscenium wall of at least 1-hr fire resistance rating in such a way that the stage and the audience seating area form separate compartments.

(b) The entire stage side of the proscenium wall shall be fitted with an automatic sprinkler system which complies with the requirements in Chapter 6.

(c) The proscenium opening shall be protected by fire curtain with fire resistance rating of at least 1 hour, automatically operated by a fusible link or a smoke detector. In lieu of fire curtain, a smoke curtain is acceptable, if engineered smoke control and automatic sprinkler systems are to be provided to the stage area.

(d) Not more than three other openings can be provided in the proscenium wall. Such openings shall not exceed 2m2 in area and shall be fitted with doors having fire resistance rating of at least ½ hour and fitted with an automatic self-closing device.

Explanation and Illustrations

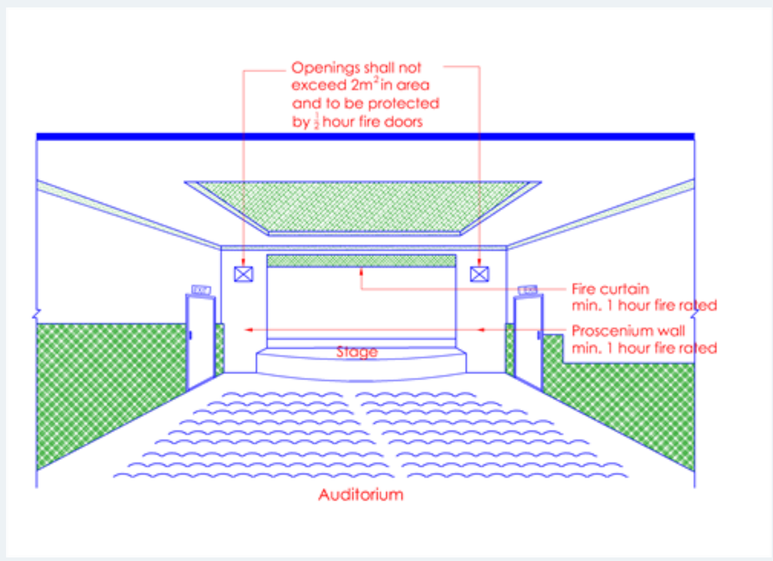


Figure 9.7.3b(4)

Fire separation between stage and auditorium is required to avoid causing panic to audience owing to a fire outbreak in the stage area.

(5) Smoke control system

(a) Multi-tier/level seating auditorium shall be protected by an automatic sprinkler system and engineered smoke control system. For single tier/level seating auditorium that is either sprinkler-protected or non sprinkler-protected, smoke vents complying with the following criteria can be provided in lieu of engineered smoke control system:

(i) at least 2.5% of the floor area;

(ii) at least 600mm X 600mm in size;

(iii) adequately distributed such that no part of the auditorium is more than 12m from any ventilation opening;

(iv) located at high level close to soffit of the ceiling or within a perforated ceiling space; and

(v) activated by automatic device.

(b) Exception:

Lecture theatres and the like are exempted from the requirement to provide smoke vents, provided they fulfil all of the following criteria:

(i) without stage curtain, fly tower, props, and back stage areas;

(ii) used solely for the conduct of lessons;

(iii) not located below ground level; and

(iv) not exceeding 5000m^2 in size.

Rationale

Adequate smoke vents facilitate effective dispersion of smoke to external of building, thereby minimising the risk of a smoke-logged situation in an auditorium. These dimensions have been validated through a fire engineering study.

9.7.4 Outdoor Refreshment Areas (ORAs)

a. General

(1) This set of fire safety requirements shall be applicable to all food and beverage (F&B) outlets where ORAs are permitted by the authority have jurisdiction. F&B outlets shall include eating houses, restaurants, coffee shops, hawker centres, fast food outlets, cafeterias, canteens, pubs, bars and the like.

(2) The total occupant load within each F&B outlet shall not exceed 200 persons. Where the limit is exceeded, alternate rear exit opening directly into a back lane or safe external space shall be provided.

(3) Where an ORA encroaches on neighbouring property(s) or state land, it is the responsibility of the F&B's owner/operator to seek no objection from the property owner(s) for the setting up of the ORA on his property.

Note

Application for approval of fire safety plans for ORA shall be required, except for ORAs which comply fully to the following conditions:

a. An escape route of width not less than 1.2m along the covered walkway is provided.

b. Entrance of the F&B outlet is not blocked by tables(s), chair(s) or any form of obstruction.

c. For F&B outlet located next to an exit staircase, no table(s), chair(s) or any form of obstruction is to encroach onto the escape path from exit staircase discharge point to the external space.

d. For F&B outlet using umbrellas for its ORA, the size of umbrella is not more than 2m in diameter or 2m x 2m and the set back of umbrellas from the building line (eaves of building) is not less than 1.5m.

e. For F&B outlet having canopy/awning at the ORA, the project of the canopy/awning is not exceeding 1m.

b. Fire safety requirements for ORAs

(1) ORAs along covered walkway

(a) A five-foot way of width not less than 1.2m shall be provided along the covered walkway. Tables and chairs shall be abutting the F&B shop front or located at the outer edge of the building within the covered walkway. The entrance of the F&B outlet shall not be blocked.

(b) For F&B outlet located next to an exit staircase, a clear escape path from the staircase discharge point to external space shall be maintained. The width of the escape path shall not be less than the width of the exit staircase. No table(s), chair(s) or any form of obstruction shall encroach onto this escape path at all times.

(See *Diagram 9.7.4b.(1)*)

(2) ORAs open to the sky

(a) There is no limit to the number of table(s) or chair(s) placed in areas open to the sky, subject to compliance to other authorities having jurisdiction.

(b) When placement of table(s) or chair(s) is extended to any covered walkway, the requirements stipulated under *Cl.9.7.4b.(1)* shall be complied with.

(c) There is no control on the size/height of the ODAs and the materials used for displaying goods at the ODAs. There shall be no encroachment of table(s), chair(s) or any form of obstruction on the escape path from the exit staircase discharge point to external space. The portion of covered ORAs beyond the building lines and abutting the escape path shall be demarcated from the escape path with a red colour line of width not less than 50mm. Red colour wordings, “NO OBSTRUCTION OF EXIT”, of height not less than 100mm shall be marked along the line at regular intervals of not more than 1.5m.

(See *Diagram 9.7.4b.(2)*)

(3) ORA with umbrellas

(a) When umbrellas are used to provide shelter for diners, its size shall not be larger than 2m in diameter or 2m x 2m. The umbrellas shall be placed at a distance of not less than 1.5m from the building line (eaves of building).

(b) There shall be no limit on the number of umbrellas placed in areas open to the sky. A separation distance of not less than 1.5m shall be provided between rows of umbrella. There shall be no roofing between rows of umbrellas.

(c) Where placement of table(s), chair(s) or any form of obstruction is extended to any covered walkway, the requirements stipulated under *Cl.9.7.4b.(1)* shall be complied with.

(d) There shall be no encroachment of table(s), chair(s) or umbrella(s) or any form of obstruction on the escape path from the exit staircase discharge point to external space. Where umbrellas are placed close to the exit staircase discharge path, *Cl.9.7.4b.(2)(c)* shall be complied with.

(e) Umbrella having dimensions larger than 2m in diameter or 2m x 2m shall be treated as canopy/awning. Hence, requirements stipulated under *Cl.9.7.4b.(4)* shall be complied with.

(See *Diagram 9.7.4b.(3)*)

(4) ORAs with canopy/awning

(a) There shall be no encroachment of table(s) or chair(s) or any form of obstruction onto the escape path from the exit staircase discharge point to the external space. This path beyond the building façade shall be clearly demarcated as per *Cl.9.7.4b.(2)(c)*.

(b) For canopy/awning with projection not exceeding 1m

(i) No separation between the canopy/awning and the nearer edge of the exit staircase discharge path is required.

(ii) The high/low separation requirements stipulated under Cl.3.5.7 need not be complied with.

(iii) The requirements on set back of unprotected openings from building/notional boundary stipulated under Cl.3.5.3 need not be complied with.

(iv) Placement of table(s) or chair(s) beneath the canopy/awning is permitted.

(v) The canopy/awning can be continuous and cover the exit staircase discharge path. Separation between the canopy/ awning of the F&B outlet and those of the neighbouring units is not required.

(vi) There shall be no control on the material of the canopy/ awning.

(See *Diagram 9.7.4b.(4)(b)*)

(c) For canopy/awning with projection greater than 1m but not exceeding 2m

(i) A minimum separation distance of 500mm between the canopy/awning and the nearer edge of the exit staircase discharge path shall be maintained and shall only be exempted if the awning/canopy is designed to retract automatically when fire/smoke is detected within the F&B unit or its ORA.

(ii) The high/low separation requirements stipulated under Cl.3.5.7 shall be complied with.

(iii) The requirements on set back of unprotected openings from building/notional boundary stipulated under Cl.3.5.3 shall be complied with.

(iv) At least 500mm separation distance shall be maintained between the canopy/awning of the F&B outlet and the projection line of the separating wall and shall only be exempted if the awning/canopy is designed to retract automatically when fire/smoke is detected within the F&B unit or its ORA.

(v) For auto-retractable canopy/awning as mentioned in *C1.9.7.4b.(4)(c)(i),* the canopy/awning can be continuous and cover the exit staircase discharge path and separation between the canopy/awning of the F&B outlet and those of the neighbouring units is not required.

(vi) The surface flame spread rating of the canopy/awning shall be at least Class 2.

(See *Diagram 9.7.4b.(4)(c) - 1* & *2*)

(d) For canopy/awning with projection greater than 2m but not exceeding 3m

(i) A minimum separation distance of 500mm between the canopy/awning and the nearer edge of the exit staircase discharge path shall be maintained.

(ii) The high/low separation requirements stipulated in Cl.3.5.7 shall be complied with.

(iii) The requirement on set back of unprotected openings from building/notional boundary stipulated under Cl.3.5.3 shall be complied with.

(iv) At least 500mm separation distance shall be maintained between the canopy/awning of the F&B outlet and the projection line of the separating wall.

(v) The surface flame spread rating of the canopy/awning shall be at least Class 1.

(See *Diagram 9.7.4b.(4)(d)*)

(e) For canopy/awning with projection exceeding 3m

All relevant requirements stipulated in this Code shall be complied with.

(5) Other fire safety requirements

(a) There shall be no open-flame cooking in ORAs, except those open to the sky.

(b) For buildings which are installed with automatic fire sprinkler system, the sprinkler protection shall be extended to protected the covered ORAs.

(c) Every part of covered ORAs shall be within the coverage of fire hose reel(s).

(d) Approval of fire safety plans.

Diagram 9.7.3b.(1)(b) - 1 : Seatway width and number of seats in a row

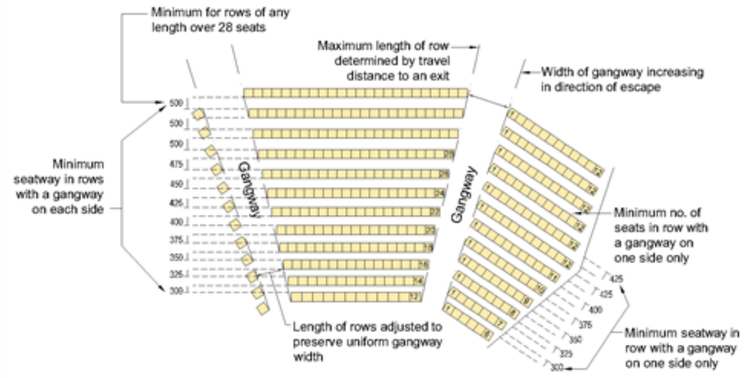
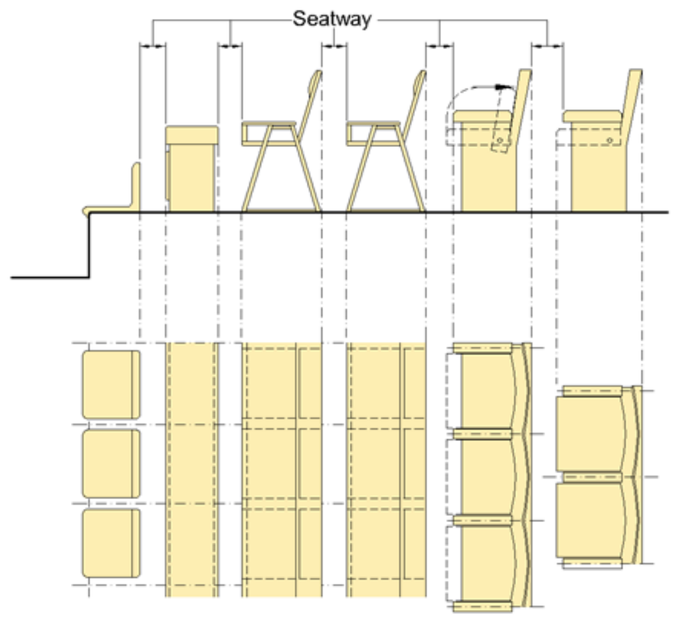


Diagram 9.7.3b.(1)(b) – 1: Seatway width and number of seats in a row

Diagram 9.7.3b.(1)(b) - 2 : Determination of seatway width



Seatway widths shall not be less than 300mm and shall be constant throughout the length of the row.

Diagram 9.7.3b.(1)(b) – 2 : Determination of seatway width

Diagram 9.7.4b.(1) : ORAs along covered walkway

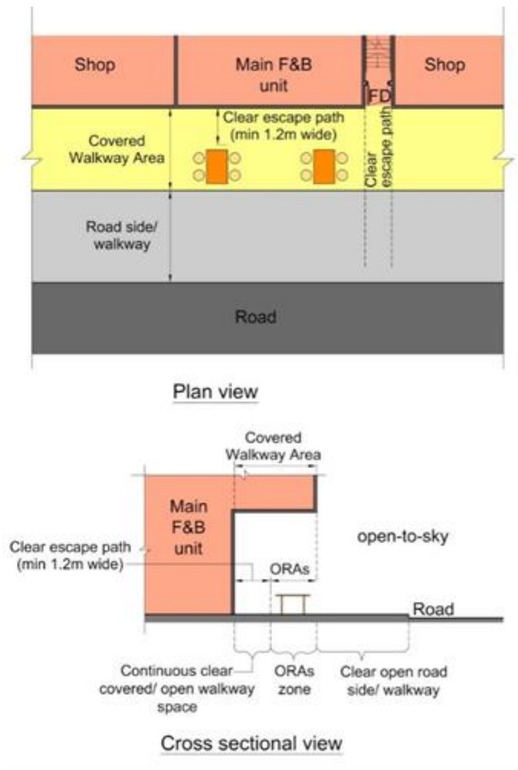


Diagram 9.7.4b.(1) : ORAs along covered walkway

Diagram 9.7.4b.(2) : ORAs open to sky

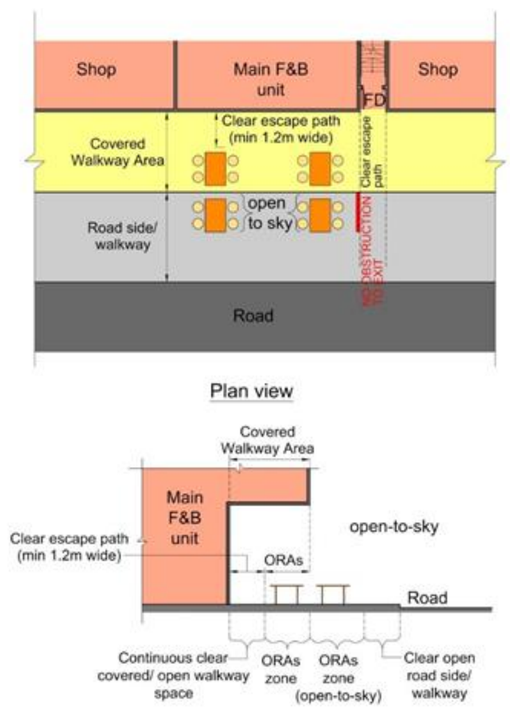


Diagram 9.7.4b.(2) : ORAs open to sky

Diagram 9.7.4b.(3) : ORAs with umbrella

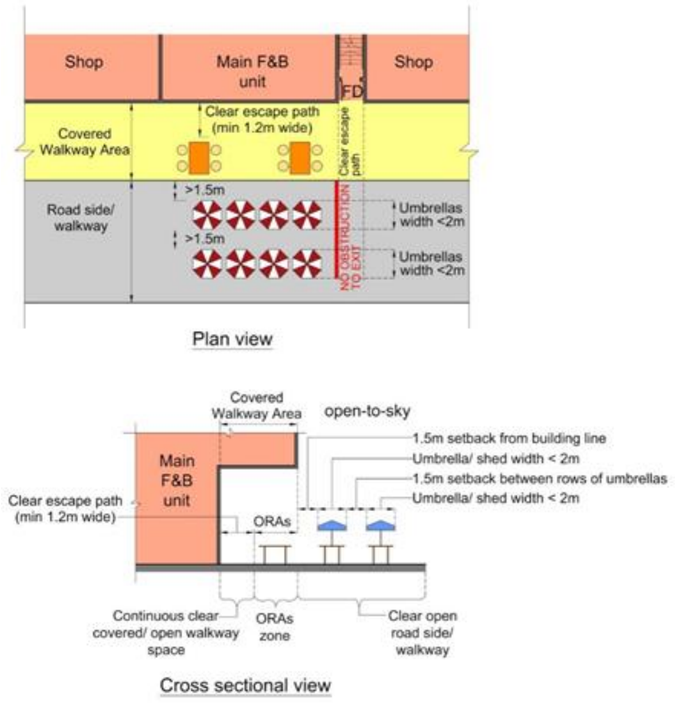


Diagram 9.7.4b(3) : ORAs with umbrella

Diagram 9.7.4b.(4)(b) : ORAs with canopy/awning projection not exceeding 1m

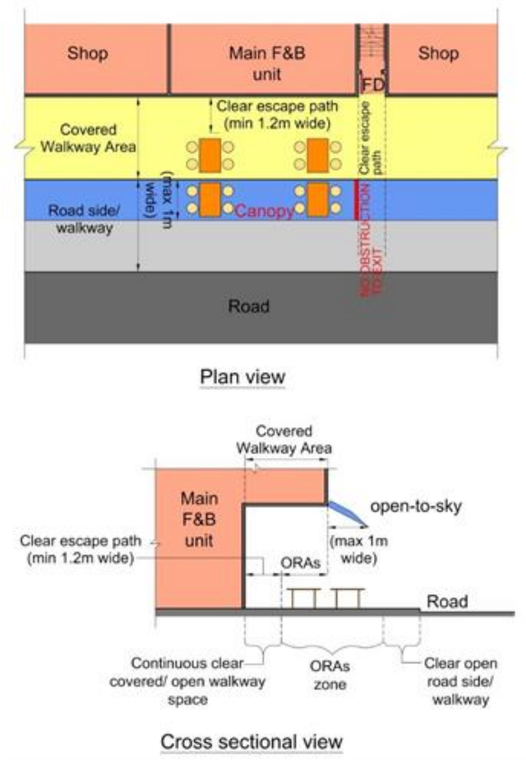


Diagram 9.7.4b.(4)(b) : ORAs with canopy/awning projection not exceeding 1m

Diagram 9.7.4b.(4)(c) - 1 : ORAs with canopy/awning projection greater than 1m but not exceeding 2m - (without auto retraction)

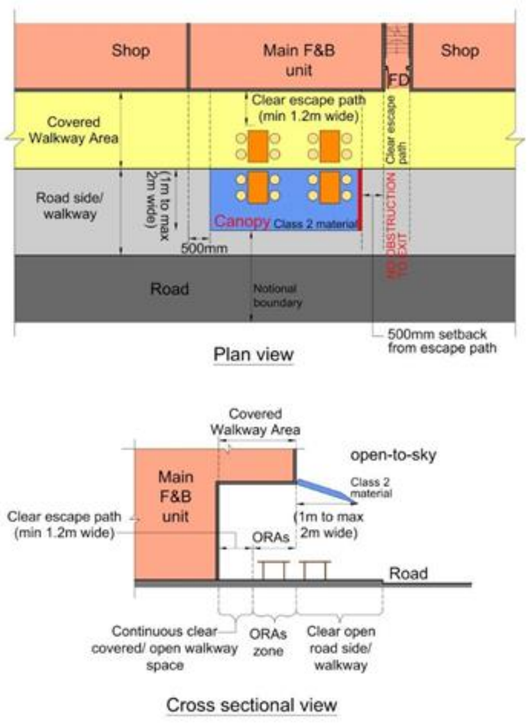


Diagram 9.7.4b.(4)(c) – 1 : ORAs with canopy/awning projection greater than 1m but not exceeding 2m – (without auto retraction)

Diagram 9.7.4b.(4)(c) - 2 : ORAs with canopy/awning projection greater than 1m but not exceeding 2m - (with auto retraction)

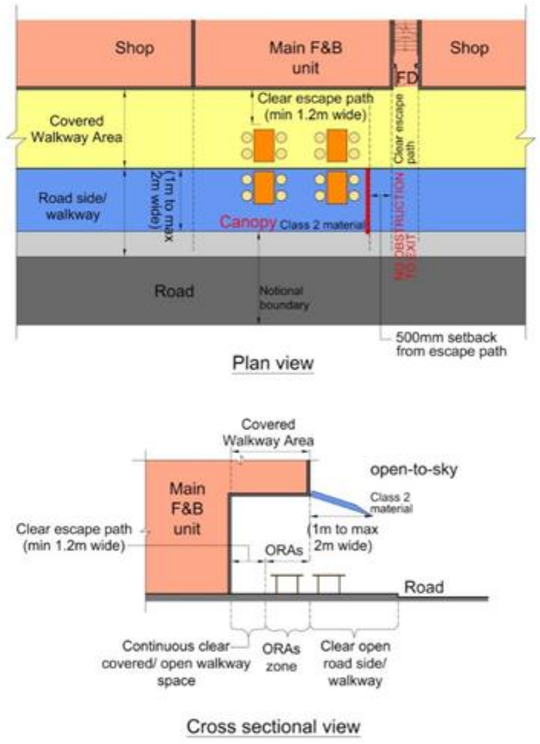


Diagram 9.7.4b.(4)(c) – 2 : ORAs with canopy/awning projection greater than 1m but not exceeding 2m – (with auto retraction)

Diagram 9.7.4b.(4)(d) : ORAs with canopy/awning projection greater than 2m but not exceeding 3m

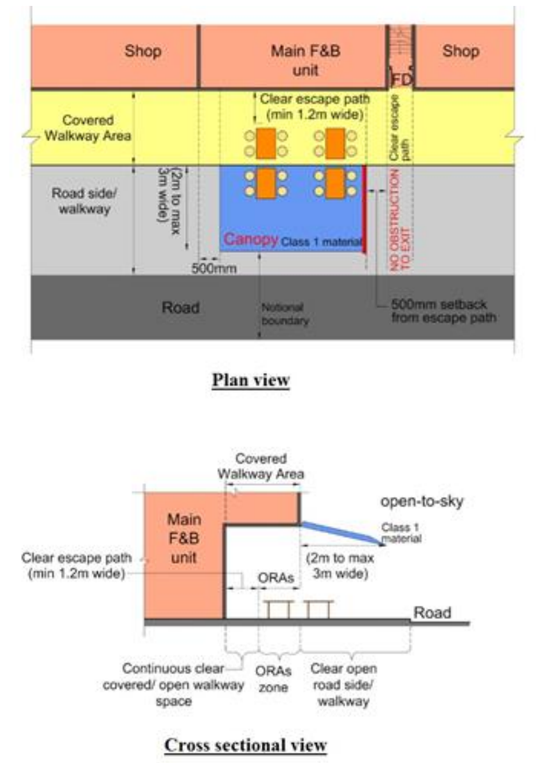


Diagram 9.7.4b.(4)(d) : ORAs with canopy/awning projection greater than 2m but not exceeding 3m

CLAUSE 9.8 PURPOSE GROUP VIII OCCUPANCY

9.8.1 General

a. Means of escape

(1) aboveground warehouse floors

One exit staircase is permitted to serve an aboveground warehouse floor provided:

(a) the habitable height of the floor shall not exceed 15m;

(b) the floor shall not be located above 4th storey; and

(c) the AFA of the floor shall not exceed 200m².

(2) Mezzanine floors

One open stair is allowed to serve a mezzanine floor(s) within an aboveground warehouse floor provided:

(a) the aggregate AFA of the mezzanine floor(s) per warehouse unit shall not exceed 60m²;

(b) the open stair shall have a width of at least 1m and be constructed of non-combustible materials;

(c) the maximum travel distance measured from remote point on the mezzanine floor(s) to the exits shall comply with *Table 2.2A*;

(d) the elements of structure of the mezzanine floor(s) shall be of at least 1-hr fire resistance construction;

(e) the habitable height of mezzanine floor shall not exceed 24m; and

(f) mezzanine floor shall only be used for store and/or ancillary office.

Explanation and Illustrations

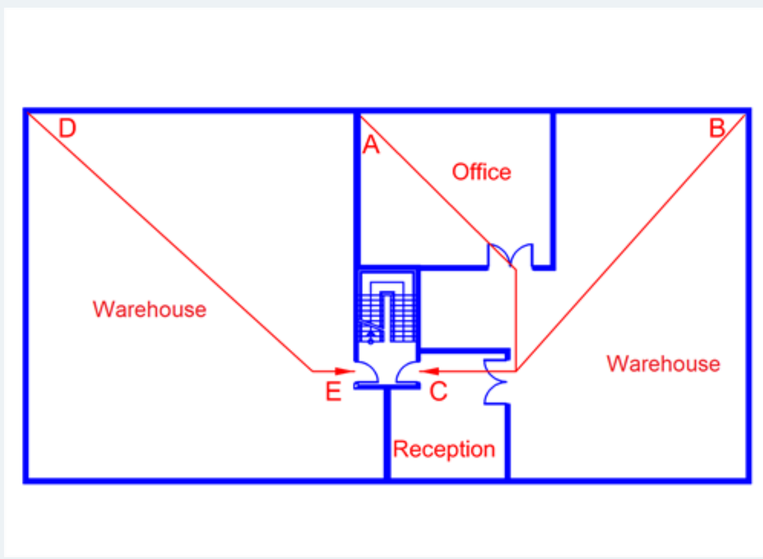


Figure 9.8.1a.(1)

• One-way travel distance AC, BC < 15m or 30m (if sprinkler-protected)

• DE shall be treated as one-way direct distance as the floor space is an open floor plan. The direct distance for DE shall be 2/3 x 15m or 2/3 x 30m, if sprinkler-protected.

• OL < 50 persons

• Floor area < 200m²

• Storey height < 4 storeys or habitable height of building < 15m whichever is lower.

b. Structural fire precautions

(1) Vehicle parking area

Fire compartmentation shall be provided between a vehicle parking area (PG VIII) and other areas, except for ancillary washrooms, letter boxes and other rooms stated in footnote (4) of *Table 6.4A*. The fire compartment walls and floors shall have at least 1-hr fire resistance rating.

Exceptions:

(a) For a sprinkler-protected factory, compartmentation between the vehicle parking areas and the factory is not required, provided the vehicle parking area/ loading and unloading bay and adjacent driveway are provided with an engineered smoke control system.

(b) For a sprinkler-protected warehouse, thermal insulation of the fire-rated shutters between the vehicle parking area and the warehouse is not required, provided the vehicle parking area/ loading and unloading bay and adjacent driveway are provided with an engineered smoke control system.

Explanation and Illustrations

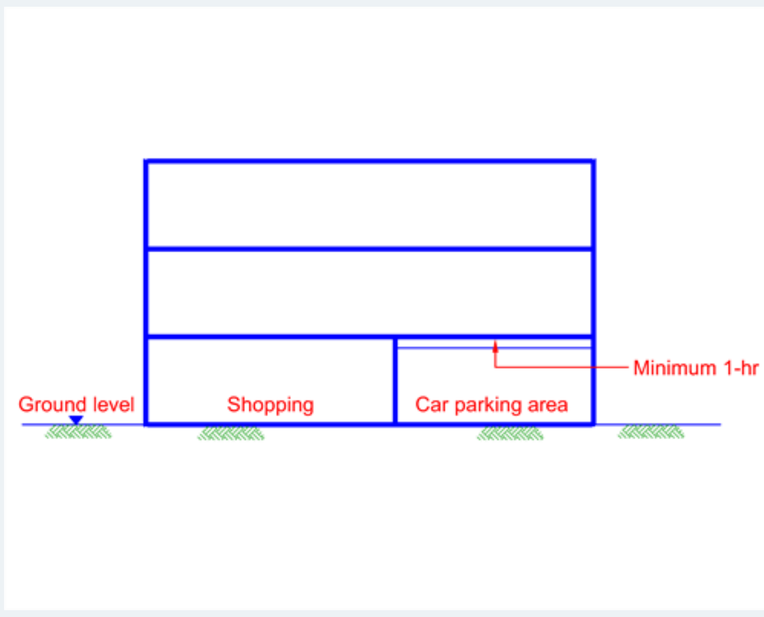


Figure 9.8.1b.(1)

(2) Warehouse

Warehouse compartment size exceeding 700m² for above ground level and 100m² for below ground level are subject to full compliance of Cl.9.8.3.

(3) Tenancy units

Fire compartmentation between individual tenancy units within a warehouse building shall be provided. The entire enclosure of each of these units shall be fire compartmented with walls and floors of at least 1-hr fire resistance rating.

9.8.2 Coldroom

Where coldrooms are provided in PG III, IV, V, VI, VII or VIII buildings, the following requirements shall be complied with:

a. Coldroom constructed of combustible insulation panels

(1) For non-sprinkler-protected buildings

Where the aggregate floor area of coldroom(s) exceeds 10m², a separate outer layer of non-combustible construction, including the door, having at least 1-hr fire resistance rating, shall be provided to compartmentalise the coldroom(s) from other areas. The maximum aggregate floor area of the coldroom(s) shall not exceed 100m^2 in each compartment.

(2) For sprinkler-protected buildings

Where the aggregate floor area of coldroom(s) exceeds 20m², a separate outer layer of non-combustible construction, including the door, having 1-hr fire resistance rating, shall be provided to compartmentalise the coldroom(s) from other areas/usages. The maximum aggregate floor area of the coldroom(s) shall not exceed 700m^2 in each compartment.

(3) Non-compartmentalised coldroom shall not be used for storage of highly flammable chemicals.

b. Coldroom constructed of fire-rated insulation panels

Where the coldroom panels are constructed of material having at least 1-hr fire resistance rating, the compartment sizes stipulated in *Cl.9.8.2a.(1)* and *(2)* above need not be complied with but are subject to a maximum of 2000m^2 (for non-sprinkler-protected buildings) or 4000m^2 (for sprinkler-protected buildings), or sizes stipulated under Cl.9.8.4 for storage of chemical/hazmat materials, whichever is applicable and smaller.

c. Properties of coldroom panel

(1) All coldroom panels shall achieve at least Class B under *EN 13501-1* or its equivalent, when tested as a composite panel with plastic or other types of core material.

(2) For a coldroom that consists of a processing/handling area, the toxicity emission and smoke density requirements shown in *Table 9.8.2c.(2)* for the insulation material shall be complied with.

TABLE 9.8.2c.(2) : TOXICITY EMISSION AND SMOKE DENSITY REQUIREMENTS

Fire risk	Applicable fire test standards	Acceptance criteria
Toxicity emission	EN 45545-2; or	CIT < 0.75
	EN 17084 Method 1 (50kw/m²)	
Smoke density	EN 13501-1; or	(a) Smoke classification to be of s1 rating
		(b) Flaming droplet classification to be d0 rating
	EN ISO 5659-2	VOF_4 < 300 min

(3) For a standalone coldroom that does not have a processing/handling area, the above toxicity emission and smoke density requirements for the insulation material need not be complied with.

d. Coldroom panels supporting structures

All coldroom panels supporting structures shall have a fire resistance rating of at least 1 hour, unless it is located at an external space.

e. Activities involving open flame

Open-flame activities shall not be carried out in coldrooms. Where such activities are required due to the nature of the operation, the areas where open- flame activities are carried out shall be protected in accordance with *Cl.3.2.5f.(1)* and *(4)* and the coldroom insulation materials shall meet the toxicity emission and smoke density requirements stipulated under *Table 9.8.2c.(2)* above.

9.8.3 General warehouses

a. General

The scope of this section covers the fire safety requirements for general warehouses which include single-storey single-user warehouses, single-storey multi-user warehouses, underground warehouses, multi-storey warehouses with or without basements and warehouse within other non-industrial buildings.

b. Compartment

(1) Departmental stores and supermarkets having displayed storage height more than 4m (with sprinkler protection) or 2.5m (without sprinkler protection) shall comply with the requirements as stipulated in this section.

(2) The size of compartment shall not exceed the maximum allowable dimensions shown in the *Table 9.8A*, depending on the type of fire protection and location of the warehouse.

(3) Compartmentation, in respect of size limitation, can be achieved by using fire-rated roller shutter. Localised smoke detector shall be installed to activate the roller shutter. The roller shutter shall also be linked to the building automatic fire alarm system which shall act as a backup for the activation of the shutter.

Note: Such localised smoke detection system shall be provided with zone indication on the main fire alarm panel with buzzer sound, however its activation is not necessary to sound the general fire alarm.

(4) Compartmentation between the warehouse and loading/unloading/ staging area shall be provided (to comply with *Cl.9.8.3b.(3)*), except where:

(a) the warehouse is a single-storey single-user or multi-storey single-user per storey type, with the loading/unloading area abutting an external space, or

(b) the roof over the loading/unloading (or staging) area abutting an external space is not more than 3m in depth.

Note: Down-stand fire wall of minimum depth 1m hanging from the ceiling shall be provided [except for *Cl.9.8.3b.(4)(b)*] between the loading/unloading area and the warehouse storage area.

(5) The compartment size limit stipulated in *Table 9.8A* shall include the loading/unloading (or staging) area if it is not fire-compartmented from the warehouse area, unless:

(a) the entire warehouse including the loading/unloading and driveway area, is protected with sprinkler and smoke control systems; and

(b) the roof over the loading/unloading (or staging) area abutting an external space is not more than 3m in depth.

c. Sprinkler protection

(1) Automatic sprinkler system shall be provided if the compartment size of the warehouse exceeds the maximum allowable size shown in the *Table 9.8A*.

(2) Sprinkler coverage shall be extended to the areas shielded by access platforms in the high-rack storage warehouse. The supporting structures of the platforms shall have the same fire resistance rating as the element of structure of the warehouse.

d. Storage height control

(1) Signage shall be provided on the walls of the warehouse (including the loading/unloading or staging area) to control the maximum allowable storage height and to maintain the minimum clearance below the sprinkler heads in accordance with SS CP 52.

(2) A 50mm wide red line shall be drawn around the wall with signage indicated as “No Storage Above This Line”. This sign shall be provided at intervals not exceeding 15m.

(3) The lettering of the sign shall be at least 100mm.

(4) The storage height limitations shall be clearly indicated on building plans and on the walls of the warehouse at intervals not exceeding 15m.

(5) Transient storage at loading/unloading (or staging) area shall comply with the *Table 9.8D* and *Table 9.8E* in terms of the storage height limit. For non-sprinkler-protected warehouse, the storage height shall be limited to 2.5m.

e. Smoke control

(1) Provision

The provision of smoke control shall be in accordance with *Table 9.8B*, either in the form of smoke vent, smoke purging or engineered smoke control system depending on the fire compartment size and type of fire protection system.

(2) Smoke vents

Smoke vents (refer to *Table 9.8B*) shall comply with the requirements stipulated below:

(a) They shall be of permanent open type and the effective opening shall be either comply with *Table 9.8B* or *Table 9.8C*. Panels can be used as smoke vents provided they are designed to be activated automatically. The use of glass blocks as smoke vents are not permitted.

(b) The minimum dimensions of vertical smoke vent shall be 400mm (length) x 600mm (height) and horizontal smoke vent (roof or ceiling) shall be 0.25m^2 in area.

(c) No area in the warehouse shall be more than the stipulated distance (refer to either *Table 9.8B* or *Table 9.8C*) measured horizontally away from any vertical or horizontal smoke vent.

(d) They shall be located at the highest unobstructed level along the perimeter walls of the warehouse.

(3) Smoke purging system

Replacement of smoke vents by smoke purging system is allowed provided that the warehouse is sprinkler-protected. The smoke purging system shall comply with *Cl.7.4.3.*

(4) Engineered smoke control

Engineered smoke control systems shall comply with the requirements stipulated below:

(a) They shall be provided if the floor area of the compartment is more than 5000m^2 or 2000m^2 for aboveground or underground warehouses respectively;

(b) They shall be designed and installed in accordance with the requirements stipulated in this Code or equivalent standards approved by the SCDF; and

(c) The fire size determined shall be concurred by the SCDF before it is used for the design of the engineered smoke control system.

f. Fire extinguishers

(1) Fire extinguishers shall be provided in accordance with SS 578.

(2) Classification of storage hazards based on storage height shall follow Table 21(A) and Table 21(B) of SS CP 52 (refer to *Table 9.8D* and *Table 9.8E*) for the different categories of storage and overall stack heights. Ordinary hazard classification in SS CP 52 shall be taken as equivalent to medium hazard classification in SS 578.

9.8.4 Chemical/HazMat warehouses

a. Scope

(1) Chemicals or hazardous materials (HazMat) have a wide range of properties and hazards, which shall be identified and understood in order to fulfil the requirements of safe warehousing. A complete understanding of the hazards requires an assessment of the container and packaging systems and storage arrangements. In addition, the requirements of general warehouse shall be complied with.

(2) The fire safety requirement for laboratory storing and using chemicals/ hazmat shall be in accordance with NFPA 45 [except for Maximum Allowable Quantity (MAQ) which shall be as stipulated in *Table 9.8K* and *Table 9.8L*].

Note

The laboratory operators shall minimize the amount of flammable liquids on benches by returning them to chemical store or safety cabinets when the liquids are not needed for the day. At the same time, the laboratory operators shall ensure that the quantity of these liquids placed on benches and fume cupboards shall not exceed 10% of the total allowable storage capacity within the laboratory unit. Liquids used for running and operating laboratory instruments or other work-in-progress which may require some quantities of solvents to operate are exempted from the 10% limit.

b. Identification of hazardous materials (HazMat)

Substances listed as hazardous materials are classified as shown in *Table 9.8F*.

Note

Consultation with Hazmat Department of the SCDF shall be sought at the initial stage (Quantitative Risk Assessment study may be required) and, at the stage of finalizing for further comment and concurrence before the formal plan submission. QP shall obtain the technical requirements from other relevant agencies first before consulting the SCDF for the following classes of HazMat:

a. SPF for Class 1

b. NEA for Class 2.3, 3, 6.1, 6.2, 7 & 8

c. MOH for Class 6.2 (Health Sciences Authority, HSA) & Class 7 (Centre for Radiation Protection under HSA)

c. Size limitation

(1) For chemical/HazMat warehouses storing Class 3, 4 & 5 hazardous materials, the maximum floor area per compartment and type of fire protection system shall be as shown in *Table 9.8G*.

(2) Storage of compressed gases (Class 2), flammable liquid (Class 3), flammable solid (Class 4.2 & 4.3), oxidising agent (Class 5.1) and organic peroxide (Class 5.2) shall be located only at the ground floor with at least one external wall facing directly to an exterior open safe space unless otherwise stipulated.

(3) Solid materials (Class 4.1) is allowed to be stored at aboveground floors of habitable height not more than 24m and the storage quantity shall be limited to 1200kg/m² of floor area.

(4) Compressed gas cylinders (Class 2) are allowed to be stored at aboveground floors of habitable height not more than 24m provided that a vehicular ramp (with turning facility) suitable for 30-tonne firefighting appliances is erected for direct access to the storage area.

(5) For Class 2 HazMat, no stacking is allowed. The hazardous materials shall be laid directly on the floor.

(6) Storage, use and handling of compressed gases (Class 2) shall be in compliance with *NFPA 55* and it be allowed to be located at aboveground floor.

(7) For sprinkler-protected warehouses, the storage height shall be limited to 18m for single- storey warehouse and 15m for warehouse that is located at 1st storey of a multiple-storey building. For non-sprinkler- protected warehouse storing Class 3 HazMat, storage height shall be in compliance with *NFPA 30* (basing on the flash points of the hazardous materials), subject to a maximum height of 3.6m.

(8) Storage of oxidizers (Class 5.1, solid or liquid) shall be in compliance with *NFPA 430* or *AS 4326*.

(9) Storage of organic peroxide (Class 5.2) shall be in compliance with *NFPA 432* or *AS 2714*.

(10) No compartment in the chemical/hazmat warehouse shall comprise more than one storey.

(11) Recommendations made within the individual Material Safety Data Sheet (MSDS) shall be complied with.

(12) An approved layout plan (with the relevant TFP/FSC) with such hazmat warehouse/storage capacity highlighted shall be kept within the premises to facilitate the inspection and emergency operation procedures.

d. Provision of fire engine accessway

(1) Fire engine accessway shall be provided for firefighting appliances. The minimum length of the accessway, based on the gross cubical extent of the entire warehouse space, shall be as shown in *Table 9.8J*.

(2) At least one external wall of the warehouse shall be directly fronting an empty space (such as turf area) of minimum width 2m. One of the access doors provided along this external wall shall be placed not more than 30m (for type K1) or 15m (for type K2) from the fire engine accessway/ fire engine access road for ease of firefighting.

(3) For K3 and K4 compartments, at least one external wall shall be directly fronting an engine access road or access way. At least two exit access doors (minimum 15m apart) shall be provided along this external wall for ease of firefighting.

(4) The loading and unloading (the area may be roofed over) shall be carried out directly from the exterior open space for type K2, K3 and K4 compartments.

(5) For type K1 compartment, the distance from the external loading/ unloading area (may be roofed over) to the access door of the compartment shall not be more than 10m for non-sprinkler-protected buildings and 15m for sprinkler-protected buildings. For Class 3 HazMat, the maximum volume of hazardous liquid shall be limited to 3000L or 5000L for non-sprinkler-protected and sprinkler-protected compartments respectively.

(6) For storage of Class 4.1 HazMat aboveground level, fire engine accessway and the associated FAPs shall be provided for the full stretch of the external wall of the storage area.

e. Water supply for private hydrant

(1) Water supply for hydrant system shall comply with the following requirements:

(a) hydrant fed by PUB mains is allowed for type K1 and K2 compartments. The water supply requirement shall comply with the *Cl.4.4.2a.*.

(b) hydrant with dedicated pumping & storage facilities shall be provided for type K3 and K4 compartments. The water supply requirement shall comply with *Table 4.4A* of this Code with minimum running pressure of 3.5 bars (it shall be designed accordingly to individual emergency response plan and respective SOP).

(2) The spillage control and retention basin for firefighting water for warehouse storage hazardous substances shall be in accordance with SS 532, NFPA 30 and requirements of authority having jurisdiction. Gate valve(s) shall be provided from the second containment (such as bund wall) at a safe location to allow the firefighters to operate during emergency and, the outlet shall be directly drained to a safe area or storm drain.

f. Mechanical ventilation systems

(1) The ventilation systems for warehouse storing Class 3 HazMat shall comply with *SS 532* and the smoke control system shall comply with the requirements for general warehouse.

(2) The ventilation system for Class 2 shall comply with *NFPA 55*.

(3) Mechanical ventilation system for removal of vapour shall be interlocked with the smoke control system to ensure that both systems will not be affecting one another.

(4) The ventilation system shall be designed to provide air-movement across all portions of the room to prevent the accumulation of vapours. Short-circuiting of the mechanical ventilation system shall be avoided.

(5) Fresh air inlets and exhaust outlets shall be properly located according to the type of gases or vapours to be exhausted.

(6) The air-conditioning system and MV system for the storage area of HazMat shall not be shared with other occupied areas.

g. Fire extinguisher

(1) Fire extinguisher shall be provided complying with *SS CP 578, SS 532* and other related standards. (Also, refer to the relevant MSDS and consult the manufacturer or supplier for the details.)

(2) Additional mobile type 50kg ABC (foam or chemical powder) fire extinguishers having minimum 6m throw and discharge hose length of minimum 6m shall be provided to cover the loading and unloading area for K2, K3 and K4 compartment under hazard grade 2, 3 & 4. The access from any remote point of the loading/unloading area (including the parking lots area) to the 50kg fire extinguishers shall not be more than 15m.

(3) For K1 compartment size, mobile type 50kg fire extinguisher shall only be required when the overall hazmat storage area is more than 100m^2.

h. Determination of exit requirement

(1) The determination of travel distance in chemical/HazMat warehouse shall be in compliance with *Table 2.2A* for high hazard occupancy, 10m/20m for non-sprinkler-protected building and 20m/35m for sprinkler-protected building.

(2) All exit and access doors shall be provided with the proper hazard and warning sign on both sides of these doors.

i. Other fire safety requirements

The following standards and codes of practices (non-exhaustive) shall be complied with for the proposed chemical/HazMat warehouse:

(1) *SS CP 10, SS CP 52*

(2) *SS 98, SS 254, SS 286, SS 532, SS 575, SS 578*

(3) *AS 2714, AS 4326*

(4) *NFPA 16, NFPA 45, NFPA 55, NFPA 400, NFPA 495*

(5) *IEC 60079*

9.8.5 Fully Automated Mechanised Car Parks (FAMCPs)

a. General

The provisions of this chapter of the Code shall serve to stipulate the fire safety requirements for the FAMCP. These requirements shall assist with plans submissions to the design, construction, protection, location and arrangement of the various fire safety provisions.

b. Parking height

The parking height refers to the height that shall be measured from the average level of the ground adjoining the outside of the external walls of the building to the highest or lowest car parking level. In situations where mixed usage involving above ground and underground car parking, the height shall be measured between the highest and lowest car parking levels.

c. Classification of FAMCP

The FAMCP shall be subdivided into three categories as follows:

(1) Category 1a: Small aboveground having the following sizes:

(a) Maximum floor area: 200m^2 (Total area of car parking decks)

(b) Maximum cubical extent: 1400m^3

(c) Maximum parking height: 10m

(d) Minimum side openings: At least one side of the FAMCP shall be fully open and facing the fire engine access road

Explanation and Illustrations

Figure 9.8.5c.(1) : Category 1a - Small aboveground FAMCP

(2) Category 1b: Small above ground with deck sunken, having not more than 2 car parking level sunken below the ground level and having the following sizes:

(a) Maximum floor area: 200m^2 (Total area of car parking decks)

(b) Maximum cubical extent: 1400m^3

(c) Maximum parking height: 14m (Subject to maximum parking height of 10m above ground level)

(d) Minimum side openings: At least one side of the FAMCP shall be fully open and facing the fire engine access road

Explanation and Illustrations

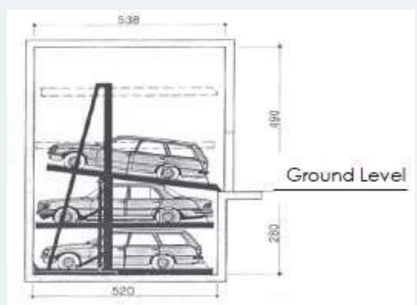


Figure 9.8.5c.(2) : Category 1b - Small aboveground FAMCP with sunken deck

(3) Category 2: Any above ground that does not fall under Category 1.

Explanation and Illustrations

Figure 9.8.5c.(3) : Category 2 – Any aboveground FAMCP not fall under Category 1

(4) Category 3: Any underground that does not fall under Category 1, including FAMCP that combines above ground (Category 2) and underground (Category 3) parking.

Explanation and Illustrations

Figure 9.8.5c.(4) – 1 : Category 3 – Underground FAMCP

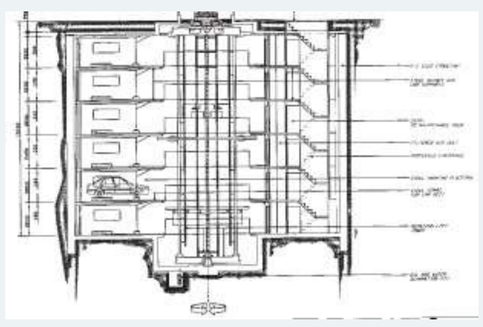


Figure 9.8.5c.(4) – 2 : Sectional view of an underground FAMCP

d. Fire safety requirements that are applicable to all three categories of FAMCP

The fire safety requirements that are applicable to all three categories of car parks are as follows:

(1) areas within the car park building shall not be accessible to the public;

(2) the car park building shall be classified as PG VIII (storage) as per *Table 1.4A*;

(3) means of escape shall be provided where there are areas that are accessible by the public and these shall be in accordance with the requirements as for PG VIII buildings;

(4) where a separation wall or floor is required, fire-rated floor of at least 2- hr fire resistance rating subject to compliance with the requirements of the elements of structure for PG VIII buildings shall be provided;

(5) where an external wall is required in Cl.3.5, fire-rated floor of at least 1- hr fire resistance rating subject to compliance with the requirements of the elements of structure for PG VIII buildings shall be provided;

(6) for unprotected openings, Table 2 of *Annex 3B* to Cl.3.5 shall be complied with;

(7) fire extinguishers having a minimum rating of 70B shall be provided at every entrance and exit of the car park;

(8) hose reel coverage shall be provided for every entrance and exit of the car park;

(9) where any such installation is required, its primary and secondary source of power supplies shall be in accordance with Chapter 5; and

(10) fire engine access roads to be provided to gain access to the exit staircases.

e. Category 1 fire safety requirements for small above ground fully automated mechanised car park (SA- FAMCP)

(1) The SA-FAMCP shall not exceed the following compartment limits as indicated in the table below:

TABLE 9.8.5e.(1) : COMPARTMENTATION OF SA-FAMCP

Compartment	Maximum Floor Area	Maximum Cubicle Extent
Compartment between average ground level and a height of 10m.	200m² (Total area of car parking decks)	1400m³

(2) The SA-FAMCP shall be constructed of structural steel construction. Fire resistance to element shall be provided according to Cl.3.3.

(3) For SA-FAMCP having multi-car parking level, vertical fire separation between the upper and lower decks by using non- perforated and non- combustible materials (e.g. structural steel plate) shall be provided.

(4) Fire engine access roads to be provided to gain access to the exit staircases.

(5) Private fire hydrants if required shall be provided in accordance with Cl.4.4.

(6) At least one side of the FAMCP shall be fully open and facing the access road. The maximum distance measured from the opening(s) to the most remote part of the car parking deck shall not exceed 8m.

Rationale

This is to minimise direct impingement of flame to the car on the upper deck and also to prevent dripping of any possible leaking fuel to the lower deck.

f. Category 2 fire safety requirements for above ground fully automated mechanised car park (A – FAMCP)

All A-FAMCP shall be subjected to the Fire Certificate scheme. The specific fire safety requirements for the A-FAMCP shall be as follows:

(1) the A-FAMCP shall be constructed of structural steel construction. Fire resistance to element of structure shall be provided according to Cl.3.3.

(2) the vertical fire separation between the upper and lower decks by using non-perforated and non-combustible materials (structural steel plate) shall be provided.

(3) firefighting provisions shall be provided as follows:

(a) all exit staircases shall conform to the requirements of Cl.2.3.3;

(b) smoke-free approach as stated in Cl.2.2.13 and Cl.2.2.14;

(c) fire doors of at least 1-hr fire resistance rating for the access of firefighters via the exit staircase into the car park. The fire door shall be of at least 850mm wide by 1m high with a visual glass panel. Wordings of "For smoke venting, do not enter" shall be posted on the external side of the door. The wordings shall be of at least 25mm in height.

(d) the numbers of exit staircases provided shall depend on the number of rising mains. Each rising main serving every car parking level shall provide the following coverage:

(i) an access platform of minimum width of 900mm shall be provided and shall be constructed with at least 1-hr fire resistance rating. Handrails shall be provided on both sides to prevent falls.

(ii) no part of any car parking deck shall exceed 28m.

(e) Breeching inlet serving rising main shall be located within 18m of the fire engine access road.

(f) Dry rising main shall be provided for height exceeding 10m and up to 60m. When the height exceeds 60m, wet rising main shall be provided. The breeching inlet shall be located at the foot of the riser stack. One standby fire hose shall be provided at the ground level of each staircase.

(g) Fire lift shall be provided for habitable height exceeding 24m.

(h) Where fire lift is required, a two-way voice communication system shall be provided between the Fire Command Centre and the following areas:

(i) every fire lift lobby, including 1st storey; and

(ii) all firefighting-related mechanical equipment rooms inclusive of sprinkler pump room, wet riser pump room, etc..

(i) FCC shall be provided in accordance with Cl.8.2.4.

(j) Private fire hydrant where required shall be provided in accordance with Cl.4.4;

(k) Fire engine access roads to be provided to gain access to exit staircases.

(l) The A-FAMCP shall be protected by active firefighting systems such as sprinklers or clean agent fire extinguishing systems:

(i) Where sprinkler protection is installed, quick response sprinklers shall be provided. Each parking deck shall be protected by at least one sprinkler head.

(ii) Where clean agent fire extinguishing systems are installed, the amount of agent required to achieve the design concentration shall be based on total flooding method. Standby cylinders at 100% capacity shall be provided on site.

(iii) All doors, shutters, dampers, and/or openings shall be closed throughout the duration of gas deployment.

(iv) Bypass door shall be provided in the event where there are occupants inside A-FAMCP during gas deployment.

(v) Firefighters shall be able to activate the clean agent manually if the system was not activated during a fire.

(m) Sump pit shall be provided to contain water discharge from sprinkler system. The capacity of the sump put shall be based on simultaneous operation of sprinklers for 4 car park decks for duration of 20 mins. Foam inlet in accordance to Cl.6.2.7 shall be provided adjacent to the sump pit to address liquid fire (burning fuel on water).

(n) For A-FAMCP protected by sprinkler systems, ventilation openings (with exhaust air outlet sited at high level and fresh air inlet sited at low level) of at least 2.5% of the largest floor area of any car parking level shall be provided. It shall be operated automatically by activation of sprinklers or heat detectors, if such openings are not naturally ventilated.

(o) For A-FAMCP protected by clean agent systems, ventilation openings (with exhaust air outlet sited at high level and fresh air inlet sited at low level) of at least 2.5% of the largest floor area of any car parking level shall be provided. It shall be operated manually by firefighters.

(p) Addressable heat detectors shall be installed according to *SS 645* and provided to every parking deck to assist firefighters in identifying the exact location of the car on fire. Each addressable heat detector shall be represented by its own LED indicator and shall be displayed at the sub-alarm panel according to their locations/levels. Sub-alarm panel shall be provided at the entrance on FAMCP.

(q) Thermocouple reading for every parking level shall be provided as a means for firefighters to identify if the fire has been effectively extinguished. No point in the FAMCP shall exceed 10m from a thermocouple. A panel to display temperature readings shall be installed adjacent to sub-alarm panel.

(r) The deck to deck height shall be at least 2.2m.

(s) Self-Contained Breathing Apparatus (SCBA) shall be provided and maintained in a clearly marked cabinet for maintenance personnel. Maintenance personnel must be equipped with SCBA while working in A-FAMCP. Signage with words minimum 50mm shall be clearly visible and state: "Personnel must be equipped with SCBA during maintenance"

(t) A-FAMCP shall be maintained and inspected yearly or at intervals specified by the individual system suppliers, whichever is shorter.

g. <u>Category 3 fire safety requirements for underground fully automated mechanised car park (U – FAMCP)</u>

All U-FAMCPs shall be subjected to the Fire Certificate scheme. The specific fire safety requirements for the U-FAMCP shall be as follows:

(1) The compartmentation of the U-FAMCP shall not exceed the following sizes:

TABLE 9.8.5g.(1) : COMPARTMENTATION OF U-FAMCP		
Maximum Parking Depth	**Maximum Floor Area**	**Cubical Extent**
28m	2000m² (Total area of car parking decks)	7000m³

(2) The U-FAMCP shall be constructed on structural steel construction. Fire resistance to element of structure shall be provided according to Cl.3.3.

(3) The vertical fire separation between the upper and lower decks by using non-perforated and non-combustible materials (structural steel plate) shall be provided.

(4) The U-FAMCP shall be provided with the following firefighting provisions:

(a) all exit staircases shall conform to the requirements of Cl.2.3.3;

(b) smoke-free approach as stated in Cl.2.2.13 and Cl.2.2.14;

(c) fire doors of at least 1-hr fire resistance rating for the access of firefighters via the staircase into the car park;

(d) the number of exit staircases provided shall depend on the number of rising mains. Each rising main serving every car parking level shall provide the following coverage:

(i) where internal access to every car parking deck is provided:

Rationale

This is to minimise direct impingement of flame to the car on the upper deck and also to prevent dripping of any possible leaking fuel to the lower deck.

• an access platform of minimum width of 900mm shall be provided and shall be constructed with at least 1-hr fire resistance rating with handrails provided on both sides; and

• no part of any car parking deck shall exceed 28m.

(ii) where no internal access to every car parking deck is provided, the maximum distance measured from the staircase door to the most remote part of the car parking deck shall not exceed 8m.

(e) Breeching inlet serving rising main shall be located within a travel distance of 18m from the fire engine accessway/fire engine access road.

(f) Dry rising main shall be provided for height exceeding 10m and up to 60m. When the height exceeds 60m, wet rising main shall be provided. The breeching inlet shall be located at the foot of the riser stack. One standby fire hose shall be provided at the ground level of each exit staircase.

(g) Fire lift shall be provided for basement depth exceeding 9m.

(h) Where fire lift is required, a two-way emergency voice communication system shall be provided between the FCC and the following areas:

(i) every fire lift lobby, including first storey; and

(ii) all firefighting-related mechanical equipment rooms, inclusive of sprinkler pump room, wet riser pump room etc..

(i) FCC shall be provided in accordance with Cl.8.2.4.

(j) Basement levels shall be provided with two-way emergency voice communication system in accordance with Cl.8.2.2.

(5) Private fire hydrant where required shall be provided in accordance with Cl.4.4.

(6) Fire engine access road to be provided to gain access to the exit staircases.

(7) The U-FAMCP shall be protected by sprinklers or clean agent fire extinguishing systems.

(a) Where sprinkler protection is installed, it shall be in accordance with *SS CP 52*. Quick response sprinklers shall be provided. Each parking deck shall be protected by at least one sprinkler head.

(b) Where clean agent fire extinguishing systems are installed, they shall comply with *NFPA 2001*. The amount of agent required to achieve the design concentration shall be based on total flooding method.

(i) Standby cylinders at 100% capacity shall be provided on site;

(ii) All doors, shutters, dampers, and/or openings shall be closed throughout the duration of gas deployment;

(iii) Bypass door shall be provided in the event there are occupants inside U-FAMCP during gas deployment; and

(iv) Firefighters shall be able to activate the clean agent manually if the system was not activated during fire.

(c) Foam inlet in accordance to Cl.6.2.7 shall be provided to address liquid fire (burning fuel on water).

(8) Sump pit shall be provided to contain water discharge from the sprinkler system. The capacity of the sump pit shall be based on simultaneous operation of sprinklers for four car park decks. Foam inlet in accordance to Cl.6.2.7 shall be provided adjacent to the sump pit to address liquid fire (burning fuel on water).

(9) Smoke vents shall apply to basements not exceeding 1000m^2 in floor area and maximum 5m in depth measured from the ground level area to the lowest floor level.

(a) For U-FAMCP protected by sprinkler systems, ventilation openings (with exhaust air outlet sited at high level and fresh air inlet sited at low level) of at least 2.5% of the largest floor area of any car parking level shall be provided. It shall be operated automatically by activation of sprinklers or heat detectors, if such openings are not naturally ventilated.

(b) For U-FAMCP protected by clean agent fire extinguishing systems, ventilation openings (with exhaust air outlet sited at high level and fresh air sited at low level) of at least 2.5% of the largest floor area of any parking level shall be provided. It shall be operated manually by firefighters. Smoke purging systems of 9 air changes per hour shall be provided if the basement exceeds 1000m^2 in floor area or 5m in depth measured from the ground level area to the lowest floor level.

(c) For U-FAMCP protected by sprinkler systems, the smoke purging systems shall be operated automatically by activation of heat detectors.

(d) For U-FAMCP protected by clean agent fire extinguishing systems, smoke purging systems shall be operated manually by firefighters.

(10) Detection systems shall be installed as follows:

(a) Addressable heat detectors shall be installed according to *SS 645* and provided to every parking deck to assist firefighters in identifying the exact location of the car on fire. Each addressable heat detector shall be represented by its own LED light indicator and shall be displayed at the sub-alarm panel in accordance to their locations/ levels. Sub-alarm panels shall be provided at the entrance of U-FAMCP.

(b) Thermocouple for every parking level shall be provided such that no point in the U-FAMCP shall exceed 10m from a thermocouple. A panel to display temperature readings shall be installed adjacent to the sub-alarm panel.

(11) The deck-to-deck height shall be at least 2.2m.

(12) Self-contained breathing apparatus (SCBA) shall be provided and maintained in a clearly marked cabinet for maintenance personnel. Maintenance personnel must be equipped with SCBA while working in U-FAMCP. Signage with words minimum 50mm shall be clearly visible and state: “Personnel must be equipped with SCBA during maintenance”.

(13) U-FAMCP shall be maintained and inspected yearly or at intervals specified by the individual system suppliers, whichever is shorter.

Rationale

Handrails provided on both sides will help to prevent falls of firefighters during the firefighting operation.

TABLE 9.8A: COMPARTMENT SIZE & STORAGE HEIGHT FOR GENERAL WAREHOUSE

TABLE 9.8A : COMPARTMENT SIZE & STORAGE HEIGHT FOR GENERAL WAREHOUSE				
Location of Warehouse	**Item**	**Sprinkler- protected**	**Non-sprinkler-protected**	
		Storage Hazard	**Storage Hazard**	
		All	**Normal**	**High**
Single storey warehouse	Max. floor area per compartment	12000m²	3000m²	2000m²
	Max. cubical extent per compartment	NC	12000m³	7500m³
	Max. storage height	18m	+Ref Table 9.8D & E	12m
Warehouse located on 1st storey of multi-storey warehouse	Max. floor area per compartment	12000m²	3000m²	2000m²
	Max. cubical extent per compartment	NC	12000m³	7500m³
	Max. storage height	15m	+Ref Table 9.8D & E	12m
Multi-storey warehouse with vehicular ramp (min. loading 30 tonnes with dry rising mains)	Max. floor area per compartment	9000m²	3000m²	2000m²
	Max. cubical extent per compartment	NC	12000m³	7500m³
	Max. storage height	15m	+Ref Table 9.8D & E	12m
Multi-storey warehouse without vehicular ramp	Max. floor area per compartment	6000m²	3000m²	2000m²
	Max. cubical extent per compartment	NC	12000m³	7500m³
	Max. storage height	15m	+Ref Table 9.8D & E	12m
Warehouse located in basement	Max. floor area per compartment	3000m²	NP	NP
	Max. cubical extent per compartment	12000m³	NP	NP
	Max. storage height	12m	NP	NP
Note : NC = No Control NP = Not Permit * = Subject to full compliance of Cl.3.2.7a. and Cl.1.4.68d. + = Storage height not exceeding the limits for goods in the various categories suitable for ordinary hazard protection (you may also refer to Table 9.8D & Table 9.8E.				

TABLE 9.8B: SMOKE CONTROL REQUIREMENTS FOR GENERAL WAREHOUSE

TABLE 9.8B : SMOKE CONTROL REQUIREMENTS FOR GENERAL WAREHOUSE			
Location of Warehouse	**Compartment Size**	**Provision of Sprinkler System**	**Smoke Control Requirement**

Aboveground level	<= 100m²	no	NR
	> 100m² and <= 400m²	no	aSmoke vent (min % openings follow Table 9.8C)
	> 400m² to size limit of Table 9.8A	no	bSmoke vent (20% / 12m)
	<= 700m²	yes	NR
	> 700m² and <= 5000m²	yes	cSmoke vent or +purging system
	> 5000m²	yes	engineered smoke control system
Underground level (*Basement)	<= 2000m²	yes	cSmoke vent or +purging system
	> 2000m²	yes	engineered smoke control system
Note: NR = Not Required a = smoke vent openings base on the Table 9.8C; b = smoke vent shall be at least 20% of the floor area it served and shall not be more than 12m measured horizontally away from any part of the warehouse; c = smoke vent shall comply with Cl.7.4.2 (adequately & evenly distributed along the perimeter of the fire compartment or basement); + = smoke purging system shall comply with Cl.7.4.3 (adequately & evenly distributed within the fire compartment or basement); * = smoke control system shall be provided for the entire basement except the protected exit shafts, lift shafts and M&E riser shafts.			

TABLE 9.8C: SMOKE VENT REQUIREMENTS FOR NON-SPRINKLER-PROTECTED BUILDING

TABLE 9.8C: SMOKE VENT REQUIREMENTS FOR NON-SPRINKLER-PROTECTED BUILDING	
Minimum size of smoke vent opening	**Horizontal distance from smoke vent***
(Percentage of floor area)	**(m)**
2.5%	12m
5.0%	15m
10.0%	18m
15.0%	21m
20.0%	24m
Note: * - No area in the warehouse shall be more than the indicated distance measured horizontally from any vertical or horizontal smoke vent	

TABLE 9.8D : HIGH-PILED STORAGE RISK INVOLVING FREE-STANDING STORAGE OR BLOCK STACKING

TABLE 9.8D : HIGH-PILED STORAGE RISK INVOLVING FREE-STANDING STORAGE OR BLOCK STACKING [Extract from TABLE 21(A) of SS CP 52]		
Category of storage	**Overall stack height (m)**	
	Non-encapsulated storage	**Encapsulated storage**
1	4.0	3.00
2	3.0	2.25
3	2.1	1.60
4	1.2	0.90
Note: 1. The term “store” or “storage” includes the warehousing or the temporary depositing of goods or materials while undergoing process. 2. To provide for any future requirements, the height of storage shall be taken as not less than 1m below any ceiling or roof.		

TABLE 9.8E : HIGH-PILED STORAGE RISK INVOLVING POST OR BOX PALLETS OR PALLETISED RACK STORAGE

TABLE 9.8E : HIGH-PILED STORAGE RISK INVOLVING POST OR BOX PALLETS OR PALLETISED RACK STORAGE [Extract from TABLE 21(B) of SS CP 52]		
Category of storage	**Overall stack height (m)**	
	Non-encapsulated storage	**Encapsulated storage**
1	3.5	2.7
2	2.6	2.0
3	1.7	1.3
4	1.2	0.9
Note : 1. To provide for any future requirements, the height of storage shall be taken as not less than 1m below any ceiling or roof. 2. Good practice dictates that box or post pallet storage shall not exceed 2 rows wide in one direction. 3. Rack storage with aisles less than 1.2m in width is treated as multiple row racks.		

TABLE 9.8F : IDENTIFICATION OF HAZARDOUS MATERIALS

TABLE 9.8F : IDENTIFICATION OF HAZARDOUS MATERIALS	
Class	**Type of HazMat**

1	Explosives (1.1 to 1.6)
2.1	Flammable gases
2.2	Non-flammable compressed gases
2.3	Poisonous gases
3	Flammable and combustible liquids
4.1	Flammable solids
4.2	Substances liable to spontaneous combustion
4.3	Substances which, dangerous when contact with water
5.1	Oxidizers
5.2	Organic peroxides
6.1	Poisonous substances
6.2	Infectious substances (etiologic agents)
7	Radioactive materials Category I
	Radioactive materials Category II
	Radioactive materials Category III
8	Corrosive materials
9	Miscellaneous hazardous materials (dangerous sub-substances)

TABLE 9.8G : SIZE LIMITATION

TABLE 9.8G : SIZE LIMITATION				
Hazard Grade#	**Maximum Fire Compartment Size (m²)**			
	K1*	**K2***	**K3***	**K4***
3 & 4	≤ 50m²	≤ 200m²	≤ 600m²	≤ 900m²
2	≤ 100m²	≤ 400m²	≤ 2400m²	≤ 3600m²
1	≤ 400m²	≤ 2000m²	**	**

Note :
(1) The required fire protection system is only restricted to the chemical/ HazMat warehouse fire compartment. However, automatic fire detectors (linked to approved alarm monitoring company) shall also be provided along the perimeter of the fire compartment wall if the building housing the HazMat warehouse is not protected with the automatic or the sprinkler system (it is only applicable where the warehouse is directly connected to other occupied area within the building through access opening).
(2) The fire compartment wall shall be constructed with at least 2-hr fire resistance rating, regardless of the type of fire protection system. For Class 3 HazMat storage, it shall be masonry construction except the ceiling (all floor element above such HazMat storage shall be masonry construction with at least 2-hr fire resistance rating) can use fire-rated board but to comply fully with the M&E riser shaft requirements.
(3) Different classes and incompatible HazMat shall be stored in separate fire compartment with at least 2-hr fire resistance rating.
(4) No basement floor is allowed to store Hazardous materials.
(5) The compartment size limit and type of fire protection system for Class 2 HazMat shall follow Hazard Grade 1 requirements.
(6) Fire-rated roller shutter is not allowed for the purpose to limit the compartment size control; any fire-rated roller shutter at the access opening shall be activated by either local automatic smoke detection system or/ and the general building automatic fire alarm system.

** = No specific limit but to comply with the fire safety requirements for general warehouse.
* = Refer to Table 9.8H for classification of fire protection system
# = Refer to Table 9.8I for hazard grade classification

TABLE 9.8H : CLASSIFICATION OF FIRE PROTECTION SYSTEMS

TABLE 9.8H : CLASSIFICATION OF FIRE PROTECTION SYSTEMS		
CLASS	**Fire Protection System**	
	Type	**Monitoring**
K1	Manual fire alarm system	To be connected to an approved alarm monitoring company
K2	Automatic fire alarm system	To be connected to an approved alarm monitoring company
K3	Automatic fire sprinkler system	To be connected to an approved alarm monitoring company
K4	Automatic foam sprinkler system	To be connected to an approved alarm monitoring company

TABLE 9.8I : HAZARD GRADE CLASSIFICATION

TABLE 9.8I : HAZARD GRADE CLASSIFICATION						
Hazard Classification		**Hazard Grade**				
		4	**3**	**2**	**1**	**0**
Liquids	Class 3	Category I & 2	Category 3	Category 4	Flash point > 150°C	Only burns with supporting fire
		Flash point < 23°C	Flash point 23 - 60°C	Flash point 60 - 150°C		
Solid Materials	Class 4	Ignites very easily and burns rapidly	Ignites and burns rapidly	Readily combustible	Moderately combustible	Combustible only with supporting fire
Oxidizing Agent	Class 5.1	Class 4	Class 3	Class 2	-	-
		Vary strong oxidizing agent (may be classified under explosive substance)	Strong oxidizing agent	Weak oxidizing agent		
Oxidizing Peroxide	Class 5.2	Class I	Class II	Class III	Class IV	Class V

TABLE 9.8J : PROVISION OF FIRE ENGINE ACCESSWAY

TABLE 9.8J : PROVISION OF FIRE ENGINE ACCESSWAY		
Cubical Extent	**Minimum Length of Fire Engine Acessway***	
	Non-sprinkler-protected	**Sprinkler-protected**
< 7100m³	⅙ perimeter	⅙ perimeter
> 7100m³ and < 14200m³	¼ perimeter	
> 14200m³ and < 28400m³	½ perimeter	¼ perimeter
> 28400m³ and < 42400m³	¾ perimeter	½ perimeter
> 42400m³ and < 56800m³	island site access	¾ perimeter
> 56800m³		island site access
Note : * = Length of fire engine accessway shall be as shown or 15m, whichever is the greater.		

TABLE 9.8K : MAXIMUM ALLOWABLE QUANTITIES (MAQ)

TABLE 9.8K : MAXIMUM ALLOWABLE QUANTITIES (MAQ) IN LABORATORY FOR LIQUID		
Laboratory Unit	**Max Quantity (excluding qty in cabinet)**	**Max Quantity (including qty in cabinet)**
	(litres per lab unit floor area)	**(litres per lab unit floor area)**
Laboratory not within hospital or healthcare occupancy 1. liquids stored/used do not consist of category 1 or 2 flammable liquid	(a) 50L or (b) 1.6 L/m² and not more than: (1) 350 L for non-sprinkler-protected building, or (2) 500 L for sprinkler- protected building)	3.2 L/m² and not more than: (1) 750 L for non-sprinkler-protected building, or (2) 1000 L for sprinkler-protected building)
2. liquids stored / used consist of category 1 or 2 flammable liquid	(a) 20 L or (b) 0.8 L/m² and not more than: (1) 250 L for non-sprinkler-protected building, or (2) 350 L for sprinkler- protected building)	1.6 L/m² and not more than: (1) 500 L for non-sprinkler-protected building, or (2) 750 L for sprinkler-protected building)
Laboratory within hospital or healthcare occupancy 1. liquids stored/used do not consist of category 1 or 2 flammable liquid	(a) 10 L or (b) 0.4 L/m² and not more than: (1) 150 L for non-sprinkler-protected building, or (2) 250 L for sprinkler- protected building)	0.8 L/m² and not more than: (1) 250 L for non-sprinkler- protected building, or (2) 500 L for sprinkler-protected building)
2. liquids stored/used consist of category 1 or 2 flammable liquid	(a) 5 L or (b) 0.4 L/m² and not more than: (1) 150L for non-sprinkler- protected building, or (2) 250 L for sprinkler- protected building)	0.8 L/m² and not more than: (1) 250 L for non-sprinkler- protected building, or (2) 500 L for sprinkler-protected building)
Note : (1) Individual lab unit shall be a fire compartment. (2) Each safety cabinet is still restricted to max of 250L (to comply with SS 532). (3) Laboratory operators are strongly advised and encouraged to minimise their amount of flammable liquids on benches by returning them to chemical store or safety cabinets (UL, FM or PLS listed product) when the liquids are not needed for the day. The quantity of these liquids placed on benches and fume cupboards shall not exceed 10% of the total allowable storage capacity within the lab unit. Liquids used for running and operating laboratory instruments or other works-in- progress which may require some quantities of solvents to operate are exempted from the 10% limit.		

TABLE 9.8L : MAXIMUM ALLOWABLE QUANTITIES (MAQ) IN LABORATORY FOR GASES

TABLE 9.8L : MAXIMUM ALLOWABLE QUANTITIES (MAQ) IN LABORATORY FOR GASES		
Item	**Types of Gases**	**Maximum Quantity (litres per lab unit floor area protected by sprinkler system)**
1	Flammable gases	(a) 170 L or (b) 3.4 L/m² per cluster
2	Oxidizing gases	(a) 170 L or (b) 3.4 L/m²per cluster
3	Liquefied flammable gases*	(a) 30 L or (b) 0.6 L/m² per cluster
4	Toxic gases	(a) 8 L or (b) 0.16 L/m² per cluster
Note : (1) The capacity in litres (L) is referred to the internal volume (water capacity) of the gas cylinder. (2) Laboratory work Area is not necessary be individual fire compartment but shall be housed within a lab unit. (3) For item 1 to 3, the MAQ shall be halved for those building which is not protected with sprinkler system. (4) Item 1 to 4 may be accommodated in a single cluster and be spaced at least 3m apart from each cluster (6m for building without sprinkler protection). (5) To comply with NFPA 45 for others requirements such as the ventilation (4 & 8 air changes), hazard identification and" No Smoking" signs etc. (6) The provision of sprinkler system shall be designed under the Ordinary Hazard Group 3 Special (SS CP 52). (7) No combustible materials shall be placed within 3m buffer range of the gas cylinder; (8) No flammable or combustible liquid shall be placed within 6m buffer range of the gas cylinder. (9) For storage and handling of Class 2 HazMat in enclosed space (including the concealed space of raised floor and ceiling), metal pipe sleeve and gas leak detection system shall be provided to reduce the accumulation of gases and vapours that may cause danger to occupant, building and emergency response team. Oxygen-level monitoring system shall be provided to prevent the possibility of oxygen-deletion (asphyxiation) within the room; (10) The air-conditioning system and MV system for laboratory unit shall not be shared with other occupied areas. * = For LPG cylinders, only 2 x 4.5kg cylinders are allowed for each lab unit.		

CLAUSE 9.9 OTHERS

9.9.1 Buildings designated for conservation and buildings built before 1969

Note

The relaxation in the use of timber staircase/flooring is only applicable to old shophouses, including residential buildings (except temporary dwelliing houses), having timber floors and/or timber staircases. Note that the QP has to upgrade the whole building to comply with the fire safety requirements stipulated in the conservation guidelines. Partial upgrading of the building is not acceptable.

a. General

Cl.9.9.1 is applicable to buildings with timber floor/ staircase designated for conservation by the authority having jurisdiction or buildings built before 1969. Change of use of these buildings to public accommodation purpose is not permitted. Upgrading of fire safety works shall be applicable to the whole building; partial upgrading of building is not allowed.

b. Timber floor joists and boards without addition of new attic

(1) 2 and 3-storey shophouses

(a) Timber floor boards shall be pressure impregnated with flame retardant chemicals, in order to expose the timber floor joists and boards to retain the existing characteristics of the shophouse. For timber floor joints that fulfil the fire resistance rating requirements, they are not required to be pressure impregnated. Alternatively, timber floor boards shall be lined on the floor joists with non-combustible boards to achieve at least ½-hr fire resistance rating. For residential use, this condition does not apply. Existing timber floors can be retained provided there is no increase in floor areas or addition of a new attic. (See *Diagram 9.9.1b.(1)(a) - 1* & *2*)

(b) Timber floor joists and boards at the soffit of the five-footway ceiling can be left exposed.

(2) 4-storey shophouses

(a) Timber floor joists and boards shall be lined on the underside between the floor joists with non-combustible boards to achieve at least 1-hr fire resistance rating.

(b) Timber floor joists and boards at the soffit of the five-footway ceiling can be left exposed.

c. Timber floor joists and boards with addition of new attic

(1) 2-storey shophouses

(a) Timber floor boards lined on the underside between the floor joists with non-combustible boards to achieve at least ½-hr fire resistance rating. (See *Diagram 9.9.1c.(1)(a)*)

(b) Timber floor joists and boards at the soffit of the five-footway ceiling can be left exposed.

(c) The floor area of the attic shall not be lower than the highest point of the front façade window at the last storey, i.e. top of the window or fanlight.

(d) The floor area of the attic shall not exceed 50% of the floor immediately below or 50m^2, whichever is less, per compartment.

(e) An open connecting staircase to the attic can be considered, provided that the travel distance complies with *Cl.9.9.1g.*.

(2) 3 and 4-storey shophouses

(a) Full protection shall be provided for floor joists and boards of all floors, i.e. timber floor boards shall be lined on the underside between the floor joists to achieve at least 1-hr fire resistance rating. (See *Diagram 9.9.1c.(2)(a)*).

(b) Timber floor joists and boards at the soffit of the five-footway ceiling can be left exposed.

(c) The floor level of the attic shall not be lower than the highest point of the front façade window at the last storey, i.e., top of the window or fanlight.

(d) The attic floor shall be set-back at least 1.5m from the inner face of the front façade and rear walls to allow for visual connection to the storey below. See *Diagram 9.9.1c.(2)(d)*.

(e) The floor area of the attic shall not exceed 50% of the floor immediately below or 50m^2, whichever is less, per compartment.

(f) An open connecting staircase to the attic is allowed provided that the travel distance complies with *Cl.9.9.1g.*.

d. Protection of exit staircases

(1) 2-storey shophouses

(a) Timber staircases, which serve as a means of escape, shall be protected and comply with:

(i) Compartmentation requirements of at least 1-hr fire resistance rating; and

(ii) Pressure impregnation with flame retardant chemicals.

(b) For residential shophouses, without addition of new attic and to be occupied by one family only, the timber staircase can be left exposed and need not be compartmentalised.

(c) For non-residential shophouses, the timber staircase can be left exposed at the second storey level, provided all of the following are complied with:

(i) Travel distances on the second storey are complied with, i.e. the distance from the most remote point of the floor to the edge of the staircase landing is less than 13m or alternative escape staircase is available, e.g. rear escape staircase.

(ii) The timber staircase is compartmentalised at the first storey by at least 1-hr fire-rated enclosures.

(iii) There is no attic level in the second storey.

(2) 3-storey shophouses

(a) Timber staircases, which serve as a means of escape, shall be protected and comply with:

(i) Compartmentation requirements of at least 1-hr fire resistance rating; and

(ii) Pressure impregnation with flame retardant chemicals.

(b) For residential shophouses, without addition of new attic and to be occupied by one family only, the timber staircase can be left exposed and need not be compartmentalised.

(3) 4-storey shophouses

Timber staircases, which serve as a means of escape, shall be protected and comply with:

(a) Compartmentation requirements of at least 1-hr fire resistance rating; and

(b) Pressure impregnation with flame retardant chemicals.

e. Air well and covering over air well

(1) 2-storey shophouses

(a) For air well that has the same usage for all floors, the following coverings shall be used:

(i) A fixed covering up to the level below the main roof eaves with approved materials such as non-drip acrylic, non-drip polycarbonate and glass, or

(ii) A fully openable covering (retractable or spring open type), by activation of smoke detectors and fire alarm system, up to the level below the roof eaves with approved materials such as non-drip acrylic, non-drip polycarbonate and glass.

(b) For air well that has different usage for all floors, the following coverings shall be used:

(i) A fixed covering up to the 2nd storey floor level with approved materials such as non-drip acrylic, non-drip polycarbonate and glass, or

(ii) A fully openable covering (retractable or spring open type), by activation of smoke detectors and fire alarm system, up to the level below the roof eaves with approved materials such as non-drip acrylic, non-drip polycarbonate and glass.

(c) The air well shall not be enclosed.

Rationale

To assist URA in their programme on conservation of old shophouses in the early 1990s,a set of fire safety guidelines was jointly drawn up by URA and SCDF, and issued by URA on 28 July 1993 under Circular No. URA/PB/93/20-CUDD. To apply the safety requirements from the existing Fire Code would mean that timber floors and timber staircases could not be retained. Hence, a separate set of fire safety guidelines was considered necessary.

Thus, it was agreed that timber floors and staircases could be retained, but the timber floors are to be upgraded to have minimum half hour fire resistance rating and that the timber staircases are required to be made protected at the 1st and upper storey, and shall be made to discharge into the five footway or rear backlane.

For shophouses that have timber floors and timber staircases, there shall be no change of use to boarding houses, hotels, workers' quarters and the like because of the sleeping risk involved. Partial upgrading of building is considered not acceptable.

For shophouses which are not designated by URA for conservation, there is no incentive for the building owners to upgrade their buildings to have proper fire protection to the timber floors and the timber staircases. These shophouses would be considered as fire hazard.

SCDF did a survey on old shophouses and decided that the above relaxation on compliance of fire safety requirements given to shophouses under conservation should be extended to old shophouses that existed before 1969. The relaxation would provide incentive for building owners to renovate their old shophouse to comply with the set of fire safety guidelines issued by URA, instead of having to change all the timber floors/staircases to non-combustible materials to comply with the current fire code.

(2) 3 and 4-storey shophouses

(a) For air well that has the same usage for all floors, the following coverings shall be used:

(i) A fixed opening up to the third storey level with approved materials such as non-drip acrylic, non-drip polycarbonate and glass, is allowed, or

(ii) A fully openable covering (retractable or spring open type), by activation of smoke detectors and fire alarm system, up to the level below the roof eaves with, such as non-drip acrylic, non- drip polycarbonate and glass.

(b) For air well that has different usage for all floors, the following coverings shall be used:

(i) A fixed covering up to the 2nd storey floor level with approved materials such as non-drip acrylic, non-drip polycarbonate and glass, or

(ii) A fully openable covering (retractable or spring open type), by activation of smoke detectors and fire alarm system, up to the level below the roof eaves with approved materials such as non-drip acrylic, non-drip polycarbonate and glass.

(c) The air well shall not be enclosed.

f. Amalgamation of shophouse units

(1) If the amalgamation of shophouses is more than two units, fire shutters or fire doors shall be provided to the openings at the separating wall between every two units of shophouses.

(2) For amalgamation of shophouse units exceeding an AFA of 2000m^2, sprinkler system shall be provided for protection against rapid spread of fire due to higher fire load in a larger space.

(3) Timber floor joints and boards shall be provided with full protection for all floors, i.e. covering the underside of the floor boards in between joists with non-combustible boards if the joist size is adequate.

(4) Addition of attic floor shall not exceed 50m^2 per compartment.

(5) There shall be at least two independent exit staircases or other exits from every storey of a building, unless otherwise permitted under Cl.9.4.1 and Cl.9.5.1.

Rationale

The reason for raising the limit of the AFA of amalgamated shophouse units from 1900m^2 to 2000m^2 is for the ease of remembering and alignment with the limit of underground compartment size where sprinkler system provision is required.

g. Means of escape for all shophouses

(1) If there is only one escape route, the maximum travel distance shall not exceed 13m for non-sprinkler-protected buildings. Residential shophouses not exceeding 3 storeys and occupied by one family only are not subject to this requirement.

(2) Provision of at least ½-hr fire-rated door at the exit staircase discharge can be accepted in lieu of *Cl.2.3.3a.(3)*, which states that there shall be no unprotected openings of occupancy areas within 1.5m horizontally of the internal exit staircase ventilation/discharge point.

h. Alarm system for all shophouses

(1) For shophouses not exceeding 3 storeys and/or amalgamation of not more than 2 shophouse units, manual alarm system is acceptable.

(2) For shophouses exceeding 3 storeys or having an amalgamation of more than 2 units, automatic alarm system shall be provided.

i. Covering of rear courtyard for all shophouses

(1) If there is a protected exit staircase located at the rear courtyard, the entire space can be covered, up to the 2nd storey floor level, provided the exit staircase discharges to the back-lane.

(2) If the exit staircase does not discharge directly to the back-lane but through the rear courtyard, that part of the rear courtyard forming the escape route from the staircase door to the back door shall be made a protected passageway.

j. Direction of door swing for all shophouses

(1) Door swings at the first storey are allowed to swing into the units so as not to obstruct the walkways.

(2) However, where the aggregate occupant load served by the exit staircase exceeds 50 persons, the door shall swing in the escape direction and shall be recessed.

k. Electrical/ water/ gas meters, telecoms trunking and hose reel pipes for all shophouses

(1) For shophouses with a separate exit staircase enclosure at the front leading to the upper storeys, electrical and water meters and Telecoms trunking are allowed to be located within the exit staircase enclosure provided that they are boxed-up with non-combustible materials, e.g. non-combustible boards or metal casing.

(2) All hose reel pipes are to be located within the shophouse and hose reels shall be located near exit doorways.

l. Retention of timber floor in main building to be conserved with new rear extension of reinforced concrete floors

(1) Timber floors in the main building to be conserved with new extension of reinforced concrete floors are subject to the following requirements:

(a) The old and new blocks are to be treated as separate buildings;

(b) Independent escape staircases are to be provided in each of the old and new blocks and the requirement on maximum travel distance is to be complied with;

(c) A fire separation in the form of fire walls and fire doors is to be provided between the old and new blocks (see *Diagram 9.9.1l(1)(c)*);

(d) Air wells, if provided, shall have a minimum distance of 4m apart between window openings; and

(e) If integration is such that it is considered as a single block, the building (old and new) shall be constructed of reinforced concrete.

(2) Existing timber flooring of PG I residential building under conservation need not comply with the above-mentioned requirements provided that the following conditions are met:

(a) the residential building shall not exceed 3 levels (attic and basement shall be considered as a level);

(b) there shall be no amalgamation of units; and

(c) other requirements stipulated in the conservation requirements, such as protection to the existing timber flooring, etc. shall be complied with.

9.9.2 Temporary buildings on construction sites

Note

Regulation 42 of the Fire Safety (Building Fire Safety) Regulations allows the building industry to self-regulate the fire safety works in temporary buildings on construction sites. Submission of plans of the temporary buildings to the SCDF is not required. However, the plans, duly endorsed by a QP, shall be available on site for inspection by the SCDF at all times.

All temporary workers' quarters shall be maintained in good condition and they shall not be allowed to deteriorate through unauthorised extensions and overcrowding. Unwanted articles shall not be stored in and around the temporary workers' quarters. All exits, escape routes and passageway shall be kept free of obstruction at all times.

All temporary structures/ buildings including site offices or housing quarters on construction sites shall comply with *SS 547*.

9.9.3 Buildings under construction

For buildings under construction, the following fire safety requirements shall be complied with.

a. Provision of dry & wet risers

Note

The main contractor of the project shall work closely with the QP to ensure that all requirements for the provision of rising mains in the building are complied with during the construction stage.

(1) All rising mains (dry & wet) shall be made operational for all storeys (except the uppermost 3 storeys) as soon as the uppermost completed storey reaches 24m.

(2) Dry & wet rising mains shall be installed progressively as the building gains height, in order to provide firefighting capabilities during all stages of construction. All outlets, landing valves inlets, water tanks and pumps, where required shall be provided and made readily operational.

b. Provision of normal lift/ passenger hoist

A normal lift shall be provided for the purpose of firefighting. If this is not possible at the construction stage, a passenger hoist (usually installed on site) shall be made available.

c. Provision of electrical supply

A generator set shall be provided for firefighting if the permanent power supply is not available prior to the completion of the building.

d. Provision of fire engine accessway

(1) Adequate fire engine accessway shall be provided where practicable.

(2) Where there is no fire engine accessway provided at site, the quantity of portable fire extinguishers shall be doubled and installed at every floor.

e. Provision of adequate pressure and flow

Rationale

This is because the uppermost 3 storeys are likely to be strutted with props and scaffoldings for the purpose of gaining structural strength. Moreover, some of the staircases are likely to be under construction and hence access to the upper storeys may not be available.

(1) Rising mains shall be hydraulically tested and a pressure-release valve shall be installed at the highest point of the riser stack. For wet riser system, a break tank of 11.5m^3 shall be installed to support firefighting for at least 5 mins. The break tank and fire pumps shall be installed before the building reaches 60m.

Rationale

This is because most of the construction sites do not have the space to accommodate full-size water tank for the wet riser system. The smaller water tank will cater for initial firefighting requirement. Subsequently, additional water supply can be drawn from the public fire hydrant after the arrival of SCDF.

(2) For the testing of flow rate for the wet riser system, the topmost landing valve shall be tested (under pump/gravity feed) with a flow rate of at least 27 L/s.

f. Inspection checklist

The inspection checklist attached as *Annex 9.9A* shall be used for checking fire safety provisions for buildings under construction.

Rationale

This minimum flow rate shall be applicable to all buildings. This is because the fire hazard in buildings of any purpose group is similar while under construction.

9.9.4 Use of hoardings and safety nets for alteration and alteration work

Note

Note to QPs/Building Owners/Managements Clause 9.9.4

1. The building owner/management and/or QP shall notify all the tenants/occupants of the locations of alternate means of escape two weeks prior to carrying out the hoarding and renovation works. At the same time, inform the nearest SCDF fire station of any hoarding works that affect the following firefighting facilities:

    a. Fire hydrants;

    b. Fire engine accessway/fire engine access road;

    c. Fire lift;

    d. Exit staircase; and

    e. Dry/wet riser.

2. These affected firefighting facilities would have to be clearly shown on the plans and submitted to the relevant fire station. The QP shall also highlight alternative or nearest firefighting facilities that can be accessed by the fire station responding personnel. The building management or building owner shall be responsible for the compliance of *Cl.9.9.4a.(2)*.

3. The building management or QP shall ensure a copy of QP-endorsed hoarding plans is kept at the FCC or security guard room (if there is no FCC) at all times if the hoarding affect the areas/facilities mentioned in the paragraph 1 above. If there is no FCC and security guard room, these QP-endorsed plans shall be kept at the information counter.

Note:

While the building management or QP can undertake the above tasks, the building management or owner (if there is no building management) shall still be responsible to ensure their compliance,

For buildings without building management, the QP shall forward a copy of the hoarding plans to the building owner and assist with the above tasks on behalf of the building owner. Thereafter, the building owner shall ensure compliance with paragraph 3 above.

4. There is no plan submission required on the use of hoarding. However, a copy of QP endorsed hoarding plans shall be kept by the building management either at the FCC or security guard room (if there is no FCC) if the hoardings affect any of the following:

    a. Means of escape.

    b. Fire protection system (e.g. sprinkler/detector points).

    c. Firefighting system (e.g. dry/wet riser, hose reel & fire extinguisher).

    d. Means of access to carry out firefighting operation, (e.g. fire lifts).

    e. Hydrants and fire engine accessway/fire engine access road.

    Note:

    The QP has to ensure that the fire safety works affected (in para 4a/b/c/d/e) shall be rectified before commencement of hoarding works.

5. Plan submission on the use of safety nets on the external façade of a building is not required. However, requirements stipulated under *Cl.9.9.4d.(1)* shall be complied with.

a. General

The use of hoardings and safety nets in existing buildings undergoing addition and alteration works shall comply with the requirements stated herein.

b. Means of escape

(1) Hoarding erected within building

(a) It shall be constructed of non-combustible material. A minimum of 1.2m wide corridor shall be provided leading to the exit(s). The hoardings shall not obstruct the escape path of occupants within the building.

(b) Alternate means of escape shall be provided outside the hoarded area if the exit(s) is obstructed due to the erection of the hoarding.

(2) Hoardings erected at the external of building

(a) It shall be constructed of non-combustible material and a minimum 1.2m wide foot path shall be maintained for pedestrians. The hoardings shall not obstruct the discharge route of occupants exiting at the 1st storey units and from the exit staircase(s).

(b) It shall not obstruct smoke dispersal and means of escape of nearby buildings. Where the close proximity of the partitions may affect the smoke dispersion and escape of occupants from the nearby building, the partitions shall be located at least 1.2m away from the building.

See *Diagram 9.9.4b.(2) - 1* to *4*

c. Fire protection and firefighting provisions

(1) Hoardings erected within building

(a) For addition & alteration works involving sprinkler/ automatic alarm system, the systems covering these areas not under addition & alteration works shall remain active. For areas not involved in addition & alteration works but detector/ sprinkler heads are being isolated due to same zone/ control valve, the management shall arrange for additional surveillance checks so as to be alerted of fire at its incipient stage.

(b) Whenever possible, new systems shall be installed first before deactivating the existing systems so as to minimise the duration of no sprinkler/ automatic alarm protection to the areas affected by A&A works.

(c) The sprinkler/ automatic alarm system shall resume its operation again immediately at the end of the day wherever feasible.

(d) Within the hoarded area(s), 50kg fire extinguisher(s) in trolley shall be provided near the hoarding exit access door. Each fire extinguisher shall not cover more than 20m.

(e) Fire extinguishers and hose reels outside the hoarded area(s) shall be made available.

(2) Hoardings erected at the external of building shall not obstruct public/private hydrant and fire engine accessway/fire engine access road.

d. Fire safety requirements for safety nets

(1) Safety nets shall not obstruct the ventilation opening to rooms/areas where smoke ventilation is required, such as exit staircase, fire lift lobby, smoke-free lobby, flammable stores, kitchen with open-flame cooking, car parks, etc.

(2) No hot work and activities which generate sparks such as welding, cutting and grinding shall be permitted within 3m from the safety net. If unavoidable, these works shall be isolated/ shielded from the safety nets by a non-combustible shielding material.

9.9.5 Engineered timber building construction

Note

1. Where automatic fire detection/suppression systems are installed, the engineered timber building owner shall undertake to engage a QP to conduct annual inspection of these systems and to submit inspection reports to the SCDF.

2. The QP responsible for the design of the engineered timber building project shall inform the SCDF of the project prior to the design and construction of the project. During the construction stage, the QP shall ensure that the engineered timber project work site complies with Cl.9.9.3. In addition, there shall be no smoking or use of naked flames within the engineered timber project work site.

3. Compliance with the requirements for an engineered timber construction does not exempt the building owner from the need to obtain the necessary permits or approval of plans from the authorities having jurisdiction, including the SCDF.

a. General

The engineered timber product shall be listed in accordance with the requirements of the product listing scheme.

b. Building design

(1) The habitable height of any healthcare occupancy in an engineered timber building shall not exceed 12m, including mezzanine levels.

(2) A fire safety performance-based (PB) approach shall be adopted in the design of any engineered timber building where its habitable height exceeds 12m.

(3) The engineered timber building shall be fully protected by an automatic sprinkler system.

Exception: An automatic sprinkler system can only be exempted under the following circumstances:

(a) alternative fire protection measures (e.g., fully encapsulated timber elements) are provided to minimise fire damage to the timber structures, in lieu of the sprinkler system;

(b) the building does not exceed 12m in habitable height;

(c) the building is protected by an automatic fire alarm system compliant with *SS 645*; and

(d) the building does not contain any healthcare occupancy.

(4) Where an automatic sprinkler system is required, the system shall be designed in accordance with *SS CP 52*. The automatic sprinkler system shall not be shared among different engineered timber buildings if the latter is under different occupier. If the external facade of the engineered timber building is unable to meet the stated performance in accordance with Cl.3.5 for prevention of external fire spread, the external facade shall be required to be protected by a deluge system in accordance to *SS CP 52*, or any other suppression system that is shown to be effective in preventing vertical fire spread.

(5) The use of engineered timber for elements of structure shall be permitted only for areas above the floor slab of the ground floor. The ground floor slab and basement floors below it shall not have elements of structure constructed using engineered timber.

(6) Essential escape provisions such as staircase shafts and lift shafts of an engineered timber building shall be constructed of non-combustible materials which achieve the necessary fire resistance rating.

Exception: Engineered timber can only be used as elements of structure for essential escape provisions under the following circumstances:

(a) the surfaces of engineered timber elements shall be protected by fire-rated board so that the composite element is able to achieve the necessary fire rating;

(b) the building does not exceed 12m in habitable height; and

(c) the building does not contain any healthcare occupancy.

This exception shall not apply to staircase shelters designed to comply with the Technical Requirements for Storey Shelters.

(7) Essential facilities for fire safety and firefighting operations (such as FCC, fire pump rooms, generator rooms, and smoke-free/ fire lift lobbies) shall be separated from other areas of the engineered timber building project by non-combustible material or encapsulated engineered timber, either of which shall achieve the necessary fire resistance rating.

(8) The use of flammable gas cylinders for cooking is not permitted in the engineered timber building premises if the engineered timber building has access to piped-gas supply for cooking.

(9) Where the usage of the building potentially involves the use of flammable gas cylinders (either for cooking, storage, factory production, etc.) which may result in explosions, the use of engineered timber as elements of structure is not allowed unless the engineered timber building is designed to take into account the explosive actions based on *EN 1991* or other relevant internationally recognised standards.

(10) Residential engineered timber building projects shall fully comply with the Technical Requirements for Household Shelters and Technical Requirements for Storey Shelters.

(11) The engineered timber building project shall comply with the design & fire test performance requirements stipulated in European (EN) standards which include *BS EN 1995, BS EN 1363, BS EN 1365* & other internationally recognised standards deemed appropriate and necessary by the SCDF.

9.9.6 Use of flammable refrigerants

a. For PG I and II buildings, the use of flammable refrigerants is not permitted in building air-conditioning systems which require installation of piping into occupied areas. This includes both single and multi-split systems.

Exception:

(1) The use of R32 is permitted in split air-conditioning systems.

(2) The use of flammable refrigerants is permitted in refrigerators, and standalone wall-mounted air-conditioners, provided:

(a) the refrigerator or air-conditioner is regulated by the a authority having jurisdiction;

(b) the refrigerator or air-conditioner is meant solely for domestic use;

(c) the amount of flammable refrigerant has a charge weight cap of at most 150g; and

(d) the refrigerant is hermetically sealed within the refrigerator.

b. For PG III to VIII buildings, the use of flammable refrigerants is not permitted in refrigeration systems, e.g., coldrooms, chiller rooms, and food storage factories, which are meant for commercial purposes.

Exception:

The use of flammable refrigerants is permitted in standalone commercial refrigeration systems, provided *Cl.9.9.6a.(2)(c)* and *Cl.9.9.6a.(2)(d)* are complied with.

c. For industrial process refrigeration systems, flammable refrigerants are not permitted unless:

(1) there are no alternatives which can achieve the necessary specific performance required for the industrial process; and

(2) workplace safety requirements of the authority having jurisdiction are complied with.

9.9.7 Mega underground developments

a. General

This section provides the broad fire safety requirements for mega underground developments. It is applicable to mega underground developments regardless of size and number of occupants. Mega underground development refers to underground levels with lifts and/ or horizontal access as the primary means of egress. There is no habitable space immediately above the cavern units, which are enclosed chambers within the fire-compartmented underground developments.

b. Means of escape

(1) Each underground development shall be provided with at least two exit shafts.

(2) At least two exit staircases (at least 1.5m in width but not exceeding 2m) located at the exit shafts shall be provided for the underground development. The width of exit staircases shall be determined by the occupant load and uses of the cavern. The minimum width requirement is not applicable to exit staircases serving the cavern units. Such exit staircases shall comply with the requirements stipulated in Cl.2.3.3. Exit staircases are not the primary means of escape.

(3) Fire lift lobby shall be provided at each exit shaft.

(4) All cavern units shall be provided with at least two-way escape regardless of whether one-way travel distance can be complied with. One-way travel distance shall not exceed 20m and two-way travel distance shall not exceed 50m.

(5) The travel distance refers to the distance required to be traversed from the most remote point in the cavern to the edge of a fire door opening directly into the protected corridor.

(6) Protected corridors (enclosed by fire-rated wall/ floor) shall be provided for all cavern units at every storey. The corridor shall have direct access to the protected shaft.

(7) Protected corridors shall be sectorised by fire doors. Each sector shall not consist of more than four cavern units or more than 60m (measure along the corridor). Only those doors in the sectors affected by fire need to be closed during activation of alarm.

c. Structural fire precautions

(1) Fire compartmentation shall be provided for each cavern unit. Each compartment shall not exceed 4000m^2 and 15000m^3.

(2) Different tenancy units shall be compartmented.

(3) The element of structure/compartment of each cavern unit shall have fire resistance rating of at least 4 hours.

(4) Walls, ceilings, roof covering and finishes containing plastic material shall comply with the requirements stipulated in Cl.3.15.19.

(5) Internal non-load bearing walls and ceilings shall be constructed of non- combustible material.

(6) The surface of a wall or ceiling along protected corridor shall have a surface spread of flame of Class 0 rating.

(7) The exit staircases shall be constructed of masonry. However, if drywall construction is used it shall comply with *Cl.3.8.7b.*.

d. Vehicular access

(1) Fire engine access road having minimum 4m width and overhead clearance of at least 4.5m for access by pump appliance shall be provided for firefighters to conduct firefighting and rescue operations.

(2) Provision to alternative means of vehicle access into the underground development shall be considered.

(3) The fire engine access road shall be protected from fire and smoke, and shall lead directly to the ground level.

(4) Clear smoke height shall be maintained along the access road. Pushing the smoke out directly through the tunnel is not allowed.

(5) Private hydrants shall be provided along the fire engine access road such that every part of the fire engine access road shall be within an unobstructed distance of 50m from the nearest hydrant.

e. Firefighting provisions

A room shall be provided to house the firefighting and rescue equipment. The requirements for storage area are as follows:

(1) two storage areas per storey, with one near each of the exit shafts;

(2) room size shall comply with the dimensions 2m in width, 2m in length and 2.1m in height; and

(3) provision of four 64mm-diameter hoses, four 38mm-diameter hoses, one dividing breeching, two 38mm-diameter nozzles and two complete sets of breathing apparatus.

(4) buggies shall be provided at each level to facilitate firefighting and rescue operations. The requirements for buggies are as follow:

(a) 2 buggies per level. Each near the room storing firefighting equipment;

(b) 4 seaters;

(c) able to mount 1 stretcher;

(d) electrically-operated;

(e) the size of the buggies shall be of approved type by the SCDF; and

(f) the buggies can be used by in-house fire and security personnel provided the buggies are driven back to the holding area during emergency.

f. Firefighting system, detection and alarm

(1) The underground development shall be protected with an automatic sprinkler system.

(2) Wet risers shall be provided such that every part of the underground development is not more than 38m from the nearest wet riser landing valve. The wet riser pipes are allowed to run horizontally but the landing valves shall be located within the protected corridor.

(3) Breeching inlet shall be installed at one of the vertical access shafts at ground level. It shall be located near the FCC.

(4) At least two fire lifts shall be provided for each exit shaft. The fire lift shall have access to every habitable floor and shall be adjacent and accessible to an exit staircase and be approached by a firefighting lobby at each storey. The fire lifts shall home to the ground level (i.e., top of shaft) during activation of alarm and power failure.

(5) All passenger lifts shall be double up as evacuation lift and shall be located within the fire lift lobby. They need not be fire lifts but shall be installed with evacuation switch, connecting to the emergency backup supply, and shall home to ground level in an emergency. The use of these lifts for emergency evacuation shall be supervised by the emergency responders.

(6) The fire lift car shall have a clear area/ space of not less than 2m (depth) x 1.5m (width).

(7) Water mist system can be permitted as substitute of automatic sprinklers provided that the requirements are in accordance with Cl.6.4.6.

(8) FCC shall be located at ground level. It shall be located beside one of the protected shafts.

g. Effective communication systems and holding area

(1) Effective communication system shall be provided for the SCDF at the underground developments to conduct firefighting and rescue operations.

(2) One-way emergency voice communication system such as emergency wireless broadcast system shall be provided for the underground developments. Two-way emergency voice communications system shall be provided between FCC and the essential areas stipulated in *Cl.8.2.2*.

(3) A holding area shall be provided for the underground development. The size of the holding area shall take into considerations the total occupant load within that floor and shall be calculated based on 0.3m2/person.

(4) The holding area shall be provided with engineered smoke control system and shall have direct connection to the fire lift lobby.

h. Mechanical ventilation and smoke control system

(1) Engineered smoke control system shall be provided for the underground development and fire engine access road.

(2) Exit staircases, smoke-free lobbies and fire lift lobbies shall be pressurised.

(3) The air-handling system for the affected smoke zone and the adjacent zones shall be shut down to avoid re-circulating through the system.

i. Restriction of hazardous materials

(1) Hazardous, flammable and combustible materials shall be prohibited or controlled strictly if they have to be used within the facilities.

(2) If small quantities are needed, special approval has to be obtained from the SCDF.

j. Provision for emergency directional signage/ generator

(1) Photoluminescent marking/ tape to guide occupants along evacuation routes to appropriate exits shall be provided:

(a) along internal walls and/ or floors of the exit staircase and protected lobby;

(b) at the exit staircase door; and

(c) in designated corridor with exit directional sign.

(2) The duration of operation for standby generator shall be in accordance with the requirements stipulated in *SS 535*.

(3) Lifts at the cavern units shall be connected to the standby generator.

Diagram 9.9.1b.(1)(a) - 1 : Retaining existing 2-storey shophouse

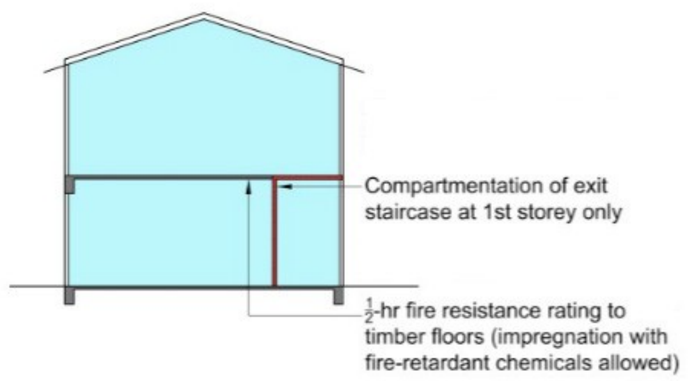


Diagram 9.9.1b.(1)(a) - 1 : Retaining existing 2-storey shophouse

Diagram 9.9.1b.(1)(a) - 2 : Retaining existing 3-storey shophouse

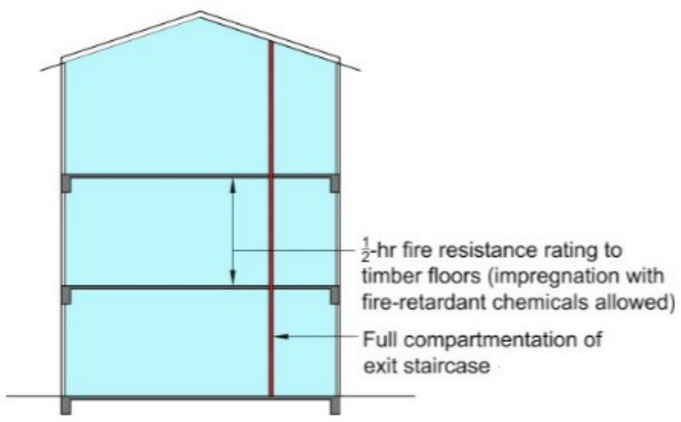


Diagram 9.9.1b.(1)(a) - 2 : Retaining existing 3-storey shophouse

Diagram 9.9.1c.(1)(a) : Adding new attic to existing 2-storey shophouse

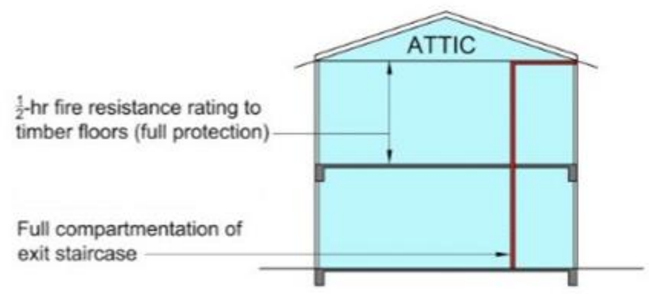


Diagram 9.9.1c.(1)(a) : Adding new attic to existing 2-storey shophouse

Diagram 9.9.1c.(2)(a) : Adding new attic to existing 3-storey shophouse

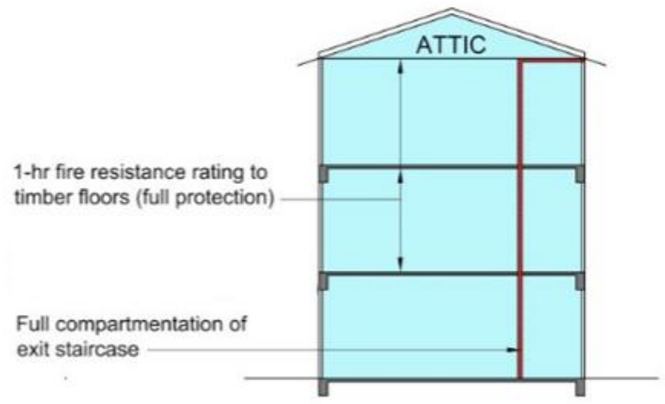


Diagram 9.9.1c.(2)(a) : Adding new attic to existing 3-storey shophouse

Diagram 9.9.1c.(2)(d) : Visual connection between the attic and the floor below

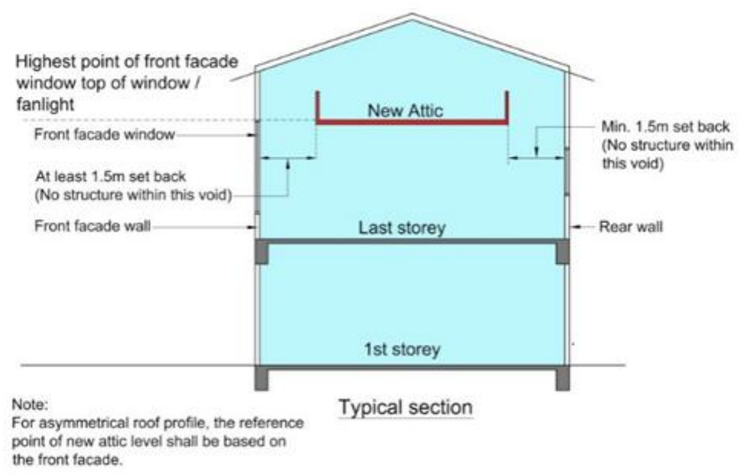


Diagram 9.9.1c.(2)(d) : Visual connection between the attic and the floor below

Diagram 9.9.1l.(1)(c) : Fire separation between the old and new blocks

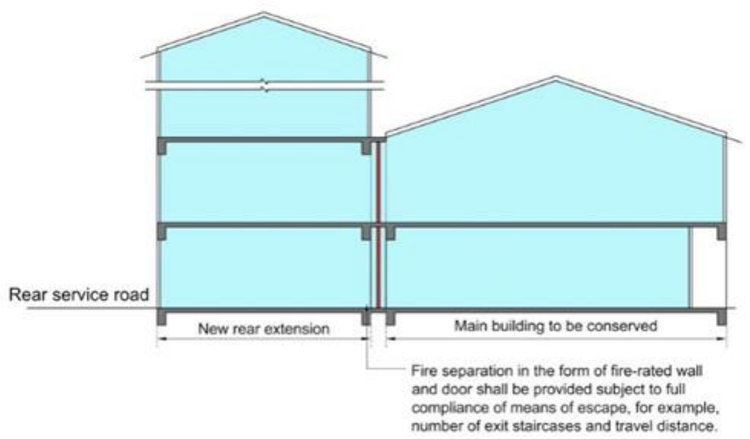


Diagram 9.9.1l(1)(c) : Fire separation between the old and new blocks

Diagram 9.9.4b.(2) - 1 & 2 : Hoarding obstructing means of escape

Diagram 9.9.4b.(2) - 1: Hoarding obstructing means of escape

Diagram 9.9.4b.(2) – 2 : Hoarding obstructing means of escape

Diagram 9.9.4b.(2) - 3 & 4 : Hoarding obstructing openings for smoke dispersal

Diagram 9.9.4b.(2) – 3 : Hoarding obstructing openings for smoke dispersal

Diagram 9.9.4b.(2) – 4 : Hoarding obstructing openings for smoke dispersal

ANNEX 9.9A

ANNEX 9.9A : INSPECTION CHECKLIST FOR BUILDING UNDER CONSTRUCTION					
S/No.	**Description**	**In Order**		**If no, remedy action/comments**	
		Yes	**No**		
PART A : PROVISION OF FIREFIGHTING SYSTEMS					
Rising Mains					
1	Dry rising mains shall be installed progressively during the course of construction as per approved plan and made operational for all storeys except the uppermost 3 storeys, for building exceeding 8 storeys or habitable height of 24m.				
2	Wet rising mains shall be installed progressively during the course of construction as per approved plan and made operational for all storeys except the uppermost 3 storeys, for building exceeding 18 storeys or habitable height of 60m. The following shall be provided: (a) break tank with minimum water capacity of 11.5m³; and (b) fire pumps which are operational and supplied with emergency power supply.				
3	Provision of breeching inlets (2-way/4-way)* provided as per approved plan. The following shall be complied with: (a) breeching inlets made operational and housed in protective enclosure; and (b) labelled and numbered accordingly.				
4	Riser stacks are labelled and numbered and: (a) earthing is provided; and (b) air relief valve is provided.				
5	Landing valves provided with blank caps and are strapped and padlocked in closed position.				
Lift					
6	Lift/passenger hoist ready for firefighters' use shall be provided for building exceeding 8 storeys or habitable height of 24m.				
Generator					
7	Generator set or adequate PUB power supply shall be provided for emergency lighting and firefighting purpose.				
Fire Engine Accessway					
8	Provision of adequate fire engine accessway (where practicable) for firefighting purpose.				
Fire Extinguisher					
9	At least one fire extinguisher of 13A rating shall be provided for every 500m² or less on each floor. Where provision of fire engine accessway is not practicable, the quantity of fire extinguishers shall be doubled on each floor.				
PART B : TESTING OF RISING MAINS					
Breeching inlet					
1	Inlet housed in protective enclosure.				
2	Rigidly support				
3	Labelled "dry/wet riser inlet" and numbered accordingly				
4	Clear of obstruction				
Riser					
5	Air relief valve provided				
6	Labelled & numbered accordingly				
7	Earthing provided				
Landing Valve					
8	Blank cap provided				
9	Strapped and padlock in closed position				
10	Clear of obstruction				
Pressure/Flow					
11	Rising mains pipping Hydrostatically tested at 1380 kPa (13.8 bar) or 1.5 times the design pressure, whichever is greater, for 2 hours.				
12	Wet rising mains (a) Flow rate at the topmost fully-opened landing valve (under pump/gravity feed) is at least 27 L/s; and (b) Running pressure is between 2 bars and 5.5 bars at the landing valve				

* Delete as appropriate

Date inspected:_____ by_____ Signature_____

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
9.1.1a.(2)		01 Mar 2019	Revised, formerly Cl.3.2.5(c)(i)		---
9.1.1b.(2)		01 Mar 2019	Revised, formerly Cl. 3.2.5(c)(i)		---
9.1.1b.(2) (dated 1 Sep 2024)	1 Sep 2024	1 Sep 2024	Relaxation	9.1.1b. Structural fire precautions (2) Floor over a basement For PG I building which has four or more levels (including the basement storeys and attics), the floor immediately over the basement storeys shall be compartmented by compartment walls/ floors. Where there is an internal connection between the basement storeys and upper levels, it shall be compartmented by a fire-rated door at the 1st storey landing.	1 Mar 2024
9.1.1c.	1 Sep 2021	1 Sep 2021	Clarification	Nil	1 Sep 2021
9.1.1d.	1 Sep 2021	1 Mar 2022	Revised/ Clarification	Nil	1 Sep 2021
9.2.1a.(10)(a)		01 Mar 2019	Revised, formerly Cl.2.3.3(f)		---
9.2.1a.(10)(b)	1 Mar 2024	1 Mar 2024	Relaxation	9.2.1a.(10)(b) Common internal corridor (i) ..... (ii) If the common internal corridor is cross-ventilated, all the following requirements shall be complied with: • The ventilation openings shall be located at high level and positioned directly opposite to each other. • Each ventilation opening shall be at least 50% of the superficial area of the opposing external walls. • No part of the floor area of the corridor shall be at a distance of more than 12m from any ventilation openings, or from the outer plane of recess void space, if ventilation opening is in recess position.	25 Aug 2023
9.2.1a.(5)	1 Mar 2024	1 Mar 2024	Revised/Clarifications	9.2.1a.(5) Exits from residential unit (a) In each residential apartment or maisonette unit, the exit access door or doors shall be provided such that the travel distance measured from any point within the unit to the entrance door(s) of the unit shall not exceed 20m. See Diagram 9.2.1a.(5)(a). (b) In the case of a maisonette unit comprising not more than two storeys, where a single entrance door is provided: (i) the door shall not be located on the upper storey of the unit; and (ii) the floor area of the upper storey shall not exceed 60m² unless a separate exit is provided on this upper storey. (c) All exits from residential, or maisonette units shall have direct access to an exit staircase, exit passageway, or external space.	25 Aug 2023
9.2.1c.	1 Sep 2021	1 Sep 2021	Clarification/Relaxation	Nil	1 Sep 2021
9.2.2		1 Mar 2019	Relocated from Appendix 8 of Fire Code 2013, revised		---
9.2.2a	15 Sep 2020	15 Sep 2020	Reinstatement of past requirements	Refuge floor A super high-rise residential building shall be provided with at least one refuge floor at an interval of not more than 20 storeys, i.e. each refuge floor shall not serve more than the 20 storeys immediately above it. The refuge floor shall the following requirements:	15 Sep 2020
9.3.2b(5)(b)		01 Mar 2019	Revised, formerly Cl.2.5.1(a)(iv)(2)		---
9.3.2b(5)(c)		01 Mar 2019	New		---
9.3.2b.(4)	10 May 2019	10 May 2019	Clarification	Every upper storey used for the accommodation of patients shall be provided with at least one area of refuge. The size of the area of refuge shall be computed based on Table 1.4B. For hospital and nursing home, the area of refuge shall be sized adequately to accommodate the number of beds computed based on occupant load factor of 2.8m²/person for the ward served by the area of refuge. The area of refuge shall be able to accommodate a bed size of minimum dimension 2.55m (length) by 1.1m (width).	10 May 2019
9.3.2b.(4)(a)(ii)		01 Mar 2019	New		---
9.3.2b.(4)(b)		01 Mar 2019	New		---
9.3.2b.(6)(a)		01 Mar 2019	Revised, formerly Cl.2.5.1(a)(v)(1)		---

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
9.3.2b.(7)	1 Mar 2024	1 Mar 2024	Relaxation	9.3.2b.(7) Internal access to wards A patient..... (a) ..... (b) ..... (c) ..... (d) an internal corridor shall be naturally ventilated with fixed openings in an external wall, such ventilation openings being not less than 15% of the floor area of the internal corridor; (e) the ventilation opening in the external walls shall not be less than 3.5m², with at least 1.75m2 on each side shall be unobstructed by parapet walls or balustrade levels upwards and be positioned on opposite sides of the internal corridor such that they provide effective cross ventilation throughout the entire space of the corridor; (f) the ventilation openings in the external walls shall not be more than 12m from any part of the internal corridor; (g) an internal corridor can be provided with mechanical ventilation and pressurisation in lieu of natural ventilation; and (h) other non-patient accommodation areas or spaces which open into or form part of the internal corridor, and which can jeopardise the means of escape provision, shall be compartmentalised by 1-hr fire-rated enclosures and ½-hr fire-rated doors unless otherwise allowed under Cl.9.3.2b.(4)(b) and Cl.9.3.2b.(6)(c).	25 Aug 2023
9.3.2d(2)	10 May 2019	10 May 2019	Change in requirements	(2) where such facilities are located on the 1st storey, they shall be provided with direct access to the exterior of the building;	10 May 2019
9.3.2d(3)	10 May 2019	Immediate	Change in requirements	where located on upper storeys, they shall be sited adjacent to an exit staircase with have direct access through a smoke-stop lobby to the exit staircase (minimum one exit staircase);	10 May 2019
9.3.2d.	1 Sep 2021	1 Sep 2021	Reinstatement	Custodian care facility It shall comply with the following additional requirements: (1) compartmentalised from other spaces and occupancies by walls and doors having at least 1-hr fire resistance rating; Exception: The requirement on the provision of fire compartmentation will not apply if the building is sprinkler-protected. (2) with direct access to the exterior of the building; (3) with direct access through a smoke-free lobby to the staircase (minimum one exit staircase); (4) direct access to the exit staircase; (5) an area of refuge in accordance with Cl.1.4.9 and Table 1.4B; and (6) except Cl.9.3.2b.(6) on provision of escape bed lift and Cl.9.3.2b(10) on staircase landing width/depth.	1 Sep 2021
9.3.2g (dated 15 Sep 2020)	15 Sep 2020	15 Sep 2020	Clarification	Other outpatient clinics For outpatient clinics that do not fall under the above categories, the fire safety requirements under Cl.9.3.2b. are not applicable. Instead, these clinics shall comply with the provision of fire-rated wall to separate the clinics from other usage as stipulated in Cl.3.2.5b., except for the frontage of the clinic.	15 Sep 2020
9.3.2g.		01 Mar 2019	Revised, formerly Cl.2.5.1(f)		---
9.3.3	30 July 2020	1 Feb 2021	Revised	Workers' dormitory Workers' dormitories shall comply with the following additional requirements: a. Each dormitory bedroom shall not exceed 120m² and an occupant load of 40 persons. b. The occupant load shall be based on accessible floor area on the basis of 3m² per person. c.	30 July 2020

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
9.3.3e.	1 Mar 2024	1 Mar 2024	Relaxation	9.3.3e. Internal corridor to dormitory bedrooms Dormitory bedrooms with access through an internal corridor shall comply with the following requirements: (1) ..... (2) ..... (3) an internal corridor shall be naturally ventilated with fixed openings on the external walls, with such ventilation openings having an aggregate free area of: (a) at least 15% of the total floor area of the internal corridor, or (b) at least 3.5m²m whichever is greater. (4) each ventilation opening in the external walls shall have at least 1.75m2 free area, unobstructed by parapet walls or balustrade levels upwards such that they provide effective cross ventilation throughout the entire space of the corridor; (5) the ventilation openings in the external walls shall be at most 12m from any part of the corridor; (6) pressurisation of internal corridors in lieu of natural ventilation is not permitted; and (7) other rooms or spaces	25 Aug 2023
9.3.3h.	25 Aug 2023	25 Aug 2023	Revised/Clarifications	9.3.3h. Bedroom compartmentation (1) Each dormitory bedroom shall be compartmented from adjoining rooms and other parts of the same building by construction having at least 1-hr fire resistance rating, unless otherwise permitted under Cl.9.3.3f. for the provision of window openings between the bedroom and external corridor; (2) Dormitory bedrooms and other rooms or spaces which open into or form part of the dormitory bedroom corridor shall be separated from the corridor to comply with Cl.9.3.3e. and Cl.9.3.3f.; and (3) Kitchen shall be enclosed with at least 1-hr fire-rated compartment wall, including at least ½-hr fire-rated door. Kitchen can be located within each floor but shall not be within the dormitory bedroom.	25 Aug 2023
9.3.4		Immediate 1 Mar 2019 (revised portion)	Relocated from Appendix 16 of Fire Code 2013, revised		---
9.3.4 (dated 30 Jul 2020)	30 July 2020	30 July 2020	Reinstatement of past requirement	9.3.4 Temporary workers' quarter in uncompleted permanent buildings on construction a. (1) fire engine access road level of the uncompleted building and shall not be lower than first basement level. (2) within the construction site. (3) quarters are located. b. (1) does not exceed 20 persons on any storey. The exit staircase shall directly to exterior open space. (2) workers' quarters located in basement levels or when the more than 20 persons on any storey. c. (1) Such kitchen, shall be enclosed with at least 1-hr fire-rated compartment wall and at least ½-hr fire-rated door and shall not be located within the dormitory unit. (2) workers' quarters are located. They shall be compartmented from the accommodation areas with at least 1-hr fire-rated compartment wall and at least ½-hr fire-rated door. d. (1) requirements for the development. Only the portion of the fire engine access road serving the temporary workers' quarters shall be made (2) fire hydrant is exempted. (3) connected to a 150mm diameter pipe, which shall be connected the other end to a 4-way breeching inlet. This breeching inlet shall be within 18m from any fire engine accessway or fire engine access road having minimum 4m width and within 50m from any wet fire hydrant. e. Emergency power supply lasting at least 2-hr shall be provided for all systems f. (1) commissioned and made operable for the storeys housing the temporary workers' quarters during the accommodation period. (2) for basement provided all of the following requirements are complied with: (a) (i) void for spaces that are in between two openings or voids; (ii) ventilated by such opening or void on only one side;	30 July 2020

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
				(iii) (iv) 20% of the total basement floor area. (b) (3) sprinkler system is exempted for the temporary workers' quarters located in the basement(s). (4) shall be provided as stipulated under Table 6.3A. (5) company is not required. g. Engineered smoke control and sprinkler systems shall be required for the ventilation stipulated in Cl.9.3.4.f. cannot be fulfilled. h. All stores of highly flammable substances shall be sited in open space at a minimum distance of 5m away from the building where the temporary workers' quarters are located and shall comply with the relevant standards. Temporary workers' quarter in uncompleted permanent buildings on construction a. (1) fire engine access road level of the uncompleted building and shall not be lower than first basement level. (2) within the construction site. (3) quarters are located. b. (1) provided that the one-way travel distance is complied with Table 2.2A and the occupant load does not exceed 20 persons on any storey. The exit staircase shall discharge directly to exterior open space. (2) workers' quarters located in basement levels or when the occupant load exceeds more than 20 persons on any aboveground storey. (3) those exits designated for escape of the workers shall be included in the exit capacity calculations. c. (1) Such kitchen, shall be enclosed with at least 1-hr fire-rated compartment wall and at least ½-hr fire-rated door and shall not be located within the dormitory unit. (2) workers' quarters are located. They shall be compartmented from the accommodation areas with at least 1-hr fire-rated compartment wall and ½-hr fire-rated door. (3) temporary workers' quarters. (4) worker bedrooms shall not exceed 120m2. Compartment wall of having fire resistance rating of at least 1-hr shall be provided to separate the bedrooms so as to limit each compartment size to a maximum of 120m2. (5) having fire resistance rating of at least 1-hr. Doors opening into the internal corridor shall have fire resistance rating of at least half an hour. (6) having fire resistance rating of at least 1-hr, except that ventilation openings of non-combustible construction can be fixed at or above a level of 1.1m, measured from the finished floor level of the external corridor to the sill height of the opening. Doors opening into the external corridor are not required to have fire resistance rating. d. (1) requirements for the development. Only the portion of the fire engine serving the temporary workers' quarters shall be made (2) unobstructed distance of 50m from the nearest working fire hydrant. Where the remotest temporary workers' quarter is located not more than 100m away from the site entrance at the public road, provision of working private fire hydrant is exempted. (3) to a 150mm diameter pipe, which shall be connected the other end to a 4-way breeching inlet. This breeching inlet shall be within 18m from any fire engine accessway or fire engine access road having minimum 4m width and within 50m from any wet fire hydrant. e. (1) systems serving the temporary workers' quarters. (2) secondary source of power supply, be it in the form of battery, standby generator, inverter or other accepted equipment, shall be in accordance with Chapter 5. f. (1) commissioned and made operable for the storeys the temporary workers' quarters during the accommodation period.	

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
				(2) for basement provided the basement is effectively cross-ventilated as follows: (a) void for spaces that are in between two openings or voids; (b) ventilated by such opening or void on only one side; (c) (d) 20% of the total basement floor area. (3) sprinkler system is exempted for the temporary workers' quarters located in the basement(s). (4) system shall be provided as stipulated under Table 6.3A. (5) company is not required. (6) that the temporary workers' quarters are adequately covered by fire hose reel(s).	
				(7) (8) g. Engineered smoke control and sprinkler systems shall be required for the ventilation stipulated in Cl.9.3.4.f. cannot be fulfilled. h. (1) minimum distance of 5m away from the building where the temporary workers' quarters are located and shall comply with the relevant standards. (2) accordance with Cl.10.1. i. The occupant load shall be based on the floor area of the temporary workers' quarters on the basis of 3m² per person, excluding non-simultaneous areas such as toilets, kitchens etc., or the actual number of occupants for which each occupied space of the floor is designed as shown on the plan, whichever is greater. j. Emergency lightings and exit signs serving the temporary workers' quarters shall be in accordance with Cl.8.1.	
9.3.4i	30 July 2020	1 Feb 2021	Revised	Occupant load The occupant load shall be based on the floor area of the temporary workers' quarters on the basis of 3m²per person, excluding non-simultaneous areas such as toilets, kitchens etc., or the actual number of occupants for which each occupied space of the floor is designed as shown on the plan, whichever is greater.	30 July 2020
9.3.4i. (dated 1 Sep 2022)	1 Sep 2022	1 Sep 2022	Revised/Clarification	Occupant load The occupant load shall be based on the floor area of the temporary workers' quarters on the basis of 6m2 per person, excluding non-simultaneous areas such as toilets, kitchens etc., or the actual number of occupants for which each occupied space of the floor is designed as shown on the plan, whichever is greater.	1 Mar 2022
9.4.1a.(1)(c)		01 Mar 2019	Revised, formerly Cl.2.6.1(c)		---
9.4.1a.(2)		01 Mar 2019	New		---
9.5.1a.(2)		01 Mar 2019	New		---
9.6.1a.(1)(c)		01 Mar 2019	Revised, formerly Cl.2.6.1(c)		---
9.6.1c.	1 Sep 2021	1 Mar 2022	Revised/ Clarification	Nil	1 Sep 2021
9.6.2v.(2)	1 Sep 2021	1 Mar 2022	New	Electrical equipment and area classification All electrical wiring and equipment shall be of a type suitable for the location, in accordance with NFPA 70 or SS 254.	1 Sep 2021
9.6.2v.(2) (dated 2 Sep 2024)	2 Sep 2024	2 Sep 2024	Clarification	9.6.2v.(2)(b) Main isolation shut-off switches shall be provided as per Cl.10.4.2.	2 Sep 2024
9.6.2v.(3)	2 Sep 2024	2 Mar 2025	New		2 Mar 2025
9.6.4	1 June 2021	1 June 2021	Revised/ Clarification	Nil	1 Dec 2020
9.6.5	1 Sep 2021	1 Mar 2022	Revised/ Clarification	Nil	1 Sep 2021
9.6.7b.	1 Mar 2024	1 Mar 2024	Revised/Clarifications	9.6.7b. General requirements (1) ..... (2) ..... (3) The underground structure housing the transformer shall not be sited within 15m of an exit staircase shaft.	25 Aug 2023
9.6.8	1 Mar 2024	1 Mar 2024	New	New Requirements for Sea-based buildings	25 Aug 2023
9.7.1a.	2 Sep 2024	2 Mar 2025	Relaxation/ New	9.7.1 General (Not in use)	2 Mar 2025
9.7.2	1 June 2021	1 June 2021	Revised/ Clarification	Hotel, boarding houses, serviced apartments, hostels & backpacker hotels	1 Dec 2020

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
9.7.2a.(3) (dated 25 Aug 2023)	1 Mar 2024	1 Mar 2024	Revised/Clarifications	9.7.2a. Access through an internal corridor (1) ..... (2) ..... (3) The common internal corridor shall have ventilation openings of not less than 15% of the floor area and located not more than 9m from any part of the common internal corridor. Internal corridors which cannot be naturally ventilated shall be pressurised to comply with the requirements in Chapter 7.	25 Aug 2023
9.7.2b.(3)		01 Mar 2019	Revised, formerly Cl.2.7.2(c)		---
9.7.2f.	1 June 2021	1 June 2021	Revised/ Clarification	Nil	1 Dec 2020
9.7.3b.(5)		01 Mar 2019	Revised, formerly Cl.7.7		---
9.7.4b(4)(c)(vi)	10 May 2019	10 May 2019	Clarification	The surface flame spread of the canopy/awning shall be at least Class 2.	10 May 2019
9.8.1b.(1)		01 Mar 2019	New		---
9.8.1b.(1) (dated 2 Sep 2024)	2 Sep 2024	2 Sep 2024	Clarification	9.8.1b. Structural fire precautions (1) Vehicle parking area Fire compartmentation shall be provided between a vehicle parking area (PG VIII) and other areas, except for ancillary washrooms and other rooms stated in footnote (4) of Table 6.4A, the fire compartment walls and floors shall have at least 1-hr fire resistance rating. Exceptions: (a) For a sprinkler-protected factory, compartmentation between the vehicle parking areas and the factory is not required, provided the vehicle parking area and adjacent driveway are provided with an engineered smoke control system. (b) For a sprinkler-protected warehouse, thermal insulation of the fire-rated shutters between the vehicle parking area and the warehouse is not required, provided the vehicle parking/ loading and unloading area and adjacent driveway are provided with an engineered smoke control system.	2 Sep 2024
9.8.1b.(1) (dated 3 Mar 2025)	3 Mar 2025	3 Mar 2025	Clarification/ Revised	9.8.1b. Structural fire precautions (1) Fire compartmentation shall be provided between a vehicle parking area (PG VIII) and other areas, except for ancillary washrooms, letter boxes and other rooms stated in footnote (4) of Table 6.4A, the fire compartment walls and floors shall have at least 1-hr fire resistance rating. Exceptions: (a) parking areas and the factory is not required, provided the vehicle parking area and adjacent driveway are provided with an engineered smoke control system. (b) shutters between the vehicle parking area and the warehouse is not required, provided the vehicle parking/ loading and unloading area and adjacent driveway are provided with an engineered smoke control system.	3 Mar 2025
9.8.1b.(3)	1 Sep 2021	1 Sep 2021	Reinstatement	Structural fire precautions (1) Fire compartmentation shall be provided between a vehicle parking area (PG VIII) and other areas, except for ancillary washrooms, the fire compartment walls and floors shall have at least 1-hr fire resistance rating. Exceptions: (a) parking areas and the factory is not required, provided the vehicle parking area and adjacent driveway are provided with an engineered smoke control system. (b) shutters between the vehicle parking area and the warehouse is not required, provided the vehicle parking/loading and unloading area and adjacent driveway are provided with an engineered smoke control system. (2) Warehouse compartment size exceeding 700m² for above ground level and 100m² for below ground level are subject to full compliance of Cl.9.8.3.	1 Sep 2021

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
9.9.1e.	1 Sep 2021	1 Sep 2021	Reinstatement	Air well and covering over air well (1) 2-storey shophouses (a) For air well that has the same usage for all floors, the following coverings shall be used: (i) A fixed covering up to the level below the main roof eaves with approved materials such as non-drip acrylic, non-drip polycarbonate and glass, or (ii) A fully openable covering (retractable or spring open type), by activation of smoke detectors and fire alarm system, up to the level below the roof eaves with approved materials such as non-drip acrylic, non-drip polycarbonate and glass. (b) For air well that has different usage for all floors, the following coverings shall be used: (i) A fixed covering up to the 2nd storey floor level with approved materials such as non-drip acrylic, non-drip polycarbonate and glass, or (ii) A fully openable covering (retractable or spring open type), by activation of smoke detectors and fire alarm system, up to the level below the roof eaves with approved materials such as non-drip acrylic, non-drip polycarbonate and glass. (c) The air well shall not be enclosed. (2) 3 and 4-storey shophouses For air well that has the same usage for all floors, the following coverings shall be used: (a) A fixed opening up to the third storey level with approved materials such as non-drip acrylic, non-drip polycarbonate and glass, is allowed, or (b) A fully openable covering (retractable or spring open type), by activation of smoke detectors and fire alarm system, up to the level below the roof eaves with, such as non-drip acrylic, non-drip polycarbonate and glass.	1 Sep 2021

CLAUSE 10.1 LIQUEFIED PETROLEUM GAS (LPG) CYLINDER INSTALLATIONS

The requirements in this chapter shall be read in conjunction with other requirements relevant to the installations stipulated in Chapter 1 to 9 of this Code. Where there are conflicting requirements between this chapter and the preceding chapters, the requirements stipulated in this chapter shall take precedence.

Note

The list of items to be included in the building plan submission are as follows:

1. Endorsement on this guideline, NFPA 58, NFPA 54, other relevant and approved standards and the Fire Code.

2. Location and site plan associated with the LPG installation.

3. Detailed plan and elevation views associated with the LPG installation showing the following:

a. Location and number of cylinders as well as quantity in kilograms.

b. Housing for the LPG cylinders, e.g. cabinets, fencing.

c. Location of ancillary fittings, e.g. vaporizer, 1st stage regulator, emergency shut off valves, change over valve, remote cable pull, knock out pot and pipe entry.

d. Hydrant location, fire engine access way, source of ignition, boundary line, building line, internal roads and parking area.

e. Location of exits, staircases, details of horizontal openings (e.g. doors, air intakes and windows) and ground openings (e.g. drains, manholes and entrance to basement).

f. Fire safety provisions like, hose reel, fire extinguishers, indication of sprinkler protection, gas leak detectors, mechanical ventilation, exhaust systems and fire suppression systems, where applicable. (Fire Protection Plan and Mechanical Ventilation Plan shall be submitted accordingly in addition to the Building Plan submission.)

4. Warning sign/Notice as indicated in Diagram 10.1.2e. and other relevant information associated with the LPG installation.

10.1.1 General

a. This section stipulates the fire safety requirements for the commercial, industrial and residential premises with eating outlets, eating places, canteens, restaurants and other eateries which use LPG for cooking purposes. Usage of LPG systems that is not specifically covered in this Code (for e.g., non-manifold LPG systems in places of public resort for the purpose of social cooking events such as barbeques) is not allowed. It is also intended for commercial and industrial applications such as hot works, mass food production etc.

b. All LPG cylinder installations shall be located outdoors and on the ground levels for all commercial and industrial buildings. Locating LPG cylinders indoors shall comply to the requirements of *Cl.10.1.4*.

c. A maximum of 30kg (2 x 15kg cylinders) is permitted to be installed or stored within private dwelling unit for domestic use.

d. *NFPA 54* and *NFPA 58* shall be referred to for requirements not effected or covered under this chapter.

e. LPG plans shall include the following items:

(1) LPG's storage and manifold system.

(2) Location and site plans.

(3) Schematic diagrams of the LPG supply system showing change-over valve, vaporiser, regulator, emergency shut-off valve, remote cut-off device, knock-out pot, pipe entry and all other required safety features.

(4) Plan and elevation views showing the following details:

(a) Location, quantity and capacity (in kg) of LPG cylinders.

(b) Locations of ancillary fixtures and fittings, e.g. vaporisers, regulators, emergency shut-off valves, change-over valves, remote cut-off devices, knock-out pots, pipe entries, droppers, etc.

(c) Housing for the LPG cylinders, e.g. cabinets, fencing, compartment wall, etc.

(d) All openings (doors, air intakes, windows, drains, manholes, etc.) and exits adjacent to the LPG installation.

(e) Locations of hydrant, access way, access road, car parking area, building and boundary lines, source of ignition, etc.

(f) Fire safety provisions, e.g., fire hose reel, fire extinguisher, sprinkler protection (if any), gas leak detector (if any), etc.

(5) The following factors shall be taken into consideration when deciding on the practicality and reasonableness to use LPG:

(a) adequacy of ventilation;

(b) extent of usage of individual rooms;

(c) existing fire hazard;

(d) suitable means of escape; and

(e) firefighting equipment and provisions.

10.1.2 Design requirements

a. Codes of practice and standards

All cylinders and their ancillary fittings shall be designed, fabricated and tested in accordance with the accepted Code or Standard as stated in *Annex 10.1A*.

b. Fire stopping

All pipes penetrating fire wall or floor slab shall be fire-stopped appropriately.

c. Pressure

No liquid LPG or LPG vapour at pressure exceeding 20psi (approximately 138kPa) shall be piped into any building.

d. Fire extinguisher

The LPG installation shall be provided with at least one approved portable B:C rating dry chemical fire extinguisher having a minimum capacity of 9kg.

e. Warning sign/notice

Warning signs/notices as shown in *Diagram 10.1.2e.* shall be provided.

10.1.3 Outdoor LPG cylinder installation

a. Siting of LPG cylinders

LPG cylinders shall be located in accordance with the following requirements:

(1) LPG cylinders shall be placed on a firm, clean, dry and level base. They shall be sited at ground level and a well-ventilated area where any gas leakage can safely and rapidly disperse. They shall not be placed close to any passageways or exits and shall not cause any obstruction or danger to the occupants during gas leakage or fire.

Note

Consent from relevant government agencies shall be obtained for locating the LPG installation on state land. Shop unit with LPG installation shall have a Fire Safety Certificate (FSC).

(2) LPG cylinders shall not be located within 3m of any fire exit route of a building having only one exit. If the 3m distance cannot be complied with, a 2-hr fire-rated masonry wall of at least 1.8m high shall be provided between the fire exit and the LPG installation so as to achieve the equivalent 3m horizontal distance.

(3) LPG cylinders shall be located at least 1.5m horizontally away from any openings (windows, doors, air vents, balanced-flue outlets, etc.) of the building having more than one exit. If the 1.5m distance cannot be complied, a 2-hr fire-rated masonry wall of at least 1.8m high shall be provided between the openings and the installation so as to maintain a 1.5m horizontal distance.

(4) A minimum distance of 3m shall be maintained between the edge of a vehicle parking lot.

(5) LPG cylinders shall be located at least 5m horizontally from any mechanical air intake which is below any part of the manifold system and 1.5m from any mechanical intake which is above any part of the manifold system.

(6) LPG cylinders can be installed below windows or openings provided that there is a minimum distance of 150mm between the top of any cylinder or the manifold system and the bottom of the windows or openings.

(7) LPG cylinders of total capacity up to 600kg shall be located at least 1.5m from any uncovered opening that is below the level of the cylinders, such as drains, pits, openings to basements, etc.. For LPG cylinders having total capacity above 600kg, the distance from any uncovered opening shall be at least 3m.

(8) LPG cylinders shall be located at least 3m away from any boundary and any fire engine accessway.

(9) LPG cylinders shall be located at least 10m away from any fire hydrant.

b. Protection for LPG cylinder installation

LPG cylinder installations shall be protected in accordance with the following requirements:

(1) LPG cylinders located in places accessible to the public shall be protected and locked against tampering and accidental damage by fencing of height not less than 1.8m, a suitable housing or a cabinet made of non-combustible material; and

(2) there shall not be any corrosive, toxic or oxidizing materials located within 6 meters from the cylinder installation.

c. Safety provisions

The following safety provisions shall be adhered to for LPG cylinder installations:

(1) For kitchen provided with fixed fire suppression system, activation of the system shall automatically shut off the supply of LPG to the kitchen.

(2) Remote emergency shut-off valve shall be located at least 3m away from the edge of the installation. It shall be clearly marked and placed at a suitable height for easy access during emergencies. (see *Diagram 10.1.3d.(1)* and *10.1.3d.(2)*).

(3) There shall be no ignition source within 3m from the cylinder installation.

(4) All fixed electrical equipment within 1.5m of the installation shall be spark-proof and intrinsically safe in accordance with the relevant clause in *SS 254*.

(5) Vaporisers shall not be installed inside the steel cabinet or within the same housing of the LPG cylinders. Wall-mounted vaporisers shall be located at least 1.8m above the ground and 600mm away from any LPG cylinder.

(6) The distance between two separate manifold systems shall be at least 3m. If a 2-hr fire-rated wall is constructed, the distance between the two nearest cylinders can be halved.

d. Allowable quantities

(1) Eating outlets

LPG cylinder installation (for eating outlets) with capacity up to a maximum of 600kg by weight attached to a single manifold system installed adjacent to a building is allowed provided that the following requirements are fully complied with. See *Diagram 10.1.3d.(1)* and *Table 10.1A*:

(a) a maximum of two steel cabinets is allowed for each installation, and each cabinet is allowed to house a maximum of 6 x 50kg LPG cylinders;

(b) the separation distance between the two cabinets shall be at least 600mm;

(c) the building is of non-combustible construction and the wall has a rating of at least 2-hr fire resistance; and

(d) the maximum number of LPG manifold systems shall not exceed two per building.

(2) Industry buildings

LPG cylinder installation of capacity exceeding 600kg to a maximum of 1000kg by weight attached to a single manifold system can be used for industrial applications only, provided that the following requirements are fully complied with. See *Diagram 10.1.3d.(2)* and *Table 10.1A*:

(a) a maximum of two steel cabinets is allowed for each installation and each cabinet is allowed to house a maximum of 10 x 50kg LPG cylinders; and

(b) a wall of at least 2-hr fire resistance rating or a spacing of 3m shall be provided to separate the LPG cylinders into two groups of maximum 10 x 50kg per group.

10.1.4 Indoor LPG cylinder installation

a. Location

(1) LPG cylinder installation shall be properly located so as not to cause any obstruction to the fire escape and any danger to the public. Suitable access to the cylinder for emergency services shall be provided.

(2) The edge of the installation shall be at least 3m from any boundary or any fire engine accessway.

b. Safety provisions

(1) The location of the gas leak detector shall not be more than 300mm above the ground level and not more than 4m away from the edge of the installation and the point of consumption.

(2) Remote emergency shut-off valve shall not be installed inside the compartment and shall be at least 1.5m away from the edge of the installation. It shall be clearly marked and at a suitable height to access during emergencies.

(3) Fixed fire suppression system, if installed, shall be linked to the LPG cylinder installation in such a way that activation of the system shall automatically shut off the supply of LPG to the kitchen.

(4) Vaporisers (where applicable) shall not be installed inside the compartment or within the same housing of the LPG cylinders.

(5) The compartment shall only be used for LPG cylinder installation. No other usage is allowed.

(6) The floor of the compartment shall be a smooth concrete base containing no opening or drain where vapour can accumulate and shall be level or slope down towards the ventilated external wall.

(7) A ramp or sill of 250mm high shall be provided across the doorway (where applicable) into the compartment where LPG cylinders are installed to contain any heavy LPG vapour within the compartment.

(8) All electrical connections and appliances shall be installed in accordance with the relevant clauses in *SS 254*.

c. LPG cylinder installation in separate compartment

LPG cylinders are allowed to be installed in a separate compartment on the ground floor, provided that the following requirements are complied with. See *Diagram 10.1.4c.* and *Table 10.1B*:

(1) Allowable quantity

(a) A maximum of 400kg of LPG is allowed to be installed using a single manifold system inside a compartment. The quantity of cylinder is restricted to 8, regardless of the capacity of each cylinder (e.g. 2 groups of 4 x 50kg cylinders or 2 groups of 4 x 15kg cylinders).

(b) The area or compartment in which the LPG cylinders are installed shall be sprinkler-protected. If the compartment is not sprinkler-protected, the quantity of LPG shall be halved (i.e., 200kg).

(c) For commercial premises, the maximum number of LPG manifold system shall not exceed two per building.

(2) Compartment

(a) The compartment shall have at least one external wall and there shall be no access from the compartment into the building.

(b) Walls common to the compartment and the internal spaces of the building shall be 2-hr fire-rated and shall be of masonry construction.

(c) Each compartment shall contain only one LPG manifold system.

(3) Ventilation

(a) Doors shall have high and low level louvers and shall be opened outwards.

(b) Natural ventilation is allowed if the total length of the compartment external wall is not less than 6m and the distance between the external wall and its opposite wall is not more than 3m. Otherwise, mechanical ventilation shall be provided.

(c) High and low vents shall be provided on the external wall at just below ceiling level and above floor level. The total free area of the vents provided shall be at least 300cm²/m² of floor area.

(d) The vent openings shall be kept free from obstruction and shall not discharge directly onto a public place, e.g. a pavement or path. It shall not be less than 5m from any air intake openings and shall be at least 1.5m horizontally away from any building opening which is below the vent opening level.

(e) Where mechanical ventilation is used, air circulation shall be at least 0.3m^3/min.m^2 of floor area. Discharge outlets shall be at least 1.5m horizontally away from any building opening which is located below the discharge level.

d. LPG cylinder installation in recessed area

Building recess used for housing LPG cylinder installation shall comply with the following requirements. See *Diagram 10.1.4d.* and *Table 10.1B*:

(1) Design

(a) The maximum depth of the recess shall be not more than 1m deep.

(b) The floor, ceiling and the dividing walls between the recess and the internal spaces of the building shall be brick, concrete or other non-combustible materials shall have a fire resistance rating of not less than 2 hours.

(c) Access to the recess shall only be from the external of the building.

(2) Location

(a) The recess shall be at ground floor and shall be for the exclusive use of housing LPG cylinders.

(b) The recess shall not be located within 3m of any fire exit route from a building that has only one designated means of exit. If the 3m distance cannot be complied with, a 2-hr fire-rated masonry wall shall be provided between the fire exit and the installation so as to achieve the 3m horizontal distance.

(c) The recess shall be located at least 1.5m from any horizontal openings (windows, doors, air vents, balanced-flue outlets, etc.) of the building having more than one designated means of escape, measured horizontally from the nearest LPG cylinder. If the 1.5m distance cannot be complied with, a 2-hr fire-rated masonry wall shall be provided between the openings and the installation so as to achieve the 1.5m horizontal distance.

(d) The recess shall be located at least 3m from ignition source.

(e) A minimum horizontal distance of 3m shall be maintained between the nearest edge of a vehicle parking lot to the recessed area.

(f) Recessed area located below windows or openings shall maintain a minimum distance of 150mm between the top of the recessed area or any part of the manifold system (piping, vaporiser, etc., whichever is higher) and the bottom of the windows or openings.

(g) LPG cylinders shall be located at least 5m horizontally from any mechanical air intake which is below any part of the manifold system and 1.5m from any mechanical intake which is above any part of the manifold system.

(3) Allowable quantity

(a) A maximum of 400kg of LPG is allowed to be installed using a single manifold system inside the recessed area. The quantity of cylinder is restricted to 8, regardless of the capacity of each cylinder (e.g., 2 groups of 4 x 50kg cylinders or 2 groups of 4 x 15kg cylinders).

(b) The space or compartment where the pipework and ancillary fittings are installed shall be sprinkler-protected (except for the recessed area). If not, the LPG quantity shall be halved (200kg).

(c) For commercial premises, the maximum number of LPG manifold system shall not exceed two per building.

(4) Safety

Any pipe penetration on the walls of the recess area shall be suitably fire-stopped to maintain the 2-hr fire resistance rating of the walls.

(5) Ventilation

Permanent unobstructed high and low ventilation openings, not less than 300cm²/m² of recess floor area, shall be provided for venting the recess space to the external of the building.

Rationale

The purpose of providing smooth floor surface is to reduce sparks when LPG cylinder rubs against the floor during the replacement of cylinders.

10.1.5 Gas leak detection system and other requirements

a. Gas leak detection system shall be provided within area, room or compartment involving LPG piping system, regardless whether the mentioned spaces are naturally ventilated, mechanically ventilated or air-conditioned. The gas leak detection system shall, upon detection, automatically shut off gas supply and sound the alarm (see *Cl.A2.3* of *Annex 10.1A* on Gas Leak Detection).

b. A fail-safe central solenoid isolation valve interlocked with the gas leak detection system shall be installed at the main pipe immediately outside the metal cabinet.

c. All flexible pigtail tubings shall be of heavy duty type, UL listed and integrated with one-way check valve.

d. If vapour manifold is installed for temporary use when vaporiser is under repair or replacement, its design shall adhere to the similar design criteria for liquid line.

e. The LPG installation (i.e. including all pipings, manifold system, devices/ equipment such as vaporiser and pressure release valves etc.) shall be separated with 2-hr fire-rated masonry wall from other area and all shop units.

f. The installation shall be protected with 2-hrs fire-rated roof cover if there is any other equipment such as air-condition condensing unit etc. installed above it.

g. All electrical fittings shall comply with *IEC 60079*, including Parts 10, 14 and 17, i.e., electrical installations in hazardous areas.

h. Hose reel coverage shall be provided.

i. The LPG installation shall be within 45m range from fire engine access road and fire hydrant is within 50m range from the fire engine access road.

j. Where LPG installation is located within a back-lane, public street or service road, it shall be accessible to firefighters from both ends of the back-lane, public street or service road.

10.1.6 Reduced separation distances between LPG storage and boundaries

a. The separation distances stipulated under *Cl.10.1.3a.(2)*, *Cl.10.1.3a.(3)* and *Cl.10.1.3a.(8)* can be reduced as follows provided all the conditions stipulated under are fulfilled:

(1) at least 1.5m separation between LPG installation and the common boundary lines of the two abutting shop units;

(2) at least 3m separation between LPG installation and the opposite property;

(3) at least 1.5m separation between LPG installation compartment and the exit, if this exit is the only exit for the shop unit; and

(4) at least 1.5m separation between LPG installation and the final discharge of exit staircase, if this staircase is the only exit staircase serving upper or basement levels.

b. Conditions for reduced separation distances between LPG installation and boundaries

(1) The LPG storage shall be fully protected with masonry wall including 2-hrs fire-rated roof cover; access door shall also be 1-hr fire-rated with low level air gap of 75mm for ventilation purpose; the masonry wall facing abutting shop unit shall be extended at least 300mm higher than the entire LPG installation.

(2) In addition to *Cl.10.1.5a.*, gas leak detector(s) shall be provided at the LPG installation that shall upon detection, automatically shut off the gas supply, sound the alarm and activate the strobe light located next to the LPG storage (with "Gas Leak" indication beside the strobe light).

(3) The minimum alarm sounding duration shall be 3 mins and the strobe light (blue) shall flash continuously.

(4) Red background signage with white lettering of 50mm in size with the following details shall be placed at the LPG storage compartment and at the emergency shut-off valve pull box.

GAS LEAK WARNING

When strobe light and/or alarm soundings is activated, keep away and call 995

Gas supplier's contact: 6xxxxxx

(5) Emergency shut-off switch for the isolation valve shall be provided beside the emergency shut-off valve pull box.

(6) The total number of gas cylinders shall be limited to 6.

Diagram 10.1.2e. : Warning sign/notice for LPG cylinder installation

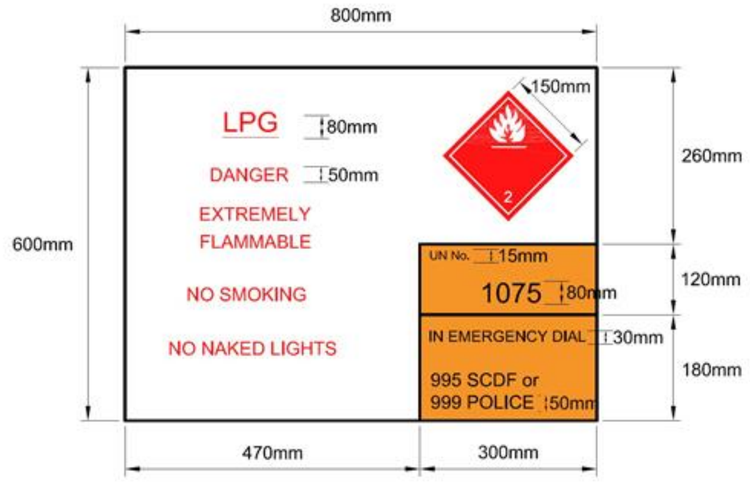


Diagram 10.1.2e. : Warning sign/notice for LPG cylinder installation

Diagram 10.1.3d.(1) : LPG cylinder installation for eating outlets

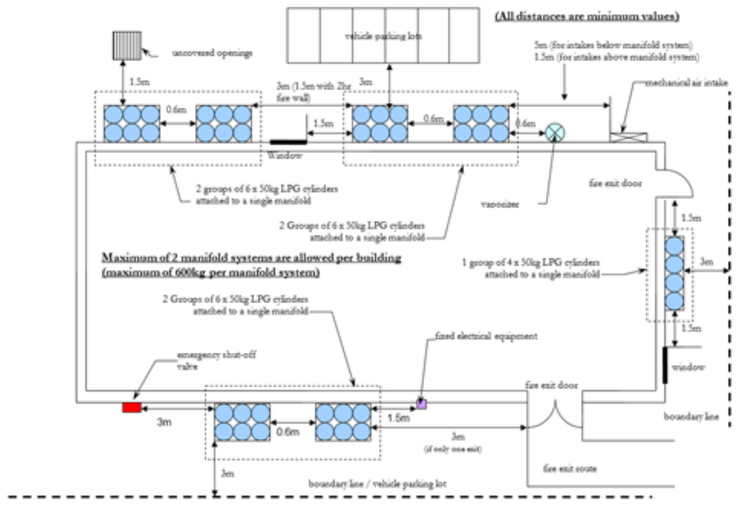


Diagram 10.1.3d.(1) : LPG cylinder installation for eating outlets

Diagram 10.1.3d.(2) : LPG cylinder installation for industrial applications

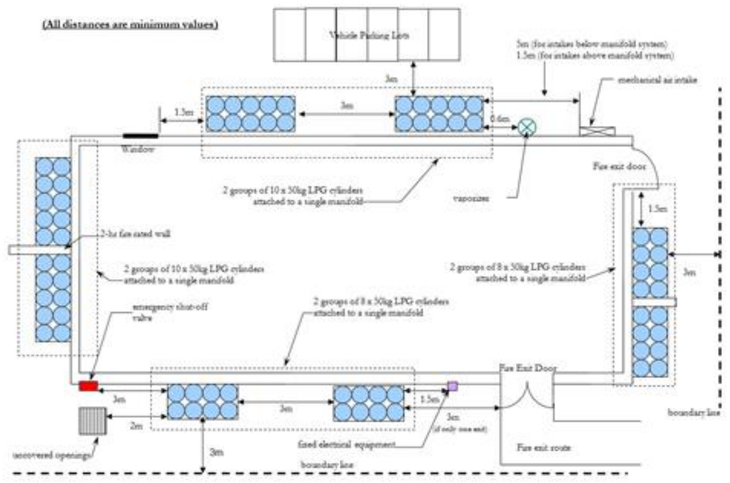


Diagram 10.1.3d.(2) : LPG cylinder installation for industrial applications

Diagram 10.1.4c. : Indoor LPG cylinder installation in separate compartment

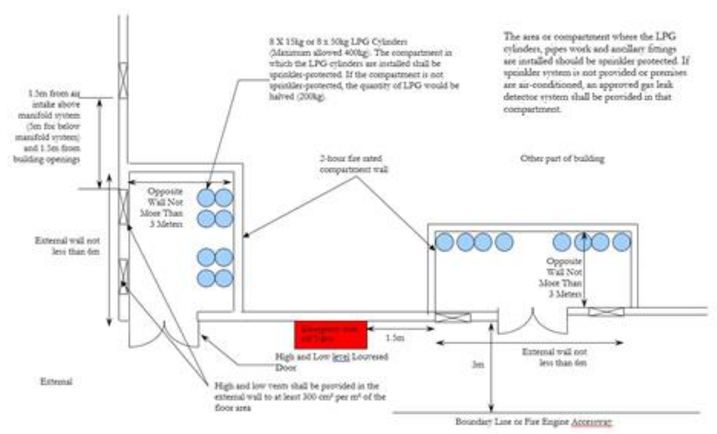


Diagram 10.1.4c. : Indoor LPG cylinder installation in separate compartment

Diagram 10.1.4d. : LPG cylinder installation in recessed area

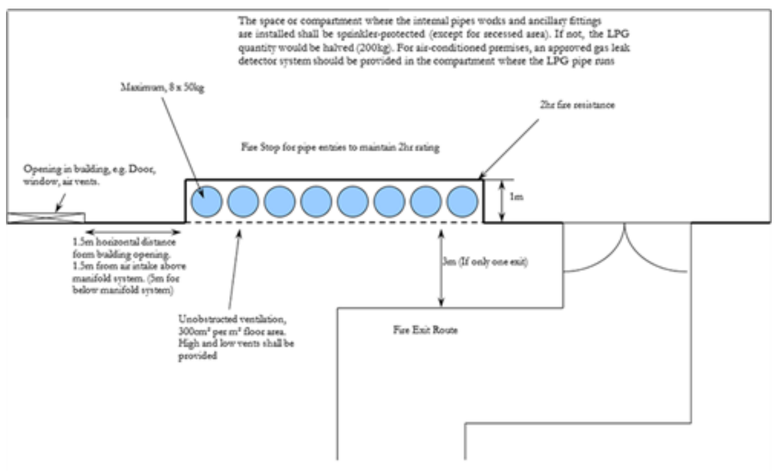


Diagram 10.1.4d. : LPG cylinder installation in recessed area

TABLE 10.1A : VARIOUS DISTANCES FOR OUTDOOR LPG INSTALLATIONS

TABLE 10.1A : VARIOUS DISTANCES FOR OUTDOOR LPG INSTALLATIONS											
LPG quantity	**Distance from boundary**	**No. of cabinets per manifold**	**No. of cylinders per cabinet / cluster**	**No. of cylinders per manifold**	**Distance between cabinet / cluster**	**Distance from drains, pit, manhole, oil tank bund wall, basement opening etc.**	**Distance from fire exit route**	**Horizontal distance from windows, doors, vents, balance flue outlets, etc.**	**Distance from mechanical air intake**	**Distance between manifold systems**	**Distance from vehicle parking lot**
(kg)	**(m)**	**(no.)**	**(no.)**	**(no.)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**	**(m)**
Not more than 600kg	3m minimum	2 maximum	6 maximum	12 maximum	0.6m minimum	1.5m minimum	3m min. (one exit only) 1.5m min. (more than one exit)	1.5 minimum	5m min. (intakes be low manifold system) 1.5m min. (intakes above manifold system)	3m min. (no fire-rated wall) 1.5m min. (with 2-hr fire-rated wall)	3m minimum
600kg to 1000kg (industrial applications only)	3m minimum	2 maximum	10 maximum	20 maximum	3m minimum or 2-hr fire-rated wall	2m minimum	3m min. (one exit only) 1.5m min (more than one exit)	1.5m minimum	5m min. (intakes be low manifold system) 1.5m min. (intakes above manifold system)	6 min. (no fire-rated wall) 3m min. (with 2-hr fire-rated wall)	3m minimum

TABLE 10.1B : TECHNICAL DETAILS FOR INDOOR LPG INSTALLATIONS

TABLE 10.1B : TECHNICAL DETAILS FOR INDOOR LPG INSTALLATIONS								
Location of LPG	**Quantity Allowed (kg)**	**Fire rating of compartment (hr)**	**Distance from Open flame, ignition source (m)**	**Sprinkler / Gas Leak detector**	**Natural Ventilation**	**Mechanical Ventilation (m^3/min)**	**Distance from exits (m)**	**Min. Dist. Of discharge from mech. air intake (m)**
Separate Compartment	400kg. max. (8 x 50kg or 8 x 15kg) Maximum 8 cylinders	2	Not applicable	Sprinkler required else only max 200kg of LPG is allowed If no sprinkler or if air-conditioned, gas leak detector is required	a) 300cm^2 opening per m^2 of compartment floor area b) high and low vents shall be provided c) min. length of external wall 6m	0.3 per meter square of compartment floor area	1.5m	1.5m min. (intakes above manifold system) 5m min. (intakes be low manifold system)
Recessed Area	400kg. max. (8 x 50kg or 8 x 15kg) Maximum 8 cylinders	2	3	Sprinkler required (excluding recessed area) else only max 200kg of LPG is allowed If no sprinkler or if air-conditioned, gas leak detector is required (excluding recessed area)	a) 300cm^2 opening per m^2 of compartment floor area b) high and low vents shall be provided	Not applicable	3m if only one exit, otherwise 1.5m	1.5m min. (intake above manifold system) 5m min. (intakes be low manifold system)

CLAUSE 10.2 SOLAR PHOTO-VOLTAIC (PV) INSTALLATION

10.2.1 Roof-mounted PV installations

a. General

This set of fire safety requirements shall be applicable to roof-mounted PV installations. For PV installations on the roof of PG I buildings, the requirements are stipulated in *Cl.9.1.1d.*

b. Means of access

(1) For access to PV installations on the roof (excluding non-PV areas), at least one exit staircase shall be provided. Where the area is large and one-way travel distance to the exit cannot be met, an additional cat ladder or ship ladder adequately separated from the exit staircase, in accordance with Cl.2.2.11 and leading to the circulation area of the floor below shall be provided, except for the following:

(a) Single storey buildings with roof height not more than 12m or any buildings with inaccessible pitched roof up to 24m from grade level are required to provide a portable sturdy ladder or cat/ ship ladder. If there is a fire engine access road serving roof height not more than 12m or fire engine accessway serving inaccessible pitched roof exceeding 12m and up to 24m is provided, access to PV installation is not required.

(b) External/ open-sided overhead bridge/ shed/ linkway/ walkway with clear width not more than 6m, roof height not more than 12m and without any commercial activities.

(2) For buildings where plans submission on the installation of PVs on the roof level was made on or before 16 June 2016, the provision of single exit staircase is not required. Instead, a cat/ship ladder to provide access to the roof shall be provided.

(3) The computation of travel distance for roof areas which are open to the sky for any purpose group can be based on the requirement for sprinkler-protected compartments/buildings.

(4) All access hatches, if provided, shall be readily accessible from the roof. The access hatch opening shall have a minimum clear width of 1m in diameter.

c. Fire performance of PV modules

(1) PV modules shall meet a minimum of Class C for both spread of flame and burning brand tests, in accordance with *IEC 61730-2*.

(2) System components associated with the PV modules, such as wirings and switchboard assemblies, shall comply with the installation requirements as stipulated in *SS 638*.

d. Design and installation criteria

(1) Each array of a PV installation shall not exceed the maximum dimensions of 60m x 40m.

(2) A clearance of 3m around the access/ hatch opening and exit doors shall be provided.

(3) Access aisles of minimum clear width of 1.5m shall be provided such that no part of any PV array is more than 20m from any of them. PV arrays may extend to the roof edge, provided that all portions of the array are within 20m of an access aisle. Where the access aisle abuts the edge of the roof, the clear width of the access aisle shall be at least 2.5m unless a perimeter parapet/ railing is provided to prevent fall from height by the authority having jurisdiction. For buildings with roof height not exceeding 24m, access aisles along the roof perimeter may be omitted where the perimeter faces a fire engine accessway.

(4) Storages or services located below PV arrays excluding those stated under *Cl.10.2.1b.(1)(b)*, shall be separated from the PV arrays as follows:

(a) For sprinkler-protected space below arrays, a non-combustible separation shall be provided.

(b) For sprinkler-protected space below arrays, if the PV modules comply with *Cl.10.2.2b.*, no separation is required.

(c) For non-sprinkler-protected space below arrays, a 1-hr fire-rated separation shall be provided.

Exception:

A non-combustible separation can be used in lieu of 1-hr fire-rated separation for the following:

(i) PV installation on roof of PG VI except high hazard occupancy stated in Cl.1.4.68, with a minimum height of 4m measured between the vehicle access level/ highest habitable floor and the average roof level, or

(ii) PV installation on roof of PG VIII, except high hazard occupancy stated in Cl.1.4.68, with a minimum height of 8m measured between the vehicle access level/ highest habitable floor level and the average roof level, or

(iii) Buildings, except high hazard occupancy stated in Cl.1.4.68, shall be protected with an automatic fire alarm system compliant with *SS 645*, and the PV modules shall be installed at least 200mm above the finished roof level, or

(iv) PV modules shall comply with *Cl.10.2.1c.* with its outer layers constructed of glass or non-combustible material, and shall be installed at least 200mm above the finished roof level of buildings, except high hazard occupancy stated in Cl.1.4.68, or

(v) PV modules comply with *Cl.10.2.2b*.

(5) PV modules, wirings, switchboard assemblies and other equipment shall not cover and have a minimum horizontal clearance of 500mm from any ventilation system on the roof (e.g., smoke control/ extraction systems or air well) and skylight.

(See *Diagram 10.2.1d.*)

e. Emergency disconnection

(1) Manual emergency shut-off system for the disconnection of the PV modules shall be provided on both the AC-power side (typically where inverters are placed) and the switch room side.

(2) Operating instructions for the emergency shut off system shall be placed at a height of between 1.5m to 2m from the finished floor level and clearly displayed near to the emergency shut-off system.

(3) Simplified site plan with the position of PV modules and system circuit diagrams shall be placed at a height of between 1.5m to 2m from the finished floor level and displayed close to the access openings or the exit staircase from the roof.

10.2.2 Wall-mounted PV installations

a. General

This set of fire safety requirements shall be applicable to wall-mounted PV installations.

b. Fire performance of PV modules

(1) PV modules shall comply with all of the following requirements:

(a) the outer layers shall be constructed of glass or non-combustible material;

(b) a minimum of Class B with Fire Growth Rate (FIGRA) ≤ 70 W/s under *EN 13501-1*;

(c) a minimum of Class A for both spread of flame and burning brand for Module Safety Tests (MST) 23 (fire test), in accordance with *IEC 61730-2*;

(d) at least a pass for MST 22 (hot spot endurance test), MST 25 (bypass diode thermal test) and MST 26 (reverse current overload test), in accordance with *IEC 61730-2*;

(e) Junction boxes shall comply with *IEC 61730-1* for glow wire test and achieve flammability class V-1 for outer accessible parts, flammability class HB for inner parts, flammability class 5V on the end-product and the result is assessed in accordance with flammability class 5VB; and

(f) Cables used shall comply with *IEC 61730-1* for vertical flame propagation.

(2) System components associated with the PV modules, such as wirings and switchboard assemblies, shall comply with the installation requirements as stipulated in *SS 638*.

c. Design and installation criteria

(1) PV installations shall comply with all of the following:

(a) PV installations shall be mounted on external walls of at least 1-hr fire resistance.

(b) PV installations shall be installed at least 5m vertically above grade level. Alternatively, PV installations can be installed 3m above grade level, if a 1-hr fire-rated horizontal projection that extends at least 600mm from the building is installed beneath the PV installation.

(c) PV installations shall be installed away from any unprotected openings, or combustible material/ construction within 1.5m horizontally or within 3m vertically, or adjacent to or facing it. Alternatively, the 3m vertical separation can be exempted if a 1-hr fire-rated horizontal projection that extends at least 600mm from the building is installed between the PV installation and the unprotected opening.

(d) PV installations located adjacent to exit staircases shall comply with *Cl.2.3.3a.(3)* or *Cl.2.3.3b.(2)(b)*.

(e) Only components (i.e., cables, junction box, etc.) serving the PV installations are allowed to be run between the PV modules and the external wall.

(f) All cables and related components shall be housed in a non-combustible conduit. The positive and negative DC cables shall be installed in separate containments.

d. Emergency disconnection

(1) Manual emergency shut-off system for the disconnection of the PV modules shall be provided on both the AC-power side (typically where inverters are placed) and the switch room side.

(2) Operating instructions for the emergency shut-off system shall be placed at a height of between 1.5m to 2m from the finished floor level and clearly displayed near to the emergency shut-off system.

(3) A simplified site plan with the position of PV modules and system circuit diagrams shall be placed at a height between 1.5m to 2m from the finished floor level and displayed close to the switch room or FCC, if applicable.

10.2.3 Wall-integrated PV installations

a. General

This set of fire safety requirements shall be applicable to wall-integrated PV installations, where PV is integrated into the building such as windows or curtain walls.

b. Fire performance of PV modules

PV modules shall be in accordance with *Cl.10.2.2b.*.

c. Design and installation criteria

PV installation shall comply with the following:

(1) All spaces abutting/ facing PV installations shall be fully protected by an automatic sprinkler system or automatic fire extinguishing system, unless they comply with all of the following conditions:

(a) the building does not exceed 12m in habitable height;

(b) the building is protected by an automatic fire alarm system compliant with *SS 645*; and

(c) the building does not contain healthcare occupancy (inpatient).

(2) PV installation located adjacent to exit staircases shall comply with the *Cl.2.3.3a.(3)* or *Cl.2.3.3b.(2)(b)*.

(3) All cables and related components shall be housed in a non-combustible conduit. The positive and negative DC cables shall be installed in separate containments.

(4) The opening occurring at the junction between the edge of a structural floor and the wall-integrated PV shall be sealed to prevent the spread of smoke and flame from the lower floor to the upper floor via the opening. Fire stopping materials for sealing the openings shall have the same fire resistance rating as the elements of structure.

d. Emergency disconnection

Emergency disconnection of the PV modules, it shall be in accordance with *Cl.10.2.2d.*

Diagram 10.2.1d. : Roof-mounted PV Installation Criteria

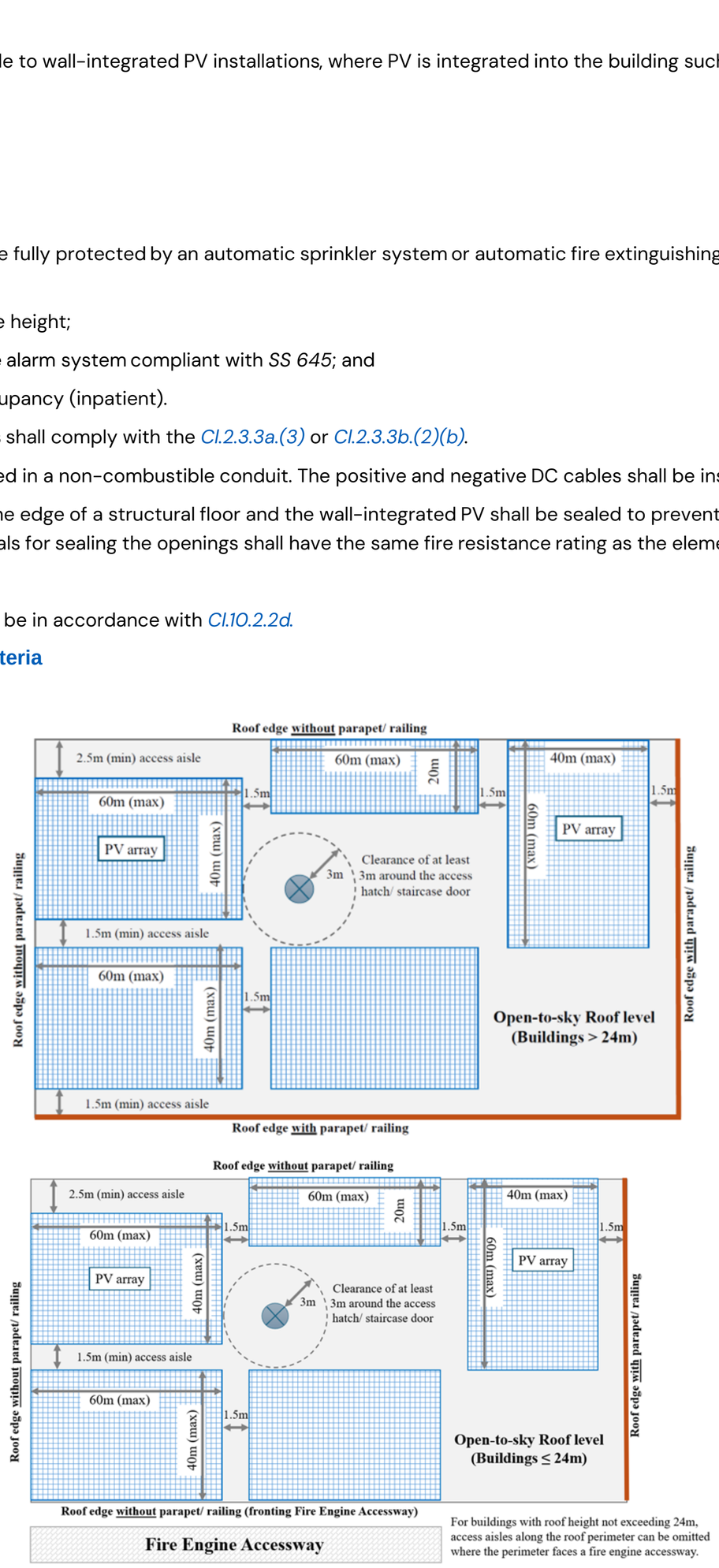


Diagram 10.2.1d. : Roof-mounted PV Installation Criteria

CLAUSE 10.3 ENERGY STORAGE SYSTEMS

Energy Storage System (ESS) refers to one or more devices, assembled together, capable of storing energy in order to supply electrical energy.

10.3.1 Aboveground ESS installation

a. This set of fire safety requirements applies to ESS which supply electrical energy at a future time to the local power loads, to the utility grid, or for grid support. It shall apply to ESS installations where the total stored energy exceeds the Threshold Stored Energy listed in Table 10.3.1 below.

b. All Energy Storage System installations shall be located at the same storey as the fire engine accessway/ fire engine access road.

Exception:

(1) Where the compartmented ESS room is located above the fire engine accessway/ fire engine access road level, prior approval from the SCDF is required. In such cases, the following shall also be met:

(a) ESS units shall be subjected to the fire and explosion testing specified under *UL 9540A*.

(b) NFPA 855 Hazard Mitigation analysis report shall be submitted to SCDF for approval.

c. Each compartmented ESS room shall not exceed 100m^2.

d. The allowable Maximum Stored Energy for the various battery technologies in each compartment shall be as listed in Table 10.3.1.

Exception:

(1) Where the compartmented ESS room exceeded the maximum stored energy as stipulated in Table 10.3.1, prior approval from the SCDF is required. Requirements shall comply with *Cl.10.3.1b.(1)(a) & (b)*.

TABLE 10.3.1: STORED ENERGY CAPACITY OF ENERGY STORAGE SYSTEM

Type	Threshold Stored Energy a (kWh)	Maximum Stored Energy a (kWh)
Lead-acid batteries, all types	70	600
Nickel batteries b	70	600
Lithium-ion batteries, all types	20	600
Sodium nickel chloride batteries	20	600
Flow batteries c	20	600
Other batteries technologies	10	200

Note:

a It shall refer to an aggregated stored energy capacity per compartment. For battery rating in Amp-Hours, kWh is equal to maximum rated voltage multiplied by amp-hr rating divided by 1000.

b Nickel battery technologies include nickel cadmium (Ni-Cad), nickel metal hydride (Ni-MH), and nickel zinc (Ni-Zn).

c Includes vanadium, zinc-bromine, polysulfide-bromide, and other flowing electrolyte-type technologies.

e. Fire protection system

(1) Each compartmented ESS room shall be protected by a sprinkler system classified under high hazard occupancy with a minimum discharge density of 12.2mm/min and area of operation of up to 230m^2 in accordance with the *SS CP 52*.

(2) Each ESS unit shall be housed in open rack under direct and full coverage of sprinklers.

f. Detection and ventilation system

(1) A smoke purging system with air circulation of at least 9 air changes per hour or higher shall be provided for each compartmented ESS room based on the worst-case scenario.

(2) Each compartmented ESS room shall be provided with smoke detectors in accordance with *SS 645* and smoke purging system shall be activated upon detection.

(3) A dedicated flammable gas detection system shall be provided for each compartmented ESS room to continuously monitor and limit the maximum flammable gases concentration to below 25% of Lower Explosive Limit (LEL) by activation of the smoke purging system.

g. A display panel showing the location and temperature reading status of the affected ESS unit shall be located at the main entrance of each compartmented ESS room. Thermocouple reading for each compartmented ESS room shall be provided as a means for firefighters to identify if the fire has been effectively extinguished. No point in the compartmented ESS room shall exceed 10m from a thermocouple.

h. Pressure relief provision

Each compartmented ESS room shall be designed with adequate ventilation or pressure relief vent to avoid any excessive built-up of pressure due to the spontaneous ignition of combustible gases. Either one of the following shall be provided:

(1) Explosion prevention systems designed, installed, operated, maintained, and tested in accordance with *NFPA 69*.

(2) Deflagration venting installed and maintained in accordance with *NFPA 68*.

i. Battery management system

Battery management system (BMS) shall be provided for monitoring operating conditions and maintaining voltages, currents, and temperatures within the manufacturer's specifications. The BMS shall remotely isolate the ESS or affected components of the ESS or place the system in a safe condition if potentially hazardous conditions are detected. BMS shall be evaluated for functional safety performance according to relevant internationally recognized standards such as *UL 1973* or equivalent standards approved by the SCDF.

j. Emergency main isolation switch

(1) A clearly identified and easily accessible switch or circuit breaker (isolation shut-off switch) shall be provided to cut-off the power supply of individual ESS unit.

(2) An emergency main isolation shut-off switch shall be provided outside the entrance of the compartmented ESS room, to cut-off power supply of all the ESS units of the affected compartmented ESS room.

k. Firefighting access

(1) To facilitate the deployment of unmanned firefighting equipment, the minimum clear path of at least 1.2m in width shall be provided for exit access door, exit door, exit staircase and corridor serving the compartmented ESS room.

(2) An access path of minimum width of 1.2m to every ESS unit shall be provided and the maximum distance measured from the door to the most remote ESS unit shall not exceed 8m.

10.3.2 Temporary Energy Storage System installation on construction sites

ESS installation on construction sites shall be located outdoors and comply with all the following requirements:

a. *Cl.10.3.1d.* on compartmentation shall be applicable;

b. All ESS installations shall be located at the ground level and sited close to the boundary line adjacent to any public road or any internal driveway that is accessible by firefighting appliances. If the ESS is sited more than 100m away from the public road, a private hydrant shall be provided;

c. ESS installation shall be protected and locked against tampering and accidental damage by non-combustible fencing of height not less than 1.8m;

d. Setback distance of 3m measured between the ESS installation and the fencing shall be provided. No combustible items shall be located within this 3m separation space;

e. Approved types of fire extinguishers of at least 2 numbers of 55A shall be provided;

f. An approved fire extinguishing system effective against ESS fire, shall be provided; and

g. Ventilation requirement for ESS installation shall be in accordance with Cl.7.1.15.

10.3.3 Basement ESS installation

Basement ESS installation shall be subdivided into two categories as follows:

a. Category 1: Small underground ESS installation having the following requirements:

(1) *Cl.10.3.1a.* on maximum stored energy capacity shall be in accordance with *Cl.10.3.3.a.(5)* & *Cl.10.3.3.b.(4)*, respectively.

(2) *Cl.10.3.1b.* on location shall not be applicable. ESS units is permitted to be located in basement not exceeding a depth of 9m below the fire engine accessway/ fire engine access road level.

(3) The requirements of compartmentation shall be applicable as specified in *Cl.10.3.1c.*

(4) Each compartmented ESS room shall not exceed 25m^2.

(5) Maximum Stored Energy in Table 10.3.1 shall not be applicable. Instead, the following shall apply:

(a) Batteries forming an ESS unit of up to 50kWh is permitted.

(b) Aggregate maximum stored energy of 250kWh comprising multiple ESS units within a single compartment room is permitted provided each ESS unit is spaced a minimum of 1m apart from each other, 1m from walls within the compartmented room and other fire hazards. Where the stored energy capacity or separation distance of the unit exceed the limit, it shall be subjected to the fire and explosion testing specified under *UL 9540A* and together with the *NFPA 855* Hazard Mitigation Analysis report to be submitted to SCDF for approval.

(c) Aggregate maximum stored energy of 500kWh comprising multiple compartment rooms is permitted.

(6) Fire protection system

(a) Each compartmented ESS room shall be protected by a sprinkler system classified under high hazard occupancy with a minimum discharge density of 12.2mm/min and areas of operation of 230m^2 in accordance with the *SS CP 52*.

(b) All ESS units shall be housed in open rack under direct and full coverage of sprinklers.

(c) Each compartmented ESS room shall be provided with smoke detectors in accordance with *SS 645* and smoke purging system shall be activated upon detections.

(7) A dedicated flammable gas detection system shall be provided for each compartmented ESS room to continuously monitor the flammable gases concentration and upon activation of the ventilation system, to limit the maximum concentration of the flammable gases to below 25% lower explosion limit (LEL) within the compartmented ESS room. Smoke purging system shall be activated upon detection.

(8) A display panel showing the location, temperature and flammable gases reading status of the affected ESS unit shall be located at the main entrance of each compartmented ESS room. It shall be connected to the SCDF Operations Centre through an approved alarm monitoring company. Thermocouple reading for each compartmented ESS room shall be provided as a means for firefighters to identify if the fire has been effectively extinguished. No point in the compartmented ESS room shall exceed 10m from a thermocouple.

(9) CCTV cameras with thermal imaging capabilities and full coverage of the entire compartmented ESS room shall be installed to facilitate situational awareness for the authorised personnel overseeing the situation. It shall be connected to the SCDF Operations Centre through an approved alarm monitoring company. Alarm signals and live video images of fire and/ or smoke captured shall be transmitted to the approved alarm monitoring company upon activation of the building fire alarm system.

(10) Pressure relief provision

Each compartmented ESS room shall be designed with pressure relief vent to avoid any excessive built-up of pressure due to the spontaneous ignition of combustible gases. Either one of the following shall be provided:

(a) Explosion prevention systems designed, installed, operated, maintained, and tested in accordance with *NFPA 69*.

(b) Deflagration venting installed and maintained in accordance with *NFPA 68*.

(11) Smoke purging system

The smoke purging system to be provided for the compartmented ESS room shall be in accordance with *Cl.7.4.3.*

(12) Battery management system

Battery management system (BMS) shall be provided for monitoring operating conditions and maintaining voltages, currents, and temperatures within the manufacturer's specifications. The BMS shall remotely isolate the ESS or affected components of the ESS or place the system in a safe condition if potentially hazardous conditions are detected. BMS shall be evaluated for functional safety performance according to relevant internationally recognized standards such as UL 1973 or equivalent standards approved by the SCDF.

(13) Emergency main isolation switch

(a) A clearly identified and easily accessible switch or circuit breaker (main isolation shut-off switch) shall be provided to cut-off the power supply of individual ESS unit.

(b) An emergency main isolation shut-off switch shall be provided outside the entrance of the compartmented ESS room, to cut-off power supply of all the ESS units of the affected compartmented ESS room.

(14) Firefighting access

To facilitate the deployment of unmanned firefighting equipment, exit staircase with at least 1.2m clear width and located within 10m measured from the nearest edge of the compartmented ESS room exit access door to the exit staircase door shall be provided. For any change of direction along the access path from the exit staircase to the compartmented ESS room, directional signages shall be provided with a letter height of at least 50mm.

b. Category 2: Large underground ESS installation shall be in accordance with *Cl.10.3.3a.* unless otherwise stated below:

(1) Premises with public accommodation purpose shall not be sited above ESS premises. Premises with ESS installation shall be segregated from other usage. For any routes linking to the ESS installation shall be through:

(a) an external corridor complying with Cl.2.3.10, or

(b) a protected lobby separated from the adjoining areas of the building by a wall and door of at least 1-hr fire resistance rating. The protected lobby shall have a minimum size of 4m (length) x 2m (width) and ventilated in accordance with *Cl.2.2.13b.(7)(a) or (b)*.

(2) For ESS unit with stored energy capacity exceeding 50kWh, it shall be housed within a 2-hr fire-rated containerised compartment except the deflagration opening(s) located at least 2m above finished floor level.

(3) Containerised ESS units shall be housed within a compartmented ESS room with a minimum 2-hr fire resistance rating and area not exceeding 100m^2.

(4) Aggregate maximum stored energy of 600kWh comprising multiple containerised ESS units within a single compartment room is permitted provided each containerised ESS unit is spaced a minimum of 3m apart from each other, 1m from walls within the compartmented room and other fire hazards.

(5) There shall not be more than 2 compartmented ESS rooms, unless otherwise permitted under *Cl.10.3.3b.(11)*.

(6) Each containerised ESS unit shall be subjected to the fire and explosion testing specified under *UL 9540A* and together with the *NFPA 855* Hazard Mitigation Analysis report to be submitted to SCDF for approval.

(7) Fire protection system

(a) Each compartmented ESS room shall be protected by a zoned wet deluge system with a minimum discharge density of 7.5mm/min and areas of operation of 230m^2 in accordance with the *SS CP 52*.

(b) Each containerised ESS unit shall be served by an independent wet deluge system with a minimum discharge density of 12.2mm/min and provided with a breeching inlet to allow direct charging of water supply to the main control valve.

(8) Ventilation and detection system

(a) A dedicated flammable gas detection system shall be provided for each containerised ESS unit to monitor the flammable gases concentration and upon activation of the ventilation system, to limit the maximum concentration of the flammable gases to below 25% lower explosion limit (LEL) within the ESS installation.

(b) Upon activation of flammable gas detection system, a dedicated mechanical ventilation system with air circulation of at least 9 air changes per hour or higher shall be provided for each containerised ESS unit based on the worst-case scenario specified under *UL 9540A* test and subjected to SCDF's approval.

(c) The smoke purging system to be provided for the compartmented ESS room shall be in accordance with *Cl.7.4.3*.

(d) Each compartmented ESS room shall be provided with smoke detectors in accordance with *SS 645* and smoke purging system shall be activated upon detection.

(9) A display panel showing the location, temperature and flammable gases reading status of the affected containerised ESS unit shall be located at the main entrance of each compartmented ESS room. It shall be connected to the SCDF Operations Centre through an approved alarm monitoring company. Thermocouple reading for each compartmented ESS room shall be provided as a means for firefighters to identify if the fire has been effectively extinguished. No point in the compartmented ESS room shall exceed 10m from a thermocouple.

(10) Firefighting access

(a) For compartmented ESS room, the following shall be provided:

(i) The fire lift shall be contained within a protected shaft, constructed to comply with the relevant requirements under Cl.3.8.

(ii) The fire lift car specifications:

• Minimum clear platform size of 3m (depth) x 3m (width).
• Minimum loading capacity of 3 tonnes.

(iii) Each fire lift shall be served by a fire lift lobby with a minimum size of at least 4m (length) x 5m (width).

(iv) Corridors and door openings serving the fire lift lobby, firefighter staging lobby and compartmented ESS rooms shall be at least 3m in clear width.

(v) An access path of minimum width of 3m to every ESS unit shall be provided and the maximum distance measured from the door to the most remote ESS unit shall not exceed 8m.

(vi) Firefighter staging lobby shall not serve more than 2 compartmented ESS rooms.

(vii) Any entrance to the compartmented ESS room shall be served by a firefighter staging lobby and shall comply with the following requirements:

• at least 12m² working space and with minimum clear width of 4m.
• fire lift lobbies in accordance with *Cl.2.2.13b.(1) to (3), (5) to (6) and (7)(b).*
• installed with designated rising mains.
• provided with two nos. of standby fire hoses.
• provided with portable 50kg AB (foam or chemical powder) type fire extinguishers having minimum 6m throw and discharge hose length of minimum 6m shall be provided.

(11) Prior approval from the SCDF is required in situations where the number of compartmented ESS room exceeds 2, in addition to the following:

(a) Comply with the requirements in accordance with *Cl.10.3.3b.(6)*.

(b) Provision of on-site Unmanned Firefighting Machine (UFM) within the fire lift lobby. The UFM shall comply with the following general specifications and subjected to the SCDF's approval:

• Minimum dimensions: 2m x 1.1m x 2m
• Minimum weight: 1.75 tonnes
• Design flow rate for monitor: 1800L/min
• Monitor throw distance: up to 60m in length
• Wireless transmission: range of up to 300m
• Ventilation capacity: 90000m^3/h

(c) A holding area of 2m x 3m for UFM shall be provided in addition to the fire lift lobby of area 20m^2.

10.3.4 Battery Swap Station

a. General

Battery Swap Station (BSS) is a facility where swappable detachable batteries of motor vehicles are available for motorists to exchange their depleted batteries. Battery charge and swap stations are EV chargers that are used for charging and exchanging depleted swappable detachable batteries, while battery store and swap stations only contain stored detachable batteries.

b. Aboveground installations

(1) BSS installations shall be located at the same storey as the fire engine accessway/ fire engine access road.

(2) BSS shall be located at vehicle parking areas that are naturally ventilated in accordance with Cl.3.2.8 *or* provided with mechanical ventilation in accordance with Cl.6.4.5.

Exception:

(a) BSS that abuts an external wall of building and is installed away from any unprotected openings, exits or combustible material/ construction within 1.5m horizontally or within 3m vertically, or adjacent to or facing it.

c. Underground installations

(1) BSS is allowed to be located within basement carparks protected by mechanical ventilation in accordance with Cl.6.4.5 and automatic sprinkler system in accordance with *Cl.6.4.1d.*.

(2) The maximum allowable depth shall not exceed 9m below the average grade level, and not more than one level below grade level.

d. Aggregate stored energy capacity

(1) Aboveground installations

Aggregate stored energy capacity of each BSS unit shall not exceed 20kWh. Where more than 1 BSS unit is installed, a minimum separation distance of 3m between BSS units shall be provided and the total aggregate stored energy capacity of all BSS units shall not exceed 100kWh.

(2) Underground installations

Aggregate stored energy capacity of BSS within basement carparks shall not exceed 10kWh.

e. Fire safety requirements

(1) BSS units shall be located at least 6m away from the nearest edge of exit staircase/ fire lift lobby/ smoke-free lobby.

(2) BSS units shall be located at least 1m away from:

(a) Non-essential equipment rooms; and

(b) Parking lots (excluding the lots used for swapping of batteries).

(3) Approved types of fire extinguishers of at least 2 numbers of 55A shall be provided.

(4) Emergency isolation shut-off switch shall be provided at each BSS unit.

(5) BSS installation at petrol service stations shall comply with specifications stipulated under *Cl.9.6.2v.(3)*.

CLAUSE 10.4 ELECTRIC VEHICLE (EV) CHARGING INSTALLATION

Note: Cl.10.4 is omitted as these requirements are specified in the First Schedule of the "Electric Vehicles Charging (Electric Vehicle Chargers) Regulations 2023" https://sso.agc.gov.sg//SL/EVCA2022-S786-2023

~~10.4.1 General~~

~~The requirements in Cl.10.4.2are exempted for PG I buildings.~~

~~10.4.2 Emergency main isolation shut-off switches~~

~~a. Each EV charging station shall be provided with at least one emergency main isolation shut-off switch(es) located such that no person need to travel more than 15m from the EV charging station and its parking lot(s) to reach a main isolation shut-off switch.~~

~~b. If more than one EV charging station is provided, the main isolation shut-off switch(es) shall be provided such that no person need to travel more than 15m from any EV charging station and its associated parking lot(s) to reach a main isolation shut-off switch.~~

~~c. Main isolation switch(es) shall be located on the same storey as the EV charging station(s) they serve. The purpose of such main isolation shut-off switch(es) is to provide a safe means of isolating the main electrical power supply to the entire EV charging system on the same storey.~~

~~d. Every EV charging stations and EV parking lots shall be located at least 3m away from the nearest edge of any main isolation shut-off switches.~~

Exception

~~Main isolation shut-off switches can be allowed to be less than 3m from an EV charging station and its parking lot(s), as long as there is at least one other main isolation shut-off switch located at least 3m away but still within 15m of this EV charging station and its parking lot(s).~~

~~e. Main isolation shut-off switches shall be located between 800mm and 1.2m above the finished floor level and shall be located in a clearly visible and easily accessible location.~~

~~f. All main isolation shut-off switches shall be clearly labelled. Clear instructions shall be indicated on how to operate the main isolation shut-off switch. Signages shall be provided with a letter height of at least 50mm.~~

~~g. Where main isolation shut-off switch(es) cannot be seen clearly or not within line of sight from the EV charging station and its parking lot(s), additional signages shall be provided to direct persons to the main isolation shut-off switch(es).~~

ANNEX 10.1A

A1.0 STANDARDS

The following standards for LPG cylinders and ancillary fittings shall be complied with:

TABLE 1 : STANDARDS FOR LPG CYLINDERS & FITTINGS		
S/N	**ITEM**	**STANDARDS**
1	Cylinder	SS 99
2	Cylinder Fittings	SS 233
	a) Flexible Hose	
	b) Regulator	SS 281, BS 3016, UL144
	c) Cylinder valve	SS 294
3	Gas Leak Detector	BS EN 60079-29-1 and BS EN 600179-14

A2.0 SPECIFICATIONS

A2.1 LPG Cylinder Fittings

a. Flexible hoses

(1) Hoses or flexible connectors used to supply LPG to utilization equipment or appliances shall be installed in accordance with the relevant clauses of *NFPA 54* and *NFPA 58*. The hose shall be securely connected to the appliance. The use of rubber slip ends without hose clips shall not be permitted for domestic cylinders.

(2) Hoses shall be tested and passed the performance criteria in accordance with *SS 233*.

b. Regulators

Regulators shall comply with the standards as specified in the table above.

c. Over pressure protection device

(1) An over pressure protection device is a device to protect the downstream installation and shut off the gas flow if the outlet pressure exceeds the set limit.

(2) In general, a regulator with over pressure protection device shall be designed to achieve the following:

(a) ensuring reliable and continuous supply of LPG;

(b) protecting downstream system against over pressure; and

(c) protecting against failure of any regulating device.

(3) Setting of over pressure protection device shall not be more than 30% of maximum operating pressure.

d. Valves

(1) Cylinder valves

Cylinder valves shall comply with the standards as specified in the table above.

(2) Safety valves

(a) Hydrostatic relief valves designed to relieve the hydrostatic pressure that might develop in sections of liquid piping between two isolating valves shall be installed in each section. Hydrostatic valves shall comply with *UL 132*, Standard for Pressure Relief Valves for LPG.

(b) Emergency shut-off valve shall be provided after the knockout pot. The emergency shut-off valve shall be linked to a release mechanism so that the valve can be closed from a safe distance of at least 3m from the LPG cylinders. The emergency shut-off valve may incorporate fusible element which melts at not more than 250° when exposed to fire, allowing the emergency shut- off valve to close by itself.

(c) An accessible gas shutoff valve shall be provided at the upstream of each gas pressure regulator. Where two gas pressure regulators are installed in series in a single gas line, a manual valve shall not be required at the second regulator.

(d) Main gas shut-off valves controlling several gas piping systems shall be prominent and readily accessible for operation and properly installed so as to protect it from physical damage. They shall be marked with a metal tag or other permanent means attached by the installing agency so that the gas piping systems supplied through them can be readily identified.

(e) An exterior shut-off valve to permit turning off the gas supply to each building in an emergency shall be provided and plainly marked.

e. Piping

(1) Pipe design and specifications shall be in accordance with the relevant clauses in *NFPA 54* and *NFPA 58*. No polyethylene material is allowed to be used for the piping system except for necessary industrial applications.

(2) Pipe material shall be tested and certified according to recognised ASTM or British Standard. The pipe supplier shall produce Mill certificates.

(3) The manifold and main LPG supply pipeline shall be welded together as far as practicable. Welders for the piping work must be qualified and certified by a recognised body.

(4) Pipelines pressure test shall be witnessed and certified by a Professional Engineer (Mechanical).

(5) The liquid LPG pipelines shall be painted in “Blue” and the vapour LPG pipelines in “Yellow” with the marking of the word “LP-Gas” at intervals of not more than 3m.

(6) When connecting additional gas utilisation equipment to a gas piping system, the existing piping shall be checked to determine if it has adequate capacity. If inadequate, the existing system shall be enlarged as required, or separate gas equipment of adequate capacity shall be provided.

f. Pigtail

(1) Pigtail shall include a 6mm flexible hose or tube, a 6mm tee-check valve or excess flow valve and a 6mm ball valve.

(2) Flexible hose shall be fabricated of materials resistant to LPG reaction both in liquid and vapour state. It shall be designed for a minimum bursting pressure of 1750 psi (121 bar) and working pressure of 350 psi (24 bar). The hose shall be marked “LPG” at intervals of not more than 3m.

(3) The tee-check valve shall be Underwriters Laboratories Inc. (UL) listed or it shall comply with other recognised/ approved standard.

(4) The ball valve shall be rated to at least 600 psi (41 bar).

g. Pressure gauge

(1) Each bank of LPG cylinder manifold shall have a pressure gauge.

(2) For high-pressure section, the gauge shall have a range of 0 to 300 psi (0 to 20.1 bar)

(3) For low-pressure section, the gauge shall have a range of 0 to 50 psi (0 to 3.45 bar)

h. Vaporiser

(1) Vaporisers, where applicable, shall be constructed in accordance with the applicable provision of *NFPA 58*, ASME Code or other recognised pressure vessel Codes and Standards for a design pressure of 250 psi (17.24 bar) and shall be permanently and legibly marked with:

(a) markings required by the Code;

(b) the allowable working pressure and temperature for which it is designed; and

(c) the name or symbol of the manufacturer.

(2) Vaporisers shall be provided with a suitable automatic means to prevent the passage of liquid through the vaporiser to the vapour discharge piping. This feature shall be permitted to be integrated with the vaporiser or otherwise provided in the external piping.

(3) Vaporisers shall have a manual shut-off valve and an automated valve (e.g., thermostatic, magnetic or float) which closes in the event of power failure or overload.

(4) Vaporisers shall have relevant temperature control and the necessary safety features.

(5) Vaporisers shall have a pressure relief valve set at 250 psi (17.24 bar) with the release point directed upward.

i. <u>Knock-out pot</u>

The knockout pot shall have at least two drain valves. The drain shall end at ground level and plugged at the end.

j. <u>Gas meters</u>

(1) Installation and application of gas meters shall be in accordance with the relevant clauses in *NFPA 54* and shall be able to take a pressure of 20 psi (1 psi = 6.895 kPa).

(2) Gas meters shall be selected for the maximum expected pressure and permissible pressure drop.

(3) Vapour meters of the tin or brass case type of soldered construction shall not be used at pressure in excess of 1 psi (7 kPa).

(4) Vapour meters of the die cast or iron case type shall be permitted to be used at any pressure equal to or less than the working pressure for which they are designed and marked.

(5) Gas meters shall be located in ventilated spaces readily accessible for examination, reading, replacement or necessary maintenance.

(6) Gas meters shall not be placed where they will be subjected to damage, such as adjacent to a driveway, under a fire escape, in public passages, halls or where they will be subjected to excessive corrosion or vibration.

(7) Gas meters shall be located at least 1m from sources of ignition.

(8) Gas meters shall not be located where they will be subjected to extreme temperatures or sudden extreme changes in temperature. Meters shall not be located in areas where they are subjected to temperatures beyond those recommended by the manufacturer.

(9) Gas meters shall be supported or connected to rigid piping so as not to exert a strain on the meters.

(10) Gas meters shall be protected against over pressure, back pressure, and vacuum, where such conditions are anticipated.

k. <u>Strainers</u>

Strainers shall be designed to minimise the possibility of particulate materials clogging lines and damaging meters or regulators. The strainer element shall be accessible for cleaning.

A2.2 Electrical bonding and grounding

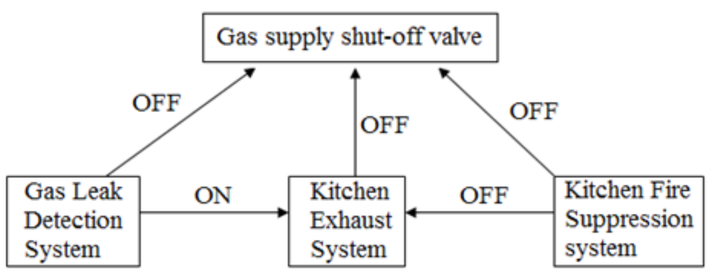
a. Electrical circuits shall not utilise gas piping or components as conductors.

b. All electrical connections between wiring and electrically operated control devices in a piping system shall conform to the requirements of *SS 254*.

c. Any essential safety control (in the vaporiser) depending on electrical current as the operating medium shall be of a type that will shut off (fail safe) the flow of gas in the event of current failure.

A2.3 Gas leak detection

a. Gas leak detectors shall be connected to a localised alert alarm, emergency shut- off valve as well as the kitchen exhaust systems. The gas supply safety shut-off valve system shall also be interlocking with the kitchen automatic fire suppression system. See diagram below.



b. LPG pipe installation shall not be permitted in the following areas:

(1) in the ground under concrete flooring within building;

(2) under building under building foundations;

(3) within lift shafts and cavity walls;

(4) in compartments or ducts dedicated for electrical switchgears, transformers or air-conditioning ducts;

(5) in refrigeration chambers, coldrooms, air handling rooms and ventilation or other hazardous materials;

(6) adjacent to pipes and vessels containing flammable, oxidizing, corrosive and other hazardous materials; and

(7) in fire lift lobby, FCC, smoke-free lobbies, fire pump rooms, firefighting water tank rooms, sprinkler control valve rooms, riser ducts, areas of refuge, protected corridors, exit staircases, bedrooms and other occupied area, etc.

c. Proper metal pipe sleeve shall be installed for the gas pipes running in enclosed non-ventilated areas or basement floor, and at least one end exposed directly to the exterior open safe space (it can be used to facilitate the gas leak detection system).

d. Gas pipe running vertically shall be enclosed within a protected riser shaft and be fully fire separated from other M&E risers. Ventilation opening shall be provided for such gas riser

~~ANNEX 10.1B~~

(Refer to the 3rd batch of amendments to the Fire Code dated 3 March 2025. Under *Clause 10.1.1b*, the reference to *Annex 10.1B* has been replaced with *Clause 10.1.4*. Thus, *Annex 10.1B* is deleted.)

~~B1.0 DEFINITION~~

~~a.~~ **~~Eating outlet~~**

~~"Eating outlet" refers to shop unit/ units operated as food outlet, food court, eating place, restaurant, hawker centre or coffee shop.~~

~~b.~~ **~~Food stall~~**

~~"Food stall" refers to stall operated by independent operator within an eating outlet.~~

~~B2.0 GENERAL REQUIREMENTS~~

~~All eating outlets shall not use or store LPG cylinders within building unless all of the following conditions are fulfilled:~~

~~a. The eating outlet is located on or above ground level.~~

~~b. The eating outlet is naturally ventilated.~~

~~B3.0 ALLOWABLE QUANTITY~~

~~a. The maximum allowable quantity of LPG shall be limited to 2 x 15kg cylinders (including standby cylinder) per food stall.~~

~~b. The total capacity for each eating outlet shall not be more than 200kg.~~

~~B4.0 FIRE SAFETY REQUIREMENTS~~

~~B4.1 Compartmentation~~

~~a. The eating outlet shall be separated by fire-resistant walls (1-hr fire resisting rating for sprinkler-protected building and 2-hr for non-sprinkler-protected building) from other areas.~~

~~b. Stalls within food court or coffee shop shall be separated from each other with 1-hr fire-resisting side-walls.~~

~~B4.2 Connection of LPG cylinders~~

~~Each cylinder shall be connected to cooking hob/stove with flexible hose. The LPG cylinders shall not be connected together with manifold system.~~

~~B4.3 LPG cabinet~~

~~a. LPG cylinders shall be housed in a 2.5mm thick steel cabinet. There shall be not more than 2 x 15kg cylinders in each cabinet.~~

~~b. The cabinet shall be placed directly on a firm floor.~~

~~c. The cabinet shall be adequately ventilated with openings at the bottom of the cabinet.~~

~~d. The cabinet shall always be kept free of any combustible materials.~~

~~B4.4 Gas leak detection system~~

~~a. Gas-leak detection system (see *Cl.A2.3* of *Annex 10.1A*) shall be provided (be supplied directly from the building electrical power supply). The system shall be linked to shut off the LPG supply automatically and activate local alert alarm. The gas-leak detector shall be located at low level and near to the possible leak areas such as the connecting hoses, LPG cylinder cabinets, etc.~~

~~b. If kitchen automatic fire suppression system is provided, it shall also be linked to shut off the LPG supply automatically.~~

Amendment History - Chapter 10 - Requirements for Special Installations

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
10.1.1 to 10.1.4		Immediate	Relocated from Appendix 13 of Fire Code 2013		--
10.1.1b.	3 Mar 2025	3 Sep 2025	Clarification/ Revised	10.1.1b. All LPG cylinder installations shall be located outdoors and on the ground levels for all commercial and industrial buildings. Locating LPG cylinders indoor is normally not permitted, unless otherwise approved by the SCDF under special circumstances (See Annex 10.1B).	3 Sep 2025
10.1.1e.(4)(b)	1 Mar 2023	1 Mar 2023	Revised/Clarifications	Locations of ancillary fixtures and fittings, e.g. vaporiser, regulators, emergency shut-off valve, change-over valves, remote cut-off device, knock-out pot, pipe entries, etc..	1 Sep 2022
10.2.1	1 Sep 2021	1 Mar 2022	Revised/ Clarification	General This set of fire safety requirements shall be applicable to roof-mounted PV installations.	1 Sep 2021
10.2.1d.(4)	3 Mar 2025	3 Sep 2025	Relaxation/ Revised	10.2.1 Roof-mounted PV installations d. Design and installation criteria (4) Storages or services located below PV arrays excluding those stated under Cl.10.2.1b.(1)(b), shall be separated from the PV arrays as follows: (a) For sprinkler-protected space below arrays, a non-combustible separation shall be provided. (b) For sprinkler-protected space below arrays, if the PV modules comply with Cl.10.2.2b., no separation is required. (c) For non-sprinkler-protected space below arrays, a 1-hr fire-rated separation shall be provided. (d) For non-sprinkler-protected space below arrays, if the PV modules comply with Cl.10.2.2b., a non-combustible separation shall be provided. (5) PV modules, wirings, switchboard assemblies and other equipment shall not cover any ventilation system on the roof (e.g., smoke control/ extraction systems or air well). (See Diagram 10.2.1.d.)	3 Sep 2025
10.2.2	1 Sep 2021	1 Mar 2022	Revised/ Clarification	Means of access a. For PV installations on the roof, at least one exit staircase shall be provided. Where the area of non-habitable roof is large and one-way travel distance to the exit cannot be met, an additional cat ladder or ship ladder adequately separated from the exit staircase, in accordance with Cl.2.3.12 and leading to the circulation area of the floor below shall be provided. b. For existing buildings which are carrying out the installation of PVs on the roof level where the provision of single exit staircase is not feasible, a portable sturdy ladder to the roof access shall be provided. Single storey buildings with roof height not more than 12m or inaccessible pitched roof up to 24m from grade level are not required to provide a sturdy ladder, if there is a fire engine accessway fronting this installation. c. The computation of travel distance for roof areas which are open to the sky for any purpose group (except PG I) can be based on the requirement for sprinkler-protected compartments/ buildings. d. All access hatches, if provided, shall be readily accessible from the roof. The access hatch opening shall have a minimum clear width of 1m in diameter.	1 Sep 2021
10.2.3	1 Mar 2024	1 Mar 2024	New	Nil	25 Aug 2023
10.3	2 Dec 2019	1 June 2020	New		2 Dec 2019
10.3.1	1 Sep 2025	1 Mar 2026	Revised	10.3.1 Aboveground ESS installation a. at a future time to the local power loads, to the utility grid, or for grid support. It shall apply to ESS installations where the total stored energy exceeds the Threshold Stored Energy listed in Table 10.3.1 below b. fire engine accessway/ fire engine access road. c. The allowable Maximum Stored Energy for the various battery technologies in each compartment shall be as listed in Table 10.3.1.	1 Sep 2025
10.3.2	1 Mar 2023	1 Mar 2023	New	Nil	1 Sep 2022
10.3.3	2 Mar 2025	2 Mar 2025	New	Nil	2 Sep 2025
10.3.4	2 Mar 2025	2 Mar 2025	Nil	New	2 Sep 2024
10.4	1 Sep 2021	1 Mar 2022	New	Nil	1 Sep 2021
10.4 (dated 2 Sep 2024)	2 Sep 2024	2 Sep 2024	Clarification	Cl.10.4 is omitted as these requirements are specified in the First Schedule of the "Electric Vehicles Charging (Electric Vehicle Chargers) Regulations 2023" https://sso.agc.gov.sg//SL/EVCA2022-S786-2023	2 Sep 2024
Chapter 10	1 Dec 2020	1 Dec 2020	Clarification	CHAPTER 10 REQUIREMENTS FOR SPECIAL INSTALLATIONS	1 Dec 2020

CLAUSE 11.1 GENERAL

This Chapter stipulates requirements relating to the certification of building materials and equipment regulated by SCDF under the Product Listing Scheme. These requirements include the acceptable test standards, certification schemes and surveillance regimes for these regulated fire safety products and materials (referred to as “products” for simplicity) (refer to *Table 11A*), as well as the duties required of the various parties involved in the certification process. For the full list of requirements, this Chapter shall be read in conjunction with the Fire Safety Act (FSA) and its subsidiary legislations, as well as CT 12 of SAC’s “Criteria for Product Certification Bodies (Regulated Fire Safety Products)”.

CLAUSE 11.2 DEFINITION

11.2.1 Accredited certification body

“Accredited certification body” (CB) refers to a body corporate or corporation incorporated or constituted under the law of Singapore, accredited under the Singapore Accreditation Council (SAC)’s certification body accreditation scheme administered by the Enterprise Singapore Board.

11.2.2 Accredited laboratory

“Accredited laboratory” refers to a body corporate or corporation providing laboratory testing services, which is accredited under SAC’s laboratory accreditation scheme administered by the Enterprise Singapore Board, or recognised under the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Agreement/ Arrangement between Singapore and other countries.

11.2.3 Certificate of Conformity (CoC)

“Certificate of Conformity” refers to a certificate issued by CBs for a regulated fire safety product that meets product testing standards and certification requirements. These certified products shall be recorded in a product directory on the CB’s website for reference and verification of the CoCs’ validity.

11.2.4 Declaration of Compliance

“Declaration of Compliance” refers to a declaration of information associated with or related to a batch of certified regulated fire safety products. DoCs serve a similar purpose as serial labels, and are issued for non-discrete systems, such as fire-rated ceilings and fire-rated floors. Refer to *Table 11A* for products that require DoCs.

11.2.5 Discrete system

“Discrete system” refers to a regulated fire safety product on which it is physically practicable and/or effective to affix a product label for identification purposes. Such products include fire doors, landing valves, and fire extinguishers.

11.2.6 Local representative

“Local representative” refers to the Singapore-registered agent/ partner appointed by a foreign CoC holder, in order for its certified regulated fire safety products to be supplied in Singapore.

11.2.7 Mutual Recognition Arrangement/Agreement (MRA)

“Mutual Recognition Arrangement” or “Mutual Recognition Agreement” refers to the arrangements signed between SAC and other international assessment bodies, which mutually recognise reports and certificates issued by an accredited Conformity Assessment Body (CAB) as equivalent to their own accreditation requirements.

11.2.8 Non-discrete system

“Non-discrete system” refers to a regulated fire safety product on which it is not physically practicable or effective to affix a product label, for example on walls, floors and cables. Suppliers are instead issued with DoC certificates for these products.

11.2.9 Product Listing Scheme (PLS)

“Product listing scheme” refers to the third party certification scheme administered by SCDF for regulated fire safety products.

11.2.10 Scheme Type 1b (Scheme 1b)

“Scheme Type 1b” consists of type testing of a sample of a production. Every subsequent batch shall also be tested or inspected. Refer to *Table 11A* for the test requirements.

11.2.11 Scheme Type 2 (Scheme 2)

“Scheme Type 2” consists of type testing of a sample during initial certification, and subsequent surveillance testing of samples from the market (i.e., warehouse, project site, etc.) to check that items produced fulfil the specified requirements.

11.2.12 Scheme Type 5 (Scheme 5)

“Scheme Type 5” consists of type testing and factory inspection during initial certification, and ongoing assessment of the entire quality management system, including auditing the production process and management system. Surveillance testing of the product is done either from the market or at the point of production, or both, to check that items produced fulfil the specified requirements.

11.2.13 Serial label

“Serial label” refers to a certification label issued by CBs, with unique serial numbers. These are affixed to certified regulated fire safety products categorised as discrete systems, such as fire-rated doors and fire alarm panels. Such labels allow tracing of these products to their corresponding CoC and the specific installation location of each product. Refer to *Table 11A* for products that require serial labels.

11.2.14 Surveillance window

'Surveillance window”, also known as “surveillance cycle”, refers to the period of 12, 36 or 60 months (depending on product category, as stipulated in *Table 11A*), starting the date that a CoC is issued in relation to a regulated fire safety product, and every subsequent period of 12, 36 or 60 months or shorter, if the CoC expires, or is terminated or withdrawn. Products may be subject to post-certification testing and/or inspections, based on the surveillance window.

11.2.15 Suspension of CoC

“Suspension of CoC” refers to the temporary invalidation of a CoC by a CB under circumstances not limited to the following:

a. Non-compliance to any component of the surveillance regime;

b. Products are suspected to not meet fire safety requirements, but are still in the process of being tested/ investigated; and

c. CoC holder breaching the CB’s terms and conditions (including non-payment of fees).

11.2.16 Termination of CoC

“Termination of CoC” refers to the cancellation of a CoC, either on the request of the CoC holder before its expiry, or due to reasons not related to fire safety. Examples of such circumstances include:

a. CoC holder ceases to supply the product due to business considerations (e.g., shutting down of business/undergoes liquidation); and

b. CoC holder fails to take adequate rectification measures within the given timeframe, despite being suspended for a breach in the CB’s terms and conditions (including non-payment of fees).

11.2.17 Type testing

“Type testing”, also known as prototype testing, refers to testing of a product according to the test standard(s) for that product for the application of CoC, as specified in *Table 11A*.

11.2.18 Withdrawal of CoC

“Withdrawal of CoC” refers to the cancellation of a CoC by the CB under circumstances not limited to the following:

a. Non-compliance with the requirements of the Product Listing Scheme, including:

(1) regulated fire safety product that is supplied to the industry differs from the prototype described in the CoC and laboratory test report;

(2) misuse of certification mark, logo and certificates; and

(3) supply of products from a factory. which differs from the factory declared during the CoC application.

b. Failure to take adequate rectification measures within the given timeframe, despite being suspended for a fire-safety-related non-compliance, or

c. Non-compliance that indicates failure of production process to consistently produce products of acceptable quality, including:

(1) failure or refusal of test/analysis of the product; and

(2) the surveillance regime is not completed within the surveillance window.

d. Other reasons related to fire safety.

CLAUSE 11.3 ASSESSMENT AND VALIDATION

11.3.1 General

All regulated fire safety products shall be certified and have valid CoCs before they can be used on/in buildings as part of fire safety works in Singapore (henceforth, for the purpose of this Chapter, "use in Singapore" shall be taken to mean "on/in buildings as part of fire safety works in Singapore").

11.3.2 Age of test reports for regulated fire safety products

Certification of regulated fire safety products under the Product Listing Scheme shall be based on test report(s) that were issued within the specified timeframes, as listed below.

Certification Scheme (with reference to Table 11A)		**Age of Test Reports that can be Considered for Issuance of CoC**
Scheme 1b		Less than 5 years
Scheme 2	Discrete systems	Less than 5 years
	Non-discrete systems	Less than 10 years
Scheme 5	Discrete systems	Less than 5 years
	Non-discrete systems	Less than 10 years

11.3.3 Validity of CoC for regulated fire safety product

a. A valid CoC is as defined under Part V of the FSA.

b. A CoC for regulated fire safety products is valid for 5 years from the date of issuance.

c. A CoC which is terminated, expired or withdrawn shall be considered permanently invalid, whereas a CoC which is suspended shall be considered temporarily invalid till the suspension is lifted.

d. The status of the CoC will determine whether the regulated fire safety products are permitted to be supplied and used in Singapore. Information relating to the CoCs, including the status, can be verified against CBs' online directories.

(1) For products with valid CoCs at the date of delivery to the project site, i.e. not suspended, terminated, expired or withdrawn, these are permitted to be used in Singapore.

(2) For products with CoCs that are not valid on the date of delivery to the project site, i.e. suspended, terminated, expired or withdrawn, usage of these products in Singapore is prohibited.

(3) Notwithstanding (1), for products with CoCs that were valid on the date of delivery, but are subsequently withdrawn, usage of the affected batches of such products in Singapore is subject to further assessment and investigation by SCDF and/or the CBs.

(4) Notwithstanding (1), for products with CoCs that were valid on the date of delivery, but are subsequently suspended for fire safety reasons, e.g. pending investigation, it is not recommended that such products be used, as the investigation may show that the products are non-compliant and cannot be used (e.g. products that have been installed will need to be replaced/removed).

(5) CBs shall not allow the termination of a CoC which is suspended for fire safety reasons, or which is under investigation by SCDF.

11.3.4 Accreditation requirements

a. Regulated fire safety products used in fire safety works shall be certified by a local certification body accredited by SAC.

b. Regulated fire safety products shall be accompanied by test reports from testing laboratories accredited by SAC or recognised by SAC via the International Laboratory Accreditation Cooperation (ILAC) MRA.

c. Any new CB participating in the PLS shall notify SCDF, in writing, of its accreditation by SAC, and submit its Certificate of Accreditation and Schedule issued by SAC for SCDF's record. SCDF may request for additional information from the CB.

11.3.5 Certification requirements

a. General requirements

CoCs issued for products intended for use in Singapore shall bear SAC's accreditation mark.

b. Information submitted for new CoC applications

The following information, at minimum, shall be submitted to a CB for application of a CoC. Where the information/documents are not provided in English, an official English translation, endorsed by a Notary Public, shall also be provided:

(1) CoC applicant details, including:

(a) Unique Entity Number (UEN) issued by the Accounting and Corporate Regulatory Authority (ACRA), or foreign equivalent, where applicable;

(b) Full names of the company directors, or equivalent;

(c) Name, address, contact number and email address of the company;

(d) Where the applicant is a foreign company, the details of the appointed local representative, for parts (1)(a) through (1)(c) shall also be included; and

(e) Proof of partnership between the local representative and foreign CoC holder.

(2) Manufacturer's details, for all of the manufacturing plants of components of the regulated fire safety product affecting fire safety, including:

(a) Country, name, address, contact number and email address of the manufacturer.

(3) Certification scheme details, including:

(a) Product category as classified under *Table 11A*; and

(b) Certification scheme, according to Cl 11.2.10 – 11.2.12.

(4) Product details, including:

(a) Brand and model, as determined by the manufacturer;

(b) Density and weight, where applicable, measured in kg/m^3 and kg, respectively;

(c) Dimensions, where applicable, measured in mm; and

(d) Latest product catalogue stipulating the specifications and user instructions.

(5) Details of type tests, including:

(a) The reference number of the test report;

(b) Test standards (including version of the test standard, i.e. year) which the product is tested to;

(c) Description of the product component and manner of test, where applicable (e.g. tested with the core face exposed to heat);

(d) Outcome of the test, in terms of fire performance (e.g. 60-min integrity), where applicable;

(e) Insulation test results, where applicable; and

(f) Integrity test results, where applicable.

c. Documents submitted for new CoC applications - The following documents shall also be submitted for CoC applications:

(1) Test reports, including the full type test reports and other test(s) required by the CB (e.g. material tests), which shall be:

(a) In full colour; and

(b) Bear the brand and model of the regulated fire safety product.

(2) For each test report, the credentials of the accredited laboratory which issued the test report, including:

(a) Documentation that the test laboratory is accredited by SAC or recognised by SAC via ILAC MRA and

(b) The accreditation scope indicating the test laboratory is accredited to perform such a test.

d. Information and documents submitted for renewal of CoC.

CoC holders shall submit the information stipulated in Cl 11.3.5b.(1) and (2) and provide the date of issue of the very first CoC that had been issued for the product (i.e. “Original date of issue”). The CB shall make an assessment on whether there is a need to submit information stipulated in Cl 11.3.5b.(3) – (5), as well as documents stipulated in Cl 11.3.5c.(1) and (2). CB may require submission of any further information/documents as it deems fit.

CLAUSE 11.4 FIRE SAFETY PRODUCT LABELS

11.4.1 Display of CoC information on CoCs and CB directories

a. Information displayed on CoC

(1) In addition to the information stipulated in *Cl.11.3.5b.*, the CoC shall display the following information:

(a) CoC reference number;

(b) Date of issue for the present CoC (i.e. date of the latest renewal of the CoC);

(c) Date of expiry for the present CoC;

(d) In the case of revisions made to a CoC, a summary of the key changes shall be reflected in the appendix of the CoC; and

(e) In the case of renewed CoCs, the reference number of the CoC immediately prior to the present one (i.e. "Previous CoC number") shall be indicated on the new CoC, in brackets under the new number.

(2) Notwithstanding *Cl.11.4.1a.(1),* the following information shall not be displayed on the CoC:

(a) Full names of the company directors, or equivalent, of the CoC holder and local representative;

(b) Contact number and email address of the CoC holder and local representative;

(c) Proof of partnership between the local representative and foreign CoC holder;

(d) Manufacturer's name, address, contact number and email address; and

(e) Latest product catalogue stipulating the specifications and user instructions.

b. Information displayed on CB online directory

(1) The following information relating to all CoCs that have been issued and are still valid; and CoCs which were terminated, withdrawn or which expired in the past 5 years, shall be displayed on the CBs' online directories that are accessible by the general public:

(a) CoC reference number;

(b) The reference number of the CoC immediately prior to the present one (i.e., "Previous CoC number");

(c) Date of issue for the present CoC (date of the latest renewal of the CoC);

(d) Date of expiry for the present CoC;

(e) CoC holder details, including:

(i) Accounting and Corporate Regulatory Authority (ACRA) Company Unique Entity Number (UEN), or foreign equivalent, where applicable;

(ii) Company name and address; and

(iii) Where the applicant is a foreign company, the details of the appointed local representative, for parts (i) and (ii) shall also be included.

(f) Country of manufacture;

(g) Product category;

(h) Certification scheme, according to *Cl.11.2.10 – Cl.11.2.12;*

(i) Brand and model, as determined by the manufacturer;

(j) Product description as printed on the CoC;

(k) Test reference number(s), as printed on the CoC;

(l) Test standard (incl. year) the product is tested to; and

(m) Product's fire performance (e.g., 60 min integrity and 60 min insulation), where applicable; and

(n) The present status of CoCs certified by CBs shall be published on CBs' online directories, with the following information:

(i) The statuses shall reflect one of the following classifications: "valid"; "suspended (fire safety reasons)" (e.g., non-completion of surveillance regime); "suspended (not fire safety reasons)" (e.g., non-payment of fees); "terminated"; "expired" or "withdrawn";

(ii) the effective date of the present status shall be indicated; and

(iii) any changes in status of CoCs shall be updated within 5 working days.

(2) The online directories shall be accessible at all times; in the event of downtime such as server error, the CB shall write to SCDF and SAC within 24 hours, to

(a) Notify the authorities of the downtime; and

(b) Detail the actions being taken to rectify the issue.

11.4.2 Renewal of CoCs

The following requirements apply for the renewal of a CoC:

a. Prior to expiry of the CoC, a recertification review shall be conducted before CB can renew the CoC.

b. The renewed CoC is valid for 5 years, commencing the day after the expiry date of the previous CoC. For illustration, a CoC with expiry date on 15 Oct 2020, when renewed, would have a new issue date of 16 Oct 2020, and an expiry date of 15 Oct 2025.

11.4.3 Transfer of CoCs between CBs

a. Transfer of CoC between CBs is only allowed for CoCs that are still valid. Valid CoCs are those that are not expired, withdrawn, terminated or suspended.

b. In addition to the requirements in Cl.11.3.5, subject to *Cl.11.4.3c.*, the following documents shall be submitted to the new CB:

(1) Present CoC;

(2) Declaration from the CoC holder that the current CoC is valid;

(3) Signed declaration from the previous CB that there are no outstanding issues that require rectification (e.g., failed/ missed surveillance tests, pending investigations by SCDF, etc.);

(4) Type test reports;

(5) Additional test reports (if applicable); and

(6) All records of surveillance regime reports for testing and inspections that have been completed for the currently valid CoC.

Note: Items (3) and (6) shall be provided directly from one CB to another.

c. For transfer of CoCs, type test reports submitted as stipulated in *Cl 11.4.3b.* can be the same test report that was submitted when applying for the present CoC, unless otherwise directed by the CB.

d. For transfer of CoCs, the new CB may permit CoCs previously certified to Scheme 5 to be changed to Scheme 1b, provided the surveillance regime requirements (i.e., surveillance tests over multiple years and current surveillance window) have been fulfilled.

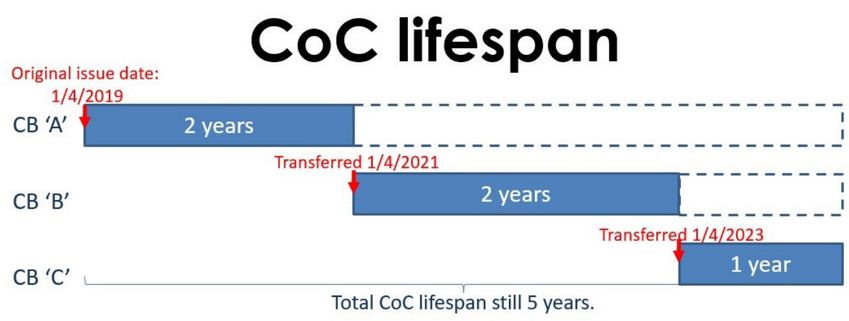
e. If the surveillance regime for that surveillance window has not been completed, transfer of CoCs are not allowed:

(1) Within the final 6 months of a surveillance window, or

(2) If there is at least 6 months left to the end of the surveillance window, but the new CB determines there is insufficient time to complete the surveillance regime prior to the lapse of the surveillance window.

f. Once the intention to transfer CoC has been indicated to the current CB, the said CB shall stop issuing labels or DoCs for the product.

g. The validity of the transferred CoC shall be limited to the remaining lifespan of the recently-valid CoC.



h. The new CB with which the CoC is held shall comply with the following, in addition to the certification requirements as stipulated in *Cl 11.3.5*:

(1) The new CB shall ensure the brand, model, manufacturing site and test standards of the regulated fire safety product is the same as that of the previous CoC; and

(2) The surveillance window for the transferred CoC shall be determined with reference to the CoC's original issue date.

11.4.4 Certification of regulated fire safety products with multiple CBs

a. Where a CoC holder wishes to list their product with multiple CBs, the applicant shall declare the status of certification held with the present CB(s), for verification by the new CB.

b. For regulated fire safety products with existing valid CoC(s) with other CB(s), application for a CoC from a new CB shall be treated as a new application, and comply with requirements in *Cl 11.3.5*. The existence of CoCs for the same products (valid or otherwise) issued by other CBs does not change how the new CB should certify the product, similar to how it would certify any new regulated fire safety product.

c. The results from surveillance tests conducted by a CB shall not be used by another CB to fulfil the surveillance regime requirements for the same product. However, the same surveillance test results may be used by another CB to fulfil the surveillance regime requirements for the same product, provided all of the following minimum requirements are complied with:

(1) The surveillance test is conducted within the surveillance window for all the CoCs the test is intended to fulfil;

(2) The product manufacturer, composition, fire seal, design and fire rating are identical;

(3) Each of the CBs which had issued a CoC for the product -

(a) are agreeable to the terms and methodology of the sampling, including the choice of sample and test laboratory, sampling location, sampling methodology; and

(b) witness the sampling of the product, and ensure the chain-of-custody when delivering the product to the test laboratory.

11.4.5 Conduct of surveillance regime

a. The CB shall remind the CoC holders to complete their surveillance tests, if yet to be completed, 6 months and 3 months prior to the end of the surveillance window.

b. Where sampling is required, the CB shall select the sample for the surveillance test/inspection.

c. The CB shall take all reasonable measures to ensure the chain-of-custody of samples meant for surveillance testing. This may include, but not limited to, signing on the sample, ensuring it cannot be tampered with, and verifying the sample has reached the test laboratory.

d. The CB shall immediately suspend the CoC if the necessary surveillance tests/ inspections are not completed within the surveillance window.

e. Surveillance tests are only considered to be completed after the CB has received the surveillance test report, indicating a 'pass' result, or a result meeting the intended performance of the product, as stated in the CoC, from an accredited test laboratory. CoC holders are thus advised not to wait till the last minute to arrange for their surveillance tests.

f. For avoidance of doubt, where surveillance tests are required in *Table 11A*, the first surveillance window commences from the date of issue of the CoC. Test reports submitted for the CoC application do not exempt the product from having to undergo surveillance testing for the first window.

Note: The above table is applicable for products with 1-year surveillance windows. For products with multiple-year windows, this would apply to the final year of the surveillance window.

g. In the case of CoC holders who are sole proprietors, the CB shall verify against the annual submission of ACRA records provided by the CoC holder to ensure that the business licence is renewed. In the event the licence is not renewed, the CoC shall be suspended.

CLAUSE 11.5 INSTALLATION OF REGULATED FIRE SAFETY PRODUCTS

11.5.1 Application for a CoC

a. The party that intends to own the CoC, whether local or foreign, shall submit the application for the CoC.

b. Foreign companies that intend to apply for a CoC to supply regulated fire safety products in Singapore, shall engage a local representative, prior to submitting the application for a CoC.

11.5.2 Duty to notify CB

a. CoC holders, and, where applicable, local representatives, shall inform CBs of any other changes (e.g., CoC holder/ local representative contact information), where the information differs from that submitted during the CoC application.

b. CoC holders and local representatives shall inform CBs of any changes to the product from the prototype that was tested when applying for the CoC.

11.5.3 Duties related to the surveillance regime

CoC holders/ local representatives shall carry out the following in relation to the surveillance regime:

a. Facilitate the conduct of factory inspections and surveillance tests (as stipulated in *Table 11A*), or unscheduled tests required by SCDF or the CB to verify conformity of the products;

b. Make arrangements with the CB on the date/ time of sampling and inspection; and

c. Provide the necessary support for the purpose of the surveillance regime (e.g., fabricating door frame for fire test involving fire-rated doors, ensure availability of samples, provide the relevant information such as location of the relevant samples, as requested by the CB).

11.5.4 Duties related to serial labels and DoCs

With reference to Regulation 10(2)(g) of the Fire Safety (Regulated Fire Safety Products) Regulations 2020, location refers to the exact address, including unit number, where applicable, where the regulated fire safety product is installed.

CLAUSE 11.6 FIRE SAFETY SERIAL LABELS AND DECLARATIONS OF COMPLIANCE

11.6.1 Management of serial labels and DoCs

a. With reference to Regulation 6(2)(b) of the Fire Safety (Regulated Fire Safety Products) Regulations 2020, documentary evidence of the location may include the Purchase Order, Delivery Order, SCDF Notice of Approval, and/ or contractual agreement indicating that the certified regulated fire safety product is or will be installed at the specific location.

b. With reference to Regulation 6(2)(b) of the Fire Safety (Regulated Fire Safety Products) Regulations 2020, the exact address of where each product is installed, including unit number, where applicable, shall be recorded.

c. For regulated fire safety products that are to be issued with DoCs as stipulated in *Table 11A*, every project where that regulated fire safety product is installed shall be issued with a DoC, even if the threshold for site inspection stated in *Table 11A* is not met.

11.6.2 Replacement of serial labels and DoCs

In the event that the serial labels are missing or damaged, a police report shall be lodged before replacement labels can be obtained from the CBs. A copy of this report shall be furnished to the CB, when requesting for replacement of labels. An investigation by the CB shall also be conducted on the nature of the damage and/or loss, with the findings reported to SCDF for accountability.

Exemption: If labels are returned to the CB with the serial numbers still legible, a police report is not required.

11.6.3 Traceability of certified PLS-listed products

a. Serial labels affixed to regulated fire safety products shall be water-proof and tamper-proof, and shall include a Quick Response (QR) code that stores the following information on an online database, which can be read by scanning the QR code:

(1) CoC holder company name;

(2) CoC holder ACRA UEN;

(3) CoC reference number;

(4) Brief product description;

(5) Exact location, including unit number, where applicable, where the regulated fire safety product is installed; and

(6) The status of the label (“valid” or “void”)

Note: The status of the label will be ‘void’ if SCDF detects discrepancies relating to the use of serial labels and digitally voided the serial label.

b. Serial labels for the following products are exempt from the need to have a QR code:

(1) Exit sign;

(2) Emergency lighting (self-contained);

(3) Fire hose reel;

(4) Standby fire hose;

(5) Door closer;

(6) Portable fire extinguisher;

(7) Landing valve; and

(8) Breeching inlet.

c. The following information shall be printed on the label itself:

(1) Product category;

(2) Unique serial number;

(3) CB’s logo or CB’s certification mark; and

(4) Fire rating, where applicable.

CLAUSE 11.7 REQUIREMENTS AND RESPONSIBILITIES FOR QUALIFIED PERSONS

11.7.1 Duty to inspect regulated fire safety products used in fire safety works

With reference to Section 57(5) of the FSA, where fire safety works involve the use of regulated fire safety products, Qualified Persons shall carry out inspections of the fire safety products, including but not limited to, the following:

a. Verify that the regulated fire safety product(s) have valid CoC(s) and that the CoC(s) match exactly with the products used;

b. Verify that the regulated fire safety product(s) are affixed with serial labels, or issued with DoCs, if said products are stipulated to have labels or DoCs issued in *Table 11A*; and

c. Where there are serial labels or DoCs, verify that the serial label affixed on the product, or the DoC issued for the product, are accurate and match exactly with the product.

CLAUSE 11.8 ADDITIONAL REQUIREMENTS FOR SPECIFIC PRODUCTS

In addition to the aforementioned requirements this chapter, the following requirements apply to these specific regulated fire safety products.

11.8.1 Composite panels

a. For composite panels used as cladding, samples of composite panels, except for honeycomb panels, shall be taken from every project site for surveillance testing, as stated in *Table 11A*. If there is no testing from project sites for the surveillance window, the surveillance test is to be conducted annually.

Note: For honeycomb panels, the requirement for testing of samples from project sites as part of the surveillance regime will be introduced at a later stage.

b. For composite panels used as cladding or roofing, CoC holders shall ensure that critical product information is printed on the composite panels, as well as their protective film, for traceability. The printing shall be legible, permanent and conspicuously located, such that the information is readable on each panel. The critical product information shall, at minimum, include:

1. Product brand and model;
2. CoC reference number;
3. Fire performance; and
4. Date of manufacture.

11.8.2 Fire-rated doors

a. Requirements for CoC

(1) The brand, model and test report number of hardware shall be displayed on the CoC, including, but not limited to:

(a) Door closer (excluding surface-mounted door closers and floor springs);
(b) Locks and latches (electromechanically operated);
(c) Door coordinator devices;
(d) Door bolts;
(e) Lever handles and knots;
(f) Mechanical locks and latches;
(g) Emergency exit devices;
(h) Panic exit devices;
(i) Single axis hinges;
(j) Cylinders for locks; and
(k) Mechatronic cylinders.

(2) Fire-rated doors of different fire-ratings shall be issued with separate CoCs (i.e., one CoC for each fire-rating), unless all of the following requirements can be met:

(a) the product manufacturer is identical;
(b) the composition (e.g., construction materials) is identical;
(c) the fire seal (e.g., intumescent seal) is identical;
(d) the design (e.g., vision panel) is identical;
(e) the thickness is at least as thick as the prototype test sample; and
(f) the CB assesses that listing the products together does not compromise the assessment of whether each product is compliant.

For example, if a ½-hr and 1-hr door are both manufactured by the same manufacturer, are of identical composition, fire seal, design, etc. these may be listed together, subject to the CB's assessment that grouping the models does not compromise the assessment of whether each is compliant. However, if the 2-hr model is of a different composition, the 2-hr door should be listed with a separate CoC.

b. Requirements for door closers

(1) Door closers (regardless if concealed, surface-mounted or floor-mounted) shall have their own CoCs.

(2) The 6-digit coding system indicating the performance of the door closer, as stipulated in *EN 1154*, shall be imprinted on the door closer.

(3) The following statement shall be included in the appendix of the CoC:

"For surface-mounted door closers, the selected door closer shall meet the performance requirements needed for the respective fire-rated door, in accordance with SS 332 Cl 6 Annex C.

Surface-mounted door closers tested with uninsulated fire-rated doors can be installed on insulated or uninsulated fire-rated doors (subject to the maximum fire-rating attained by the door closer in a fire test). Surface-mounted door closers tested with insulated fire-rated doors can only be installed on insulated fire-rated doors.

*Floor-mounted door closers (floor spring) shall only be installed on fire-rated doors, subject to the maximum fire-rating attained by the floor spring i*n a fire test."

c. Requirements for digital locksets

(1) Digital locksets shall either be certified together with the door or individually certified with their own CoCs.

(2) Digital locksets tested on uninsulated fire-rated doors can be used on insulated or uninsulated fire-rated doors.

(3) Digital locksets tested on insulated fire-rated doors shall only be used on insulated fire-rated doors, unless otherwise assessed by a test laboratory recognised as stated in *Cl.11.3.4b.*.

(4) Notwithstanding (2) and (3), the fire resistance rating of the digital locksets shall be higher than or equivalent to the fire-rated door.

d. Clustering of surveillance test

The surveillance test result for one CoC for a fire-rated door shall not be used to fulfil the surveillance test requirements of another CoC issued by the same CB, unless all of the following requirements are complied with:

(1) The surveillance test is conducted within the surveillance window for all the CoCs the test is intended to fulfil;

(2) The product manufacturer, composition, fire seal, design and fire rating of the products are identical;

(3) Where the surveillance test is meant to fulfil the surveillance requirements of products with different fire-ratings, the test shall meet the testing requirements of the product with the highest fire rating; and

(4) The CB assesses that the sharing of surveillance tests results does not compromise the assessment of whether each product is compliant.

RELATED TABLES AND DIAGRAMS OF CHAPTER 11

Table 11A: List of Regulated Fire Safety Products & Materials

S/N	Products / Materials	Acceptable Standards	Certification Scheme	Surveillance Regime	
				Testing	Factory/Site Inspection
1.	Fire alarm panel	(a) EN 54-2 and (b) EN 54-4 and (c) SS 645	Scheme 5 (Labels issued)	Scheme 5 – Testing for every 200 labels issued or At least once annually, if fewer than 200 labels issued Testing clauses shall include: Critical electrical (frequency, voltage) input and output; verify design deviation; verify functionality; verify visual & audio indicators)	Scheme 5 – Factory inspection to be conducted at least once annually and Site inspection(s) triggered by certification body (10)
			Scheme 1b (Labels issued)	Scheme 1b – Batch testing Testing clauses shall include: Critical electrical (frequency, voltage) input and output; verify design deviation; verify functionality; verify visual & audio indicators)	Scheme 1b - Batch inspection (11) and Site inspection triggered by certification body for each batch (10)
2.	Home fire alarm device (i.e. smoke detector) (7) (Refer to Cl.6.3.6 for more information)	(a) EN 14604 or AS 3786 or UL 217	Scheme 2	Annual surveillance test for products complying with Cl.6.3.6a.(9)(a) Not applicable for products complying with Cl.6.3.6a.(9)(b)-(e)	Not applicable
3.	Fire pump	(a) AS 2941 or UL 448 or FM 1311 or FM 1319	Scheme 5 (Labels issued)	AS – Annual testing FM/UL – Annual submission of reports shall include surveillance inspection and/or testing	Factory inspection to be conducted at least once annually and Site inspection(s) triggered by certification body (10)
4.	Fire-rated partition (9)	4.1 Compartment wall: (a) BS 476-22 / ASTM E119 with material testing in accordance with BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or EN 1364-1/ ISO 834-8 with material testing in accordance with EN 13501-1 (min. class A2) or AS 1530-4 with material testing in accordance with (i) BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or (ii) EN 13501-1 (min. class A2) if fire resistance test is using plate-thermocouple (b) In the case of Engineered Timber, refer to S/N 38	Scheme 5 (DoCs issued)	Annual surveillance test shall only require material testing, and adopt the same test standards that were adopted for the material testing at the point of CoC listing	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every 3500m²
		4.2 Protected shaft enclosing lift (1): (a) BS 476-22/ ASTM E119 with material testing in accordance with BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or EN 1364-1/ ISO 834-8 with material testing in accordance with EN 13501-1 (min. class A2) or AS 1530-4 with material testing in accordance with (i) BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or (ii) EN 13501-1 (min. class A2) if fire resistance test is using plate-thermocouple and (b) BS 5234-2 and (c) BS EN 520 (for gypsum plaster board) and (d) ISO 1896 (for calcium silicate or cement board) and (e) Cyclic loading & dynamic test as specified under Cl.3.8.7b.(5)	Scheme 5 (DoCs issued)	Annual surveillance test shall only require material testing, and adopt the same test standards that were adopted for the material testing at the point of CoC listing	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every 3500m²
		4.3 Protected shaft enclosing staircase or services: (a) BS 476-22/ ASTM E119 with material testing in accordance with BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or EN 1364-1/ ISO 834-8 with material testing in accordance with EN 13501-1 (min. class A2) or AS 1530-4 with material testing in accordance with (i) BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or (ii) EN 13501-1 (min. class A2) if fire resistance test is using plate-thermocouple and (b) BS 5234-2 and (c) EN 520 (for gypsum plaster board) and (d) ISO 1896 (for calcium silicate or cement board)	Scheme 5 (DoCs issued)	Annual surveillance test shall only require material testing, and adopt the same test standards that were adopted for the material testing at the point of CoC listing	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every 3500m²

5.	Fire-rated floor (9)	(a) BS 476-21 with material testing in accordance with BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2fl) or ISO 834-5 with material testing in accordance with EN 13501-1 (min. class A2fl) or AS 1530-4 with material testing in accordance with (i) BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2fl) or (ii) EN 13501-1 (min. class A2fl) if fire resistance test is using plate-thermocouple (b) In the case of Engineered Timber, refer to S/N 38	Scheme 5 (DoCs issued)	Annual surveillance test shall only require material testing, and adopt the same test standards that were adopted for the material testing at the point of CoC listing	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every 3500m²
6.	Fire-rated ceiling (1) (9)	6.1 Compartmentation: (a) BS 476-22/ ASTM E119 with material testing in accordance with BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or EN 1364-2/ ISO 834-9 with material testing in accordance with EN 13501-1 (min. class A2) or AS 1530-4 with material testing in accordance with (i) BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or ii) EN 13501-1 (min. class A2) if fire resistance test is using plate-thermocouple (b) In the case of Engineered Timber, refer to S/N 38	Scheme 5 (DoCs issued)	Annual surveillance test shall only require material testing, and adopt the same test standards that were adopted for the material testing at the point of CoC listing	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every 3500m²
		6.2 Protection to steel beams that support RC floor: (a) BS 476-23 with material testing in accordance with BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or ISO 834-5 with material testing in accordance with EN 13501-1 (min. class A2) or AS 1530-4 with material testing in accordance with (i) BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or (ii) EN 13501-1 (min. class A2) if fire resistance test is using plate-thermocouple	Scheme 5 (DoCs issued)	Annual surveillance test shall only require material testing, and adopt the same test standards that were adopted for the material testing at the point of CoC listing	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every 3500m²
		6.3 Protection to timber/ steel flooring: (a) BS 476-21 with material testing in accordance with BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or ISO 834-5 with material testing in accordance with EN 13501-1 (min. class A2) or AS 1530-4 with material testing in accordance with (i) BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or (ii) EN 13501-1 (min. class A2) if fire resistance test is using plate-thermocouple	Scheme 5 (DoCs issued)	Annual surveillance test shall only require material testing, and adopt the same test standards that were adopted for the material testing at the point of CoC listing	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every 3500m²

7.	Fire-rated enclosure/ spraying material (1) (9)	7.1. Protection to steel structure (2): (a) EN 13381-4 with material testing in accordance with EN 13501-1 (min. class A2) or BS 476-21 with material testing in accordance with BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or ISO 834-6 & ISO 834-7 with material testing in accordance with EN 13501-1 (min. class A2) or AS 1530-4 with material testing in accordance with (i) BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or (ii) EN 13501-1 (min. class A2) if fire resistance test is using plate-thermocouple and (b) BS 5234-2 and (c) EN 520 (for gypsum plaster board) and (d) ISO 1896 (for calcium silicate or cement board)	Scheme 5 (DoCs issued)	Annual surveillance test shall only require material testing, and adopt the same test standards that were adopted for the material testing at the point of CoC listing	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every 3500m²
		7.2 Protection to firefighting system (3) (i.e. Dry riser pipe, etc.): (a) FSB/PSB/001 with material testing in accordance with BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or AS 1530-4 (Including Pipe insulation criteria on fire side, 500mm from wall, shall not exceed 75^{0}C above the initial temperature) with material testing in accordance with (i) BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or (ii) EN 13501-1 (min. class A2) if fire resistance test is using plate-thermocouple	Scheme 5 (DoCs issued)	Annual surveillance test shall only require material testing, and adopt the same test standards that were adopted for the material testing at the point of CoC listing	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every 3500m²
		7.3 Protection to building service (i.e. cables, sanitary pipes, chilled water pipes, etc.): (a) BS 476-20 with material testing in accordance with BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or AS 1530-4 with material testing in accordance with (i) BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or (ii) EN 13501-1 (min. class A2) if fire resistance test is using plate-thermocouple or ASTM E119 with material testing in accordance with BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or ISO 834-1 with material testing in accordance with EN 13501-1 (min. class A2)	Scheme 5 (DoCs issued)	Annual surveillance test shall only require material testing, and adopt the same test standards that were adopted for the material testing at the point of CoC listing	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every 3500m²
8.	Smoke curtain/barrier (9)	8.1 For smoke curtain: EN 12101-1 with material testing in accordance with EN 13501-1 (min. class B)	Scheme 1b (Labels issued)	Annual surveillance test shall only require material testing, and adopt the same test standards that were adopted for the material testing at the point of CoC listing	Batch inspection (11) and Site inspection triggered by certification body for each batch (10)
		8.2 For smoke barrier: EN 12101-1 with material testing in accordance with EN 13501-1 (min. class A2)	Scheme 5 (DoCs issued)	Annual surveillance test shall only require material testing, and adopt the same test standards that were adopted for the material testing at the point of CoC listing	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every 3500m²
9.	Fire-rated duct system (4) (9) (i.e. ventilation, smoke extract and/or kitchen exhaust ducting system)	(a) BS 476-24 with material testing in accordance with BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or AS 1530-4 with material testing in accordance with (i) BS 476-4/ BS 476-11/ EN 13501-1 (min. class A2) or (ii) EN 13501-1 (min. class A2) if fire resistance test is using plate-thermocouple or EN 1366-1 with material testing in accordance with EN 13501-1 (min. class A2) or EN 1366-8 with material testing in accordance with EN 13501-1 (min. class A2) or EN 1366-9 with material testing in accordance with EN 13501-1 (min. class A2)	Scheme 5 (DoCs issued)	Annual surveillance test shall only require material testing, and adopt the same test standards that were adopted for the material testing at the point of CoC listing	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every 3500m²
10.	Fire extinguishing system for kitchen hood	UL 300	Scheme 5 (Labels issued)	Annual submission of reports shall include surveillance inspection and/or testing	Factory inspection to be conducted at least once annually and Site inspection(s) triggered by certification body (10)

11.	Fire stopping material (including fire-rated collar)	For penetration gaps and linear joints: (a) BS 476-20 or AS 1530-4 or EN 1366-3 or EN 1366-4 or ASTM E814 For curtain wall application: ASTM E2307	Scheme 5 (DoCs issued)	Not applicable	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every 1000 openings or 1000 metre run, or at least once a year if lesser
12.	Fire-rated glass block/ glass partition	(a) BS 476-22 or EN 1364-1 or AS 1530-4 or ASTM E119 or ISO 834-8 and (b) AS 2208 or EN12600	Scheme 5 (DoCs issued)	Not applicable for glass block Fire-rated glass partition – Impact tests once every 3 years	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every project
13.	Exit sign	13.1 Exit sign (powered electrically): (a) IEC 60598-2-22 and (b) SS 563-1 or ISO 30061 and (c) SS 563-2	Scheme 5 (Labels issued)	Scheme 5 – Testing for every 2000 labels or At least once annually, if fewer than 2000 labels	Scheme 5 – Factory inspection to be conducted at least once annually and Site inspection(s) triggered by certification body (10)
			Scheme 1b (Labels issued)	Scheme 1b – Batch testing and Full tests over 3 years	Scheme 1b – Batch inspection (11) and Site inspection triggered by certification body for each batch (10)
		13.2 Self-luminous sign (powered by radioactive material) (a) UL 924 and (b) SS 508-1 or ISO 3864-1 and (c) SS 508-2 or ISO 3864-2 and (d) SS 508-3 or ISO 3864-3 and (e) SS 508-5 or ISO 7010 and (f) SS 563-1 or ISO 30061 (Clause 10.5 of SS 563-1 shall be complied with for determination of the viewing distance with distance factor (Z) fixed at 50) and (g) SS 563-2 (Annex C)	Scheme 5 (Labels issued)	Scheme 5 – Testing for every 2000 labels or At least once annually, if fewer than 2000 labels	Scheme 5 – Factory inspection to be conducted at least once annually and Site inspection(s) triggered by certification body (10)
			Scheme 1b (Labels issued)	Scheme 1b – Batch testing and Full tests over 3 years	Scheme 1b – Batch inspection (11) and Site inspection triggered by certification body for each batch (10)
14.	Emergency lighting (self-contained)	(a) IEC 60598-2-22 and (b) SS 563-1 or ISO 30061 and (c) SS 563-2	Scheme 5 (Labels issued)	Scheme 5 – Testing for every 2000 labels or At least once annually, if fewer than 2000 labels	Scheme 5 – Factory inspection to be conducted at least once annually and Site inspection(s) triggered by certification body (10)
			Scheme 1b (Labels issued)	Scheme 1b – Batch testing and Full tests over 3 years	Scheme 1b – Batch inspection (11) and Site inspection triggered by certification body for each batch (10)
15.	Battery system (for exit signs and emergency lighting)	(a) SS 563-1 or ISO 30061 and SS 563-2 or AS/NZS 2293-1	Scheme 5 (Labels issued)	Scheme 5 – Testing for every 2000 labels or At least once annually, if fewer than 2000 labels	Scheme 5 – Factory inspection to be conducted at least once annually or By trigger (every 2000 labels)
			Scheme 1b (Labels issued)	Scheme 1b – Batch testing and Full tests over 3 years	Scheme 1b – Not applicable
16.	Fire hose reel	EN 671-1	Scheme 5 (Labels issued)	Scheme 5 - Testing for every 1500 labels or At least once annually, if fewer than 1500 labels Full test over 5 years for both fixed and swing types	Scheme 5 – Factory inspection to be conducted at least once annually and Site inspection(s) triggered by certification body (10)
			Scheme 1b (Labels issued)	Scheme 1b - Batch testing (Full test)	Scheme 1b – Site inspection triggered by certification body for each batch (10)

17.	Standby fire hose	BS 6391	Scheme 5 (Labels issued)	Scheme 5 - Testing for every 1000 labels or At least once annually, if fewer than 1000 labels Full tests over 5 years per type	Scheme 5 – Factory inspection to be conducted at least once annually and Site inspection(s) triggered by certification body (10)
			Scheme 1b (Labels issued)	Scheme 1b – Batch testing (Full test)	Scheme 1b – Site inspection triggered by certification body for each batch (10)
18.	Auditorium Seats (5)	BS 5852,Clause 12 (Ignition source 0, 1 & 5)	Scheme 1b (Labels issued)	Batch testing covering BS 5852: Clause 12 (ignition source 0, 1 & 5)	Site inspection triggered by certification body for each batch (10)
19.	Fire damper	19.1 Fire Damper To conduct full test comprising: 1. fire resistance test; 2. air leakage test; 3. closing reliability test; and 4. spring closing force test (if applicable) For fire resistance test: (a) SS 333 Clause 6.3 or AS 1530-4 (The damper shall be tested with the damper at open position at the start of fire test and be able to completely close during the first 90 sec of the test. Acceptance criteria shall be according to SS 333 Cl 6.3.2) or ISO 834-8 & ISO 834-9 (The damper shall be tested with the damper at open position at the start of fire test and be able to completely close during the first 90 sec of the test. Acceptance criteria shall be according to SS 333 Cl 6.3.2) For air-leakage test: (a) SS 333 Clause 6.4 or ISO 5167 & ISO 7244 or EN 1751 Clause 5.2.1 to 5.2.4 (Note: The requirements for sub-items 2, 3 & 4 shall be as specified in SS 333 Clause 6.4). or AMCA 500-D Clause 6.2 (Requirements shall be as specified in SS 333 Clause 6.4) For closing reliability test: (a) SS 333 Clause 6.5 or UL 555 Clause 11.2 For spring closing force test: (a) SS 333 Clause 6.6 or UL 555 Clause 13	Scheme 1b (Labels issued)	Full test over 3 years: 1. Fire resistance test and 2. Air leakage test and 3. Closing reliability test and 4. Spring closing force test (if applicable)	Batch inspection (11) and Site inspection triggered by certification body for each batch (10)
		19.2 Fire-smoke damper To conduct full test comprising: 1. Fire-resistance test 2. Cycling test 3. Temperature degradation test 4. Operation test 5. Air leakage test For fire-resistance test: (a) SS 333 Clause 6.3 or AS 1530-4 (The damper shall be tested with the damper at open position at the start of fire test and be able to completely close during the first 90 sec of the test. Acceptance criteria shall be according to SS 333 Cl.6.3.2) or ISO 834-8 & ISO 834-9 (The damper shall be tested with the damper at open position at the start of fire test and be able to completely close during the first 90 sec of the test. Acceptance criteria shall be according to SS 333 Cl.6.3.2) For cycling test: (a) SS 333 Clause 6.5 For temperature degradation test: (a) SS 333 Clause 6.8 For operation test: (a) SS 333 Clause 6.7 For air leakage test: (a) SS 333 Clause 6.4 or ISO 5167 or EN 1751 Clause 5.2.1 to 5.2.4 (Note: The requirements for sub-items 2, 3 & 4 shall be as specified in SS 333 Clause 6.4). or AMCA 500-D Clause 6.2 (Requirements shall be as specified in SS 333 Clause 6.4)	Scheme 1b (Labels issued)	Full test over 3 years: 1. Fire-resistance test and 2. Cycling test and 3. Temperature degradation test and 4. Operation test and 5. Air leakage test	Batch inspection (11) and Site inspection triggered by certification body for each batch (10)

20.	Fire-rated door and hardware	20.1 Fire-rated door (a) SS 332 Clause 5 or EN 1634-1 and (b) Mechanical test for relevant hardware as stipulated in SS332 (wherever applicable if installed on the fire door) EN 179, EN 1125, EN 1158, EN 1303, EN 1906, EN 1935, EN 12051, EN 12209, EN 14846, EN 15684 If product includes glass (excl. vision panel), to also conduct impact test: AS 2208 or EN 12600 and (d) Door Closer (refer to S/N 20.2)	Scheme 5 (Labels issued)	Fire test: Timber/composite door – at least once annually Steel/glass door – once every 3 years Impact test for fire-rated glass door – once every 3 years	Scheme 5 – Factory inspection to be conducted at least once annually and Site inspection(s) triggered by certification body (10)
			Scheme 1b (Labels issued)		Scheme 1b – Batch inspection (11) and Site inspection triggered by certification body for each batch (10)
		20.2 Door closer (a) EN 1154 or SS 332 Clause 6 Annex C	Scheme 5 (Labels issued)	Mechanical Test at least once annually based on EN 1154 or SS 332 Clause 6 Annex C	Factory inspection to be conducted at least once annually and Site inspection(s) triggered by certification body (10)
		20.3 Digital lockset (consisting of lever handle on plate, electromechanically operated lockcase and cylinder (if any)) (a) Fire test with batteries loaded, under SS 332, or EN 1634-1	Scheme 2	Fire Test at least once every 3 years based on the same test standard adopted at the point of CoC listing Dimension check at least once every 3 years on lever handle plate (entrance face, exit face, rubber pad/gasket); lever handle; mortise lockcase (body, fore-end, latch bolt); spindle; and cylinder	Not applicable
21.	Bin/linen chute door	(a) BS 476-22 or EN 1634-1 or AS 1530-4	Scheme 5 (Labels issued)	Fire test once every 3 years	Scheme 5 – Factory inspection to be conducted at least once annually and Site inspection(s) triggered by certification body (10)
			Scheme 1b (Labels issued)		Scheme 1b – Batch inspection (11) and Site inspection triggered by certification body for each batch (10)
22.	Fire-rated lift landing/ dumb waiter door	For lift-landing door: (a) BS 476-22 or EN 81-58 For dumb waiter door (b) BS 476-22 and If product (lift-landing door or dumb waiter door) includes glass (excl. vision panel), to also conduct impact test: AS 2208 or EN 12600	Scheme 1b (Labels issued)	Fire test once every 3 years Impact test once every 3 years	Batch inspection (11) and Site inspection triggered by certification body for each batch (10)
23.	Fire shutter/ fire curtain	(a) SS 489 Clause 5 or EN 1634-1; For fire shutter/fire curtain certified to either SS 489 or EN 1634-1, the closing time and speed of the fire shutter/ fire curtain shall comply with Cl.3.7.7c. of this Code.	Scheme 1b (Labels issued)	Fire test once every 3 years	Batch inspection (11) and Site inspection triggered by certification body for each batch (10)
24.	Fire-rated hatch door	(a) BS 476-22 or EN 1634-1 or AS 1530-4	Scheme 5 (Labels issued)	Fire test once every 3 years	Scheme 5 – Factory inspection to be conducted at least once annually and Site inspection(s) triggered by certification body (10)
			Scheme 1b (Labels issued)		Scheme 1b – Batch inspection (11) and Site inspection triggered by certification body for each batch (10)
25.	Portable fire extinguisher	(a) SS EN 3-7 and (b) EN 3-8 or EN 3-9	Scheme 5 (Labels issued)	Scheme 5 – Testing for every 5000 labels or At least once annually, if fewer than 5000 labels Full tests over 5 years per type	Scheme 5 – Factory inspection to be conducted at least once annually and Site inspection(s) triggered by certification body (10)
			Scheme 1b (Labels issued)	Scheme 1b - Batch testing	Scheme 1b – Site inspection triggered by certification body for each batch (10)
26.	Fire resistant cables	(a) SS 299 Annex ZA Table ZA.1 for power and control fire-resistant non-armoured cable (Sheathed and Non-sheathed) or SS 299 Annex ZA Table ZA.2 for power and control fire-resistant armoured cable	Scheme 5 (Certified mark printed on cables)	Full tests over 5 years	Factory inspection to be conducted at least once annually

27.	Intumescent coating system (for protection to steel structure) (6)	(a) EN 16623 (fire resistance test and durability test) or ISO 834-6or ISO 834-7(fire resistance test) and EN 16623 (durability test) or BS 476-21 or AS 1530-4 (load-bearing fire resistance test) and BS 8202-2 (durability tests)	Scheme 5 (DoCs issued)	Full durability test and fire test over 3 years	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every 3500m²
28.	Landing valve	BS 5041-1	Scheme 5 (Labels issued)	Scheme 5 – Testing for every 1500 labels or At least once annually, if fewer than 1500 labels Full tests over 5 years for both low and high pressure valve types	Scheme 5 – Factory inspection to be conducted at least once annually and Site inspection(s)triggered by certification body (10)
			Scheme 1b (Labels issued)	Scheme 1b - Batch testing	Scheme 1b – Site inspection triggered by certification body for each batch (10)
29.	Breeching inlet	BS 5041-3	Scheme 5 (Labels issued)	Scheme 5 – Testing for every 1000 labels or At least once annually, if fewer than 1000 labels Full tests over 5 years for both 2-way and 4-way types	Scheme 5 – Factory inspection to be conducted at least once annually and Site inspection(s) triggered by certification body (10)
			Scheme 1b (Labels issued)	Scheme 1b - Batch testing	Scheme 1b – Site inspection triggered by certification body for each batch (10)
30.	Raised floor panel (9)	(a) BS 476-4 or BS 476-11 or EN 13501-1 (min. class A2fl)	Scheme 2	Annual surveillance test shall only require material testing, and adopt the same test standards that were adopted for the material testing at the point of CoC listing	Not applicable
31.	Material for wall/ceiling/floor construction (9)	(a) BS 476-4 or BS 476-11 or BS 476-7 or BS 476-6& BS 476-7 or EN 13501-1 For plastic wall/ceiling/floor construction, refer to Cl 3.15.19 for the testing requirements	Scheme 2	Annual surveillance test shall only require material testing, and adopt the same test standards that were adopted for the material testing at the point of CoC listing For plastic wall/ceiling/floor construction, annual surveillance test shall be based on Cl 3.15.19	Not applicable
32.	Thermal insulation material (9)	(a) BS 476-4 or BS 476-11 or BS 476-7 or BS 476-6 & BS 476-7 or EN 13501-1 For plastic wall/ceiling/floor construction, refer to Cl 3.15.19 for the testing requirements	Scheme 2	Annual surveillance test shall only require material testing and adopt the same test standards that were adopted for the material testing at the point of CoC listing For plastic wall/ceiling/floor construction, annual surveillance test shall be based on Cl 3.15.19	Not applicable
33.	Finishing material for wall/ceiling (9)	(a) BS 476-4 or BS 476-11 or BS 476-7 or BS 476-6& BS 476-7 or EN 13501-1 For plastic wall/ceiling finishes, refer to Cl 3.15.19 for the testing requirements	Scheme 2	Annual surveillance test shall only require material testing and adopt the same test standards that were adopted for the material testing at the point of CoC listing For plastic wall/ceiling finishes, annual surveillance test shall be based on Cl 3.15.19	Not applicable
34.	Plastic finishing material for floor	For plastic floor finishes, refer to Cl 3.15.19 for the testing requirements	Scheme 2	For plastic floor finishes, annual surveillance test shall be based on Cl 3.15.19	Not applicable

35.	Roof covering material (9)	35.1 For non-fire-rated roof covering material (a) BS 476-4 or BS 476-11 or BS 476-7 or BS 476-6& BS 476-7 or EN 13501-1 or ASTM E108 For plastic roof covering, refer to Cl 3.15.19 for the testing requirements	Scheme 2	Annual surveillance test shall only require material testing and adopt the same test standards that were adopted for the material testing at the point of CoC listing For plastic roof covering, annual surveillance test shall be based on Cl 3.15.19	Not applicable
		35.2 For fire-rated roof covering material (a) BS 476-22 with material testing in accordance with BS 476-4/ BS 476-11/ EN 13501-1 (min. Class A2) or EN 1364-2 with material testing in accordance with EN 13501-1 (min. Class A2) or AS 1530-4 with material testing in accordance with: (i) BS 476-4/ BS 476-11/ EN 13501-1 (min. Class A2) or (ii) EN 13501-1 (min. Class A2) if fire resistance test is using plate-thermocouple	Scheme 5 (DoCs issued)	Annual surveillance test shall only require material testing, and adopt the same test standards that were adopted for the material testing at the point of CoC listing	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every 3500m²
36.	Composite panel (cladding to external wall) (8) (9) (Composite panel shall be tested on its core material or as an assembly)	For test on the core material of composite panel: (a) BS 476-4 or BS 476-11 or BS 476-6& BS 476-7 or EN 13501-1	Scheme 5 (DoCs issued)	Annual surveillance test to be conducted. In addition, surveillance test shall also be conducted for every project. Testing from project site during the surveillance window fulfills the annual test requirement for that window. Surveillance test shall only require material testing and adopt the same test standards adopted for the material testing at the point of CoC listing.	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every project
		For test on the composite panel assembly: NFPA 285		Annual surveillance test (finger printing) to be conducted. In addition, surveillance test shall also be conducted for every project. Testing from project site during the surveillance window fulfills the annual test requirement for that window. Surveillance test shall only require finger printing and adopt the same finger printing test standards adopted at the point of CoC listing.	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every project
37.	UPVC window frame Material	ASTM D635	Scheme 2	Annual surveillance test based on ASTM D635	Not applicable
38.	Engineered Timber	(a) EN 1363 and (b) EN 1364 with material testing in accordance with EN 13501-1 (min. Class D) or EN 1365 with material testing in accordance with EN 13501-1 (min. Class D)	Scheme 5 (DoCs issued)	Annual surveillance test shall only require material testing, and adopt the same test standards that were adopted for the material testing at the point of CoC listing	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every 3500m²
39.	Building-mounted or Building-integrated Solar Photo-voltaic (PV)	39.1 Roof-mounted module: IEC 61730-2 (MST 23 – spread of flame and burning brand tests under Annex B) with a min. fire performance rating of Class C	Scheme 2	Biennial surveillance fire test in accordance to with IEC 61730-2 MST 23 – spread of flame and burning brand tests under Annex B) as adopted at the point of CoC listing	Not applicable
		39.2 Wall-mounted or Wall-integrated or Roof-mounted(12) module: (a) IEC 61730-2 (MST 22, 23, 25 and 26). For MST 23, spread of flame and burning brand tests under Annex B with fire performance rating of Class A and (b) EN 13501-1 (min. Class B with FIGRA ≤ 70 W/s) and (c) Junction box IEC 61730-1 (for glow wire test and flammability classification) and (d) Solar cables IEC 61730-1 (for vertical flame propagation)	Scheme 5 (DoCs issued)	Scheme 5 - Annual surveillance test for EN 13501-1 or IEC 61730-2 (MST 23 – spread of flame and burning brand under Annex B) as adopted at the point of CoC listing	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every project
		39.2 Wall-mounted or Wall-integrated or Roof-mounted(12) module: (a) IEC 61730-2 (MST 22, 23, 25 and 26). For MST 23, spread of flame and burning brand tests under Annex B with fire performance rating of Class A and (b) EN 13501-1 (min. Class B with FIGRA ≤ 70 W/s) and (c) Junction box IEC 61730-1 (for glow wire test and flammability classification) and (d) Solar cables IEC 61730-1 (for vertical flame propagation)	Scheme 1b (DoCs issued)	Scheme 1b - Batch testing in accordance with EN 13501-1 or IEC 61730-2 (MST 23 – spread of flame and burning brand under Annex B) as adopted at the point of CoC listing	Site inspection to be conducted for every project

40.	Coldroom material	40.1 For non-fire-rated coldroom material (a) Flame spread test: EN 13501-1 and (b)Toxicity emission test: EN 45545-2 and (c) Smoke density test : EN 13501-1	Scheme 5 (DoCs issued)	Annual surveillance test in accordance with Flame spread test and Toxicity emission test and Smoke density test	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every 3500m²
		40.2 For fire-rated coldroom material (a) Fire resistance test: BS 476-22 or EN 1364-1 or AS 1530-4 or ASTM E119 or ISO 834-8 and (b) Flame spread test: EN 13501-1 and (c) Toxicity emission test: EN 45545-2 and (d) Smoke density test: EN 13501-1	Scheme 5 (DoCs issued)	Annual surveillance test shall only require material testing for (b), (c) and (d), and adopt the same test standards that were adopted for the material testing at the point of CoC listing	Factory inspection to be conducted at least once annually and Site inspection to be conducted for every 3500m²

Note:
1. ASTM E119 are not acceptable for load-bearing elements.
2. Cl.3.3.6 shall be complied with.
3. The insulation criterion shall be at least 30 minutes.
4. Insulation criteria of ducting system shall have both internal and external rating.
5. Requirements apply to upholstered seats and plastic seats, either in fixed position or retractable type.
6. For BS 8202 the external system durability test shall be for:
a) Humidity test, b) washing test, c) sulphur dioxide test, d) salt spray test, e) heat exposure test, f) natural exposure test, g) control specimen test.
The internal system durability test shall be for:
a) Sulphur dioxide test, b) natural exposure test, c) heat exposure test, d) washing test, e) humidity test, f) control specimen test.
For EN 16623 the durability test shall be for type 'X' intended for all conditions and type 'Y' intended for internal and semi-exposed conditions.
7. Local CoC is not required unless full testing done locally. For more information, refer to Cl.6.3.6.
8. External wall shall have fire-resistance test rating not less than 1 hour.
9. Refer to Table 3.13A, Note (2) for fire classification of construction products & building elements.
10. Site inspection refers to verifications of the installed product against the details in the CoC, type test report that was considered for issuance of the CoC, and inspection of serial labels as stipulated in Regulation 7 of the Fire Safety (Regulated Fire Safety Products) Regulations 2020. The number of site inspections to be done should be in accordance with Regulation 7 of the same Subsidiary Legislation.
11. Batch inspection shall include checks of the individual components either in factory/ site/ warehouse.
12. For roof-mounted PV modules complying with Cl.10.2.2b.

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
11.2.10	10 May 2019	10 May 2019	Clarification	Discrete System Products which are classified as discrete systems are issued with product labels by CBs which can be displayed on the products. Examples of such products include hydrants, landing valves and fire extinguishers.	10 May 2019
11.2.11	10 May 2019	10 May 2019	Clarification	Non-discrete system Products which are classified as non-discrete system are issued by CBs with DoC certificates to suppliers. Examples of such products include internal partition system and floor system.	10 May 2019
11.2.4	10 May 2019	10 May 2019	Clarification	11.2.4 Mutual Recognition Arrangement (MRA) Mutual Recognition Arrangement (MRA) refers to the global network of conformity assessment bodies recognising each other's test report.	10 May 2019
11.2.5	10 May 2019	10 May 2019	Clarification	11.2.5 Scheme Type 1b (Scheme 1b) Scheme Type 1b refers to the Scheme Type 1b specified in ISO/IEC 17067. It consists of type testing of a sample of a production and subsequent batch inspection. Regulated fire safety products certified under Scheme Type 1b are issued with product labels which are also displayed on the products. 11.2.6 Scheme Type 2 (Scheme 2) Scheme Type 2 refers to the Scheme Type 2 specified in ISO/IEC 17067. It consists of type testing of a sample and market surveillance. Market surveillance is conducted and samples of the product from the market are assessed for ongoing conformity. 11.2.7 Scheme Type 5 (Scheme 5) Scheme Type 5 refers to the Scheme Type 5 specified in ISO/IEC 17067. It consists of testing and assessment of the quality system involved. Surveillance of the quality system is conducted and samples of the product from either the market or at the point of production, or both, are assessed for ongoing conformity. Regulated fire safety products certified under Scheme Type 5 (Discrete System) are issued with product labels which are also displayed on the products.	10 May 2019
11.2.8	10 May 2019	10 May 2019	Clarification	11.2.8 Type Testing "Type testing" refers to testing of a product according to the test standard(s) for that product for the application of CoC, as specified in Table 11A. 11.2.9 Attestation "Attestation" refers to a statement of conformity which leads to the issuance of a CoC. The attestation, issued by a CB, indicates that the product is in compliance with the PLS.	10 May 2019
11.8.2	1 Mar 2021	1 Mar 2021	Clarification	Fire-rated doors a. Requirements for CoC (1) The brand, model and test report number of hardware shall be displayed on the CoC, including, but not limited to: (a) Door closer (Concealed); (b) Locks and latches (electromechanically operated); (c) Door coordinator devices; (d) Door bolts; (e) Lever handles and knots; (f) Mechanical locks and latches; (g) Emergency exit devices; (h) Panic exit devices; (i) Single axis hinges; (j) Electrically powered door hold-open devices; (k) Cylinders for locks; and (l) Mechatronic cylinders. b. Requirements for door closers (1) All door closers (regardless if concealed or surface-mounted) shall have their own CoCs. (2) For concealed door closers, these shall be tested together with the specific type of fire-rated door (i.e. brand, model, fire performance), and their CoC numbers and specifications shall be included in the appendix for that related fire door. (3) Uninsulated surface-mounted door closers shall only be used on uninsulated doors. Insulated surface-mounted door closers may be used on either insulated or uninsulated doors. (4) The 6-digit coding system indicating the performance of the door closer, as stipulated in SS 332 Cl 6 Annex C or EN 1154, shall be stored within the QR code on the serial label for the door closer. (5) The following statement shall be included in the appendix of the CoC: "For surface-mounted door closers, the selected door closer shall meet the performance requirements needed for the respective fire-rated door, in accordance with SS 332 Cl 6 Annex C. Surface-mounted door closers tested with uninsulated fire-rated doors can be installed on insulated or uninsulated fire-rated doors (subject to the maximum fire-rating attained by the door closer in a fire test). Surface-mounted door closers tested with insulated fire-rated doors can only be installed on insulated fire-rated doors.'	1 Mar 2021

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
11.8.2 (dated 25 Aug 2023)	25 Aug 2023	1 March 2024	Revised/Clarification	11.8.2 Fire-rated doors a. Requirements for CoC (1)The brand, model and test report number of hardware shall be displayed on the CoC, including, but not limited to: (a) Door closer; (b) Locks and latches (electromechanically operated); (c) Door coordinator devices; (d) Door bolts; (e) Lever handles and knots; (f) Mechanical locks and latches; (g) Emergency exit devices; (h) Panic exit devices; (i) Single axis hinges; (j) Electrically powered door hold-open devices; (k) Cylinders for locks; and (l) Mechatronic cylinders. b. Requirements for door closers (1) All door closers (regardless if concealed, surface-mounted or floor-mounted) shall have their own CoCs. (2) The door closer specifications and CoC number/CoC holder company name shall be included in the appendix for that related fire door. (3) The 6-digit coding system indicating the performance of the door closer, as stipulated in EN 1154, shall be imprinted on the door closer. (4) The following statement shall be included in the appendix of the CoC: ...	25 Aug 2023
Table 11A	15 Mar 2021	15 Mar 2021	Revised	Existing Table 11A	15 Sep 2020
Table 11A (1 March 2023)	1 March 2023	1 September 2023	Revised/Clarification	(a) SS 299-1 or BS 6387 and BS 7846 (Clauses 16.2 and 16.3)	1 March 2023
Table 11A (25 Aug 2023)	1 Mar 2024	1 Mar 2024	Revised/ Clarification	Existing Table 11A Changes made to S/N 20 and S/N 39	25 Aug 2023
Table 11A (dated 1 Sep 2021)	1 Sep 2021	1 Mar 2022	Revised/ Clarification	Existing Table 11A, items 7, 12 & 13	1 Sep 2021
Table 11A (dated 1 Sep 2024)	1 Sep 2024	1 Sep 2024	New	Existing Table 11A	1 Mar 2024
Table 11A (dated 2 Sep 2024)	2 Sep 2024	2 Sep 2024	Clarification	Existing Table 11A, item 41 & 42	2 Sep 2024

APPENDIX 01 - FIRE SAFETY REPORT

1.0 General

a. Fire Safety Report is to document the provision of fire protection, life safety features and fire safety management in the building and/ or plants/ installations. This report serves as a useful reference to Fire Safety Managers (FSMs), building owners, Registered Inspectors (RIs), the SCDF and Qualified Persons (QPs) appointed to carry out any subsequent additions and alteration works. The building owners and/ or building management shall be responsible for the custody and upkeep of the Fire Safety Report, including making the report available for SCDF. Where the nature of the additions and alteration works would require the updating of the Fire Safety Report, the QP shall be responsible to submit revised and updated report to the building owner/s and the SCDF.

b. The project QP shall submit a report on fire protection, life safety features and fire safety management when making building plan submission for projects such as:

(1) Commercial buildings exceeding 60m in habitable height.

(2) Commercial buildings with Accessible Floor Area (AFA) greater than 5000m^2 or having a total occupant load exceeding 1000 persons (car park floor areas can be excluded in the computation of AFA and occupant load).

(3) Industrial buildings with AFA floor area exceeding 5000m².

(4) Petroleum/ chemical plants and installations.

(5) Buildings exceeding 24m in habitable height where fire-rated drywalls are used for the construction of protected shafts for staircases and/or lifts.

(6) Buildings exceeding one storey using fire-rated board protection or intumescent paints for structural steel.

(7) Buildings with structural steel members coated with intumescent paint (for buildings of habitable height below 24m, only item a., b., d., e. & q. of para. 2.0 need to be included in the fire safety report).

(8) Mega underground developments.

c. In buildings under PG VI & VIII, where there may be presence of corrosive atmosphere that may affect the effectiveness of intumescent paints for protection to structural steel members of buildings and fire-rated dry board, such proposal shall be subjected to evaluation of the SCDF.

2.0 Contents of the Report

The write-up of the report on fire protection and life safety features shall include the following subjects. However, qualified person could expand or modify the report to suit his presentation:

a. project description;

b. fire safety design concept;

c. fire engine accessibility;

d. means of escape;

e. structural fire precautions;

f. control and exhaust of smoke and toxic fumes;

g. firefighting systems;

h. fire alarm system;

i. emergency power supply;

j. emergency evacuation lighting;

k. emergency voice communication system;

l. two-way emergency voice communication system;

m. emergency lift control;

n. areas of fire risk;

o. fire scenario;

p. conclusion; and

q. attachments.

3.0 Brief Explanatory Notes for Outline Report on Fire Protection and Life Safety Features

a. Project description

A description of the project with brief outline of the facilities provided. For industrial and petroleum/ chemical plants and installations, details of the following are to be provided:

(1) a diagrammatic process flow chart with a brief description of the process/ activities that will be carried out;

(2) the raw materials to be used;

(3) the nature of the products; and

(4) all hazardous chemicals, flammable liquids, solvents, etc. that will be handled/ stored.

b. Fire safety design concept

This would include the safety design concept incorporated in the project such as the application of design and provision of areas of refuge, smoke barriers, additional compartment walls/ doors in sectionalizing the large atrium floors etc. and other added fire safety features provided over and above the intent of the Code.

c. Fire engine accessibility

This would briefly outline the driveways, which are paved to withstand the load of fire engines, to be provided.

d. Means of escape

This would include the description of the escape routes that would be taken by occupants in the building in a fire scenario, besides the provision of the number, type and location of staircases, etc.

e. Structural fire precautions

This would outline the fire resistance rating and the type of structural protection to elements of structures, compartment walls/ floors, types and methods of fire-stoppings to ducts, cavity and curtain walling construction, and types and rating of all fire doors.

f. Control and exhaust of smoke and toxic fumes

This would include the description of the type of system to be provided to car parks, atrium, staircases and lobbies, air-conditioning units, etc.

g. Firefighting system

This would include the active protection system such as portable fire extinguishers, hose reels, dry/ wet rising mains, sprinkler system, gas flooding system, fixed/ portable water monitors, fixed water spray, drenchers, etc.

h. Fire alarm system

This would include the provision of passive fire protection system such as automatic fire detection systems (smoke or heat type), 'break the glass' fire alarm system. Besides naming the type of automatic system, the description should also include where the detectors would be generally located in fire risk areas/rooms such as lift motor rooms, electrical switch rooms, MDF, IDF and PABX rooms electrical ducts and enclosed elevator shafts, and how, when any of the systems is activated, the public, the people in the Fire Control Room and the nearest fire station or approved fire alarm monitoring company are alerted.

i. Emergency power supply

This would include the description of how the emergency power system operates in times of loss of normal electric power supply to any part of the building and the areas or systems that will be designed to receive emergency power.

j. Emergency evacuation lighting

This would include the description of the system designed in accordance with *SS 563*, and the location of exit signs etc., and the types of battery system, and designed time for the switchover to emergency lighting system from the time the normal power supply is cut-off.

k. Emergency voice communication system

This would involve the description of the provision of the one-way zoned and electrically monitored emergency paging system to critical areas such as lobbies, corridors, exit stairways, toilets,

restaurant, shop and offices, M&E plant rooms. The emergency public address system which generally complies with *SS 546* would include communication between FCC and all parts of the building through electrical loudspeakers.

l. <u>Two-way emergency voice communication system</u>

This would describe the operation of the 2-way zoned and coded voice communication system, which is electrically supervised from the central control located in the FCC including the provision of slave telephones to critical areas such as:

(1) every fire lift lobby including 1st storey;

(2) all firefighting related mechanical equipment rooms inclusive of sprinkler pump room, wet rising main pump room, hose reel pump room, etc.;

(3) all rooms housing smoke control equipment;

(4) all lift machine rooms;

(5) any other locations as may be required by the SCDF.

m. <u>Emergency lift control</u>

This would describe the function of the Emergency Lift Control conforming to the requirements under *SS 550*. The description of the emergency lift control would also include the sequence of events in case of:

(1) power failure;

(2) fire emergency; and

(3) both power failure and fire emergency.

n. <u>Areas of fire risk</u>

This would briefly describe the areas of fire risk such as AC plant room, generator room, oil tank room, etc., and the type of fire protection/detection system proposed.

o. <u>Fire scenario</u>

Under this subject, the qualified person would have to assume the outbreak of a fire in one of the critical floors or areas and describe the sequence of operation of the fire protection and life safety design features.

p. <u>Conclusion</u>

This would include the summing up of the outline concepts and systems that have been designed for the project.

q. <u>Attachments</u>

(1) Location plans of steel structural members coated with intumescent paint.

(2) Location plans of fire risk areas.

(3) Any other attachments required for the report.

Amendment History - Appendix 01

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
Appendix 1	1 Mar 2024	1 Mar 2024	Revised/Clarifications	Appendix 1 1.0 General a. Fire Safety Report is to document the provision of fire protection, life safety features and fire safety management in the building and/ or plants/ installations. This report serves as a useful reference to Fire Safety Managers (FSMs), building owners, Registered Inspectors (RIs), the SCDF and Qualified Persons (QPs) appointed to carry out any subsequent additions and alteration works. Where the nature of the additions and alteration works would require the updating of the Fire Safety Report, the QP shall be responsible to submit revised and updated report to the building owner(s) and the SCDF. b. The project	25 Aug 2023

1.0 GENERAL

1.0 General

a. The Fire Safety Instruction Manual is a document prepared by the project QP to remind the building owner, MCST, tenant, operator and/ or contractor on the management of fire safety provisions for the building. This includes maintenance regimes, evacuation procedures, and other relevant documents to be kept and maintained by the relevant parties.

b. The building owner shall maintain and keep the Fire Safety Instruction Manual at all times and present to the QP upon request. Where any Addition &Alteration works are carried out to the buildings, the building owner shall ensure that changes in the management of fire safety provisions are updated in the Fire Safety Instruction Manual by the QP. The updated Fire Safety Instruction Manual shall be submitted to SCDF for record.

c. The QP can expand or modify the Fire Safety Instruction Manual to suit his presentation so as to convey the fire safety intents/ requirements to the relevant parties.

d. Maintenance of fire protection systems

All fire protection systems when installed/provided in a building, shall be maintained in accordance with applicable codes or standards specified in *Table 1.2A*. The QP shall list down the maintenance details in the Fire Safety Instruction Manual and handover to the building owner for compliance at the completion of the building project.

For the purpose of this Code, “fire protection system” has the same meaning as in the Fire Safety Act 1993.

2.0 SCOPE

2.0 Scope

The project QP shall prepare a Fire Safety Instruction Manual if the project involves any of the following:

a. Fire safety provisions for PWDs

b. Chemical/ HazMat warehouse

c. Fully Automated Mechanised Car Park (FAMCP)

d. Buildings using intumescent paint

e. Liquefied Petroleum Gas (LPG) cylinder installation

f. Mega underground developments

g. Use of lifts in buildings for evacuation

h. Engineered timber building construction

i. Hoarding & safety nets

j. Temporary workers' quarters in uncompleted permanent buildings on construction sites

k. Ductless jet fans system in car parks

l. Kitchen exhaust ducts

m. Fire-rated dry construction

n. Firefighting, mechanical ventilation/ pressurisation, smoke control, emergency voice communication and any other fire safety related systems/ equipment

3.0 CONTENTS OF THE MANUAL

3.0 Contents of the Manual

The Fire Safety Instruction Manual shall include the following subjects:

a. project description;

b. list of items under paragraph 2 present in this project; and

c. relevant information for each applicable item.

4.0 RELEVANT INFORMATION TO BE INCLUDED IN THE FIRE SAFETY INSTRUCTION MANUAL

4.0 Relevant Information to be Included in the Fire Safety Instruction Manual

4.1 Fire safety provisions for PWDs

a. <u>Planning of evacuation for PWDs</u>

The building owner/ MCST shall plan the evacuation procedures for PWDs. Planning includes identifying the needs of PWDs and making arrangements for assistance during emergency. The building owner/ MCST shall keep the following information:

(1) locations plan of PWD Holding Point and PWD evacuation lift;

(2) the number of PWDs;

(3) the location of the PWDs; and

(4) the nature of their disabilities.

b. The evacuation procedures shall be tested at least once a year and involve both horizontal, if provided, and vertical evacuation.

c. The building owner/ MCST shall ensure that the staff, designated to help PWDs in the event of fire, are fully trained to execute the following evacuation procedure:

(1) Building with evacuation lift

(a) PWDs requiring assistance shall move or be directed to the PWD Holding Point in the evacuation lift lobby.

(b) The trained staff shall attend to PWDs from PWD Holding Point and direct them to the final exit.

(2) Building without evacuation lift

(a) On hearing the alarm, PWDs requiring assistance shall be moved or be directed to the nearest PWD Holding Point inside the exit staircase.

(b) The trained staff, after completing their search, shall proceed to the PWD Holding Point and assist the PWDs down the exit staircase to the final exit.

4.2 Chemical/ HazMat warehouse

a.The laboratory operators shall minimise the amount of flammable liquids on benches by returning them to chemical store or safety cabinets when the liquids are not needed for the day.

b. The laboratory operators shall ensure that the quantity of these liquids placed on benches and fume cupboards shall not exceed 10% of the total allowable storage capacity within the laboratory unit.

c. Liquids used for running and operating laboratory instruments or other work-in-progress which may require some quantities of solvents to operate are exempted from the 10% limit.

4.3 Fully Automated Mechanised Car Park (FAMCP)

a. The building owner/ MCST of Category 2 & 3 FAMCPs shall provide self-contained breathing apparatus and maintained in a clearly marked cabinet for maintenance personnel.

b. Maintenance personnel shall be equipped with the breathing apparatus while working in FAMCPs.

c. Signage with words of minimum 50mm in height shall be clearly visible and state: “Personnel must be equipped with the breathing apparatus during maintenance”.

4.4 Buildings using intumescent paint

a. <u>Inspection and maintenance</u>

(1) The building owner/ MCST, shall carry out annual inspection checks to ensure that the intumescent paint coatings are not damage or tempered with. Records of inspection shall be properly kept.

(2) For buildings with Fire Certification, the annual renewal of the certificate shall include the inspection of the columns and beams coated with intumescent paint. The inspection shall be carried out by a QP.

b. <u>Addition/ alteration works</u>

For addition/ alteration works in a building where structural steel members are protected by intumescent paint, the following requirements shall be complied with:

(1) The building owner/ MCST/ tenant, assisted by the FSM, shall engage a QP who shall submit building plans to the SCDF. The building plans shall be accompanied by the QP’s declaration as to whether the existing columns, beams coated with intumescent paint are/ will be affected.

(2) Inspection certificate endorsed by a RI shall be required and kept by the building owner/ MCST.

(3) The Fire Safety Report shall be updated accordingly.

c. There shall be no highly flammable/ combustible materials stored within the vicinity of any structural steel members protected by intumescent paint.

4.5 Liquefied Petroleum Gas (LPG) cylinder installation

a. The building owner/ MCST/ tenant shall observe the Regulation 53 of the Fire Safety (Petroleum and Flammable Materials) Regulations 2005 and the conditions stipulated under Cl.10.1 of the Fire Code for the storage/use of 15kg LPG cylinders within building.

b. The owner/ tenant of eating outlet or food stall together with the gas supplier/ dealer are responsible to ensure that the automatically shut-off system is well maintained and that the gas leak detection system is checked and calibrated periodically.

c. The Fire Certificate inspection programme for the building shall include the “automatic detection and shut-off system”.

4.6 Mega underground developments

a. The building owner/ MCST shall form a Company Emergency Response Team (CERT) for his underground development.

b. Training and other safety requirements in caverns

(1) All working occupants in the underground development are required to be properly and thoroughly briefed on the fire emergency plans.

(2) All working occupants shall be trained on basic firefighting and rescue matters. Safety hoods shall be equipped and provided for each working occupant in the caverns.

4.7 Use of lifts in buildings for evacuation

a. The building owner/ MCST shall designate his staff to supervise the evacuation during a fire emergency.

b. Evacuation using fire lifts or evacuation lifts shall only be carried out under the supervision of firefighters/ CERT.

c. Upon the arrival of SCDF at the fire scene, the designated staff supervising the evacuation shall brief the fire officer in-charge on the position and circumstances of the fire and the progress of the evacuation. SCDF will then take over the supervision of the evacuation.

4.8 Engineered timber building construction

Where automatic fire detection/ suppression systems are installed, the engineered timber building owner/ MCST shall undertake to engage a QP to conduct annual inspection of these systems and to submit inspection reports to SCDF.

4.9 Hoarding & safety nets

a. The building owner/ MCST shall ensure a copy of QP-endorsed hoarding plans is kept at the FCC, security guard room or information counter in the order of priority at all times. Such requirement is optional if the hoardings does not affect the following areas/ facilities:

(1) fire hydrants;

(2) fire engine accessway/fire engine access road;

(3) fire lift;

(4) exit staircase; and

(5) dry/ wet riser.

b. The building owner/ MCST is required to notify all the tenants/occupants of the locations of alternate means of escape 2 weeks prior to carrying out the hoarding and renovation works.

c. The building owner/ MCST is required to inform the nearest SCDF fire station of any hoarding works that affect the above-mentioned areas/ facilities.

d. The affected firefighting facilities/areas shall be clearly shown on the plans and submitted to the relevant fire station. The alternative or nearest firefighting facilities that can be accessed by the fire station responding personnel shall be highlighted on the plan.

4.10 Temporary workers’ quarters in uncompleted permanent buildings on construction sites

The main contractor shall ensure that:

a. all temporary workers' quarters within the construction site are maintained in good conditions and they shall not be allowed to deteriorate into a slum-like condition through unauthorised extensions and overcrowding

b. unwanted articles are not stored in and around the temporary workers' quarters; and

c. all exits, escape routes and passageway are kept free of obstruction at all times.

4.11 Ductless jet fans system in car parks

a. The building owner/ MCST shall keep a copy of the operations and maintenance manual as a guide for future renovations and changes to the building.

b. The manual prepared by the QP shall contain the roles and responsibilities of the building owner/ MCST, the restriction placed on the building identification of the sub-systems, servicing and maintenance plan, fault identification, etc.

4.12 Kitchen exhaust ducts

a. The building owner/ MCST /tenant/operator shall ensure that the entire kitchen exhaust system, including those within individual restaurant/F&B outlet shall be properly maintained. The entire (interior and exterior) exhaust duct and kitchen hood shall be degreased and cleaned at least once every 12 months. The work shall be carried out by a specialist and the records of cleaning and degreasing shall be kept by the relevant parties for verification.

b. The building owner/ MCST/ tenant/ operator shall verify that the maintenance records state the name and contact number of the maintenance company, method of cleaning, and the date of inspection or cleaning. Photographic evidence of the cleaning, with date and time stamps, shall be incorporated in the report.

c. Following the conduct of maintenance for the entire kitchen exhaust system, the building owner/ MCST/ tenant/operator shall verify that the cleaning contractor has prominently affixed a maintenance label (e.g., at the anchor tenant of the coffeeshop, or at the cashier of a restaurant or food stall), at least A5-sized, displaying the following information:

(1) Date of last cleaning (in DD/MM/YY format)

(2) Name and Unique Entity Number (UEN) of the maintenance company

(3) Method of cleaning (e.g., manual scraping, chemical wash, mechanical brush, radio-controlled robot, etc.)

(4) Date when the next cleaning is due (in DD/MM/YY format)

4.13 Fire-rated dry construction

The building owner/ MCST shall engage a QP for any subsequent A&A works involving new or existing fire-rated dry construction.

Amendment History - Appendix 02 - Fire Safety Instruction Manual

Clause No.	Amendment Date	Effective Date	Clause Status	Clause Before Amendment	Circular Date
4.12	1 Mar 2023	1 Mar 2023	Revised/Clarifications	The building owner/ MCST/ tenant/ operator shall ensure that the entire kitchen exhaust system, including those within individual restaurant/ F&B outlet shall be properly maintained. The entire (interior and exterior) exhaust duct and kitchen hood shall be degreased and cleaned at least once every 12 months. The work shall be carried out by a specialist and the records of cleaning and degreasing shall be kept by the relevant parties for verification by the authorities having jurisdiction and the SCDF.	1 Sep 2022