NATIONAL BUILDING CONSTRUCTION STANDARDS

PART F FIRE AND LIFE SAFETY

The Fire Services is a State subject and has been included as a Municipal function in the XIIth Schedule of the Constitution of India under Article 243(w). It is therefore primarily the responsibility of the State Governments to ensure safety of life and property in their area of jurisdiction. State/Union Territories (UTs) in the country are implementing fire safety measures either through the provisions as stipulated in their State Fire Services Act or through their building byelaws. The construction of any building and its fire safety thereof has to be ensured as per the norms and standards prescribed by the State Building Bye Laws/Development Control Regulations of the State/UTs.

The Department of Fire Services in the States/UTs is one of the agencies to issue NOC to the buildings from fire and life safety aspects and it is for the State/UT Governments to provide stringent norms for issuing NOC for the same.

This Part of NBCS is only for guidance and referral for the state government/local authority in respect of fire safety in buildings.

BUREAU OF INDIAN STANDARDS

C O N T E N T S

National Building Code Sectional Committee, CED 46

FOREWORD

The first version of this Part was formulated as Part 4, in the National Building Code of India 1970 (NBC 1970) and was revised in 1983. Subsequently the first revision of this Part was modified in 1997 through Amendment No. 3 to 1983 version of NBC. The modified version of this Part included a few tables for the fire resistance ratings of various building components, such as walls, columns, beams and floors. The requirements for wet riser, down-comer, automatic sprinkler installation, high velocity (10 m/s to 15 m/s) water spray or foam generating system, etc, for buildings were modified. Annex giving guidelines for selection of fire detectors had been deleted and relevant Indian Standards on fire alarm system and smoke detectors had been referred. Also, an annex for determination of fire loads and flue load density for arriving at the classification of occupancy hazard and calorific values of some common materials was included. Annex for broad classification of industrial and non-industrial occupancies into low, moderate and high hazard had also been included.

The NBC was then revised in 2005. In this revision, the significant modifications incorporated were: The text was divided into the following broad clauses: (a) *Fire prevention* – Covering aspects of fire prevention pertaining to design and construction of buildings on passive fire protection measures, also describing the various types of building materials and their fire rating; (b) *Life safety* – Covering life safety provisions in the event of fire and similar emergencies, also addressing construction and occupancy features that are necessary to minimize danger to life from fire, smoke, fumes or panic; (c) *Fire protection* – Covering the significant appurtenances and their related components and guidelines for selecting the correct type of equipment and installation meant for fire protection of the building, depending upon the classification and type of the building. Also, the classification of building based on occupancy was elaborated, wherein, starred hotels were covered as a new Subdivision A-6 under occupancy Group A Residential; heritage structures and archaeological monuments were covered under Subdivision D-3 occupancy Group D Assembly buildings; mixed assembly occupancies were covered as a new Subdivision D-6; underground elevated railways were covered as a new Subdivision D-7 under occupancy Group D Assembly buildings; and TV stations were covered under Subdivision E-5 of occupancy Group E Business buildings. Further, for the external stairs for exit requirements, the width and treads were increased to 1 250 mm and 250 mm, respectively; under the requirements for institutional buildings the clear width of all required exits which serve as egress from hospital or infirmary section was increased from 1.5 m to 2 m. Also, provision of patient-lift was included; and due cognizance of halon phase out programme was taken, while specifying provisions in this Part with respect to fire protection using fire extinguishers/systems. Based on various comments received from time-to-time, an Amendment No. 2 relating to Part 4 of the 2005 version of NBC, was issued.

In the 2016 revision of NBC, the following changes were made:

General:

1) The scope of application of provisions of this Part of NBC for different occupancies was clarified.
2) Definitions of various new terms were included and definitions of some of the existing terms were updated based on latest developments and use.

Fire Prevention:

3) Based on the experience in the use of the provisions of NBC in relation to various occupancies and subdivision classification under various building occupancy types, the same were reviewed and updated. Also, mixed occupancy and minor occupancy were further clarified.
4) Table 1 on fire resistance ratings of structural and non-structural elements was updated.
5) The provisions relating to fire separating walls, fire separating floors and fire partitions were detailed.
6) Provisions of fire safety requirements of services shafts were rationalized and updated.
7) A separate comprehensive clause on electrical power supply distribution for fire and life safety systems was included.
8) Detailed clauses on air conditioning systems towards safety and smoke control integration were provided.

9) Glass facade requirements were detailed towards fire protection and smoke exhaust aspects.

10) A separate comprehensive clause on Fire Command Centre (FCC) was introduced covering various requirements.

Life Safety:

11) The components of means of egress were comprehensively brought out covering specific aspects relating to exit access, exit and exit discharge. The relationship of occupant load, exit width requirements and travel distances were duly detailed enabling efficient planning for enhanced life safety provisions. The table on capacity factors was modified based on aspect of width per person approach used globally.

12) Requirement for displaying the occupancy load for assembly buildings and call centres, was included.

13) The concept of firefighting shaft for safe and efficient use by the fire fighters to access the floor on fire and also allow egress/evacuation of the occupants with simultaneous use of refuge area used as staging of the occupants, were well integrated, including in the annex for high rise buildings.

14) Aspects of compartmentation with fire barrier and its passive fire safety requirements were detailed for respective occupancies.

15) Pressurization of exits and smoke extraction requirements for respective areas including car parking were updated with an approach towards selecting alternative means therefor.

16) The clause on gas supply was comprehensively updated.

17) The clause on fire detection and alarm system was completely reviewed and updated as per the latest practices.

Fire Protection:

18) The table on minimum requirements for firefighting installations (erstwhile Table 23 renumbered as Table 7) was comprehensively updated.

19) Detailed provisions were included on fire water storage, fire pump room, sprinkler system and various alternative fire suppression systems.

Additional Occupancy-wise Requirements:

20) Concept of progressive evacuation in case of hospital buildings was included in detail to ensure life safety of the inmates.

21) Provisions relating to requirement of refuge area were updated including for D-6 occupancy and introduced for apartment buildings of height 60 m and above.

22) Separate provisions on atrium were included in Annex E.

23) Detailed separate provisions were included on commercial kitchens as an Annex.

24) Detailed separate provisions were included on car parking facilities in Annex G.

25) Separate provisions on fire and life safety requirements for metro stations and metro trainways were included in Annex J and Annex K, respectively.

In this revision, the publication is renamed as National Building Construction Standards (NBCS).

This NBCS (Part F) deals with safety from fire. It specifies the demarcation of fire zones, restrictions on construction of buildings in each fire zone, classification of buildings based on occupancy, types of building construction according to fire resistance of the structural and non-structural components and other restrictions and requirements necessary to minimize danger to life from fire, smoke, fumes, or panic before the buildings can be evacuated. The NBCS recognizes that safety of life is more than a matter of means of egress and accordingly deals with various matters which are considered essential to the safety of life. The NBCS therefore covers provisions relating to means of egress covering various components thereof namely exit access, exit, and exit discharge. It also covers provisions relating to fire protection of buildings through portable and fixed firefighting installations.

Fire protection techniques have to be based on the fire behaviour characteristics of different materials and structural elements of buildings. The activities pursued by the occupants of buildings must also be taken into consideration for assessing the extent of hazards, and method should then be devised by which the hazards could be minimized. An indefinite combination of variables is involved in the phenomenon of fire, all of which cannot be quantified. The requirements of this NBCS should, therefore, be taken as a guide and an engineering design approach should be adopted for ensuring a fire safe design for buildings. Depending upon the type and complexities in a building, qualified and trained fire protection engineers should be associated with the planning of buildings, so that adequate fire and life safety measures could be incorporated in the building design right from the beginning.

Absolute safety from fire is not attainable in practice. The objective of this Part is to specify measures that will provide that degree of safety from fire which can be reasonably achieved. The NBCS endeavours to avoid requirements that might involve unreasonable hardships or unnecessary inconvenience or interference with normal use and occupancy of buildings but insists upon compliance with minimum standards of fire safety necessary for building occupants and users. For ensuring compliance of fire protection equipment/installations to the laid down quality requirements, it is desirable to use such equipment/installation duly certified under the BIS, Certification Marks Scheme.

While providing guidelines for minimizing chances of occurrence of fire through passive fire protection measures, this Part does not intend to cover all aspects of general fire prevention including sources of ignition. Nor does it cover the prevention of accidental personal injuries from fire during the course of normal occupancy of buildings.

This Part while recognizing that panic in a building on fire may be uncontrollable, deals with the potential panic hazard through measures designed to prevent the development of panic. Experience indicates that panic seldom develops even in the presence of potential danger, so long as occupants of buildings are moving towards exits which they can see within a reasonable distance and with no obstruction or undue congestion in the path of travel. However, any uncertainty as to the location or adequacy of means of egress, the presence of smoke or fumes and the stoppage of travel towards the exit, such as may occur when one person stumbles and falls on stairs, may be conducive to panic. Danger from panic is greater when a large number of people are trapped in a confined area particularly when people are not adequately guided towards egress and safety notifications are not implemented or practiced. Consideration towards announcements and annunciations needs to be given to guide the occupants to safe egress routes and to control panic during situation of distress. These aspects are addressed in this Part.

Experience has shown that concealed spaces within a building, such as, space between ceiling and false ceiling, horizontal and vertical ducts, and shafts, etc, tend to act as flues/tunnels during a fire. Provisions therefore exist to provide fire stopping within such spaces.

Nothing in this Part of the NBCS should be construed to prohibit better types of building construction, more exits, or otherwise safer conditions than the minimum requirements specified in this Part.

Compliance with this Part should not be construed as eliminating or reducing the necessity for other provisions for safety of persons using a building or structure under normal occupancy conditions. Nor should any provision of this Part be construed as requiring or permitting any addition that maybe hazardous under normal occupancy conditions.

One of the major points brought out then in this Part (until NBC 2016) is the limitation of heights and areas of buildings based on fire safety of the occupants. Individual municipal corporations were free to alter the then Table 2 (of NBC 2016) based on local conditions, but the ratios of areas as maintained in the table for different occupancies and types of construction should be adhered to.

Advantage has been taken of the developments, particularly in fire resistance rating of materials, designating types of construction in a rational manner and relating the area limitations of different occupancies to different types of construction.

Halons (halogenated hydrocarbons) which exhibit exceptional firefighting and explosion prevention/ suppression characteristics have been found to possess high ozone depleting potential. They come under Group II of Annex A of the Montreal Protocol on Substances that Deplete the Ozone Layer, the international environmental agreement for phasing out ozone depleting substances. Due to increasing evidence that the ozone layer is getting depleted at a faster rate than thought earlier, the NBCS continues to take into cognizance the need to promote use of halon alternatives as fire extinguishing media.

In this revision, the following significant changes have been made:

a) Minor occupancies have been clarified, in **3.1.1.1**;

b) Mixed occupancy has been detailed in **3.1.11**;

c) Fire resistance rating of roofs located over 6.7 m has been updated in Table 1;

d) Occupant load factor for various occupancies has been clarified in Table 2, also with respect to the net or gross floor area;

e) Various provisions on life safety have been updated in **4**;

f) Travel distance values have been updated in Table 4;

g) Compartmentation related provisions have been comprehensively updated in **4.5**;

h) Fire detection and suppression systems based on the specific type and intensity of industrial hazards has been introduced under **5.4**;

j) Table 7 on firefighting requirements for various occupancies has been reviewed and separately detailed (in Table 7A to Table 7J) for all the occupancies;

k) Basis for water quantity required for fire-fighting are recommended for combined system protection (using sprinkler and hose) and similarly for hose protection system in Table 7K and Table 7M, respectively;

m) Fire protection of commercial kitchen has been elaborated through reference to the detailed Indian Standard, IS 18271 : 2023 'Fire safety in commercial kitchen — Guidelines';

n) Water curtain requirement for basement compartmentation has been reviewed and deleted;

p) Annex H on fire and life safety requirements for metro stations has been elaborated;

q) Annex J on fire and life safety requirements for metro trainways has been updated;

r) A new Annex M on performance based design has been introduced;

s) A new Annex N on fire protection for specific industries is included as an informative guide; and

t) Height restrictions of buildings have been eliminated.

All standards cross-referred to in the main text of this Part, are subject to revision. The parties to agreement based on this Part are encouraged to investigate the possibility of applying the most recent editions of the standards.

As the regulation of land development and buildings is a State subject and is dealt by the States and local bodies such as urban local bodies within their jurisdiction through building regulatory documents like building regulations, building byelaws, and fire regulations, this document is voluntary in nature and is non-binding. The implementation depends on adoption by concerned parties or stipulations in a contract or by appropriate adoption by the concerned authorities.

For the purpose of deciding whether a particular requirement of this Part of the NBCS is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this Part.

Important Explanatory Note for Users of the NBCS

In any Part/Section of this NBCS, where reference is made to **'good practice'** in relation to design, constructional procedures or other related information, and where reference is made to **'accepted standard'** in relation to material specification, testing, or other related information, the Indian Standards listed at the end of the Part/Section shall be used as a guide to the interpretation.

At the time of publication, the editions indicated in the standards were valid. All standards are subject to revision and parties to agreements based on any Part/Section are encouraged to investigate the possibility of applying the most recent editions of the standards.

In the list of standards given at the end of a Part/Section, the number appearing within parentheses in the first column indicates the number of the reference of the standard in the Part/Section. For example:

a) Good practices [F(4)] refers to the Indian Standards give at serial number (4) of the list of standards given at the end of this Part F, that is, IS 8758 : 2013 'Recommendations for fire precautionary measures in the construction of temporary structures and pandals (*second revision*); and

b) Accepted standards [F(1)] refers to the Indian Standards given at serial number (1) of the list of standards given at the end of this Part F, that is, IS 3808 : 1979 'Method of test for non-combustibility of building materials (*first revision*)'.

NATIONAL BUILDING CONSTRUCTION STANDARDS

PART F FIRE AND LIFE SAFETY

1 SCOPE

1.1 This NBCS (Part F) covers the requirements for fire prevention, life safety in relation to fire, and fire protection of buildings. This NBCS (Part F) specifies occupancy-wise classification, constructional aspects, egress requirements and protection features that are necessary to minimize danger to life and property from fire.

1.2 The provisions of this Part are applicable to those high rise buildings having a height exceeding a certain value, or, to special buildings (having a certain area exceeded on any floor), as given below, unless otherwise mentioned specifically in this Part:

Sl No.	*Occupancy Type*	*Height beyond which Provisions of this Part are Applicable*	*Floor Area beyond which Provisions of this Part are Applicable*
(1)	(2)	(3)	(4)
i)	Residential	24 m	750 m^2
ii)	Educational	9 m	500 m^2
iii)	Institutional	15 m	500 m^2
iv)	Assembly	9 m	750 m^2
v)	Business	15 m	750 m^2
vi)	Mercantile	15 m	1 000 m^2
vii)	Industrial – Low hazard (G-1)	Any height and the total area of the building exceeds 2 000 m^2	
viii)	Industrial – Moderate hazard (G-2)	Any height and the total area of the building exceeds 2 000 m^2	
ix)	Industrial – High hazard (G-3)	15 m	500 m^2
x)	Storage	9 m	500 m^2
xi)	Hazardous	9 m	500 m^2
xii)	Mixed Use	15 m	1 000 m^2

NOTES

1 State/Local Authority may consider modifying the above values depending on the fire vulnerability and preparedness.

2 In the case of buildings (lesser than the height or area as above) with a single staircase, the same should be of firefighting shaft type and located only on the external periphery, with its lobby and stairwell both ventilated (having 1.6 m^2 minimum size opening through fixed louvres kept permanently open). A 2 h fire door for lobby and 1 h fire door for stairwell should be provided.

1.3 Also, the provisions of this Part are applicable when buildings are altered (on an area 1 000 m^2 or more) or when change of occupancies are made to buildings.

1.4 The provisions of performance-based design (Annex M) are applicable only to validate the fire safety aspects for heritage buildings that are either made accessible to public or are converted to other building occupancy (and are constrained to provide exits as per the codal requirements, as that could damage the heritage nature). For the applicability of such performance-based approach to other buildings such as large assembly buildings, air traffic control towers, special museums, and existing buildings being modified for occupancy change, careful consideration of Annex M should be done by the state/local fire authorities on the basis of detailed performance-based calculations/report.

2 TERMINOLOGY

For the purpose of this Part, the following definitions will apply.

2.1 Assisted Evacuation — Strategy that exists during which a designated person or persons provide assistance, during an emergency, to another person(s) to leave a building or a specific part of the built environment and to reach a final place of safety.

2.2 Atrium — A large-volume space created by a floor opening or series of floor openings connecting two or more stories that is covered at the top of the series of openings and is used for purposes other than an enclosed stairway; lifts hoist-way; an escalator opening; or as a utility shaft used for plumbing, electrical, air conditioning, or communications facilities.

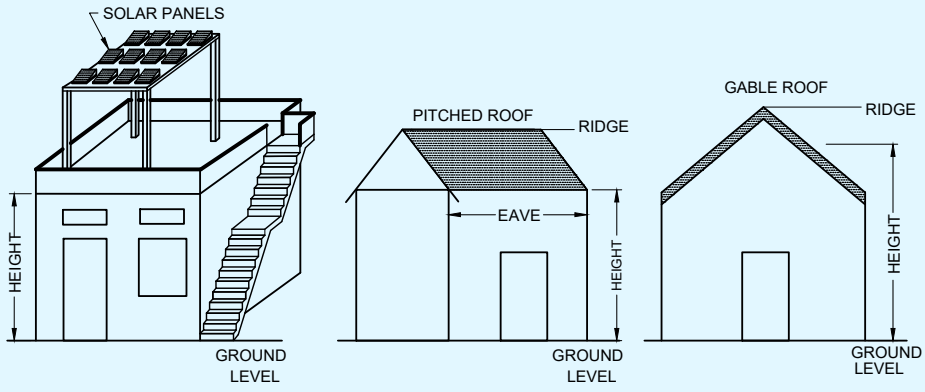
2.3 Authorities Concerned (known as Authority Having Jurisdiction) — An organization, office, or individual responsible for enforcing the requirements of a Code or standard, or for approving or accepting equipment, materials, an installation, or a procedure.

2.4 Automatic Fire Detection and Alarm System — A system comprising components and sub-systems required for automatically detecting smoke, heat or fire initiating an alarm and other actions as appropriate. This system also includes manually operated electronic fire alarm (MOEFA) system.

NOTE — MOEFA system (with or without automatic fire detection and alarm system) includes all or some of the components such as manual call stations (initiating an alarm for fire and other actions as required), talk-back system and public address system.

2.5 Building — Any structure for whatsoever purpose and of whatsoever materials constructed and every part thereof whether used as human habitation or not and includes foundation, plinth, walls, floors, roofs, chimneys, plumbing and building services, fixed platforms, veranda, balcony, cornice or projection, part of a building or anything affixed thereto, or any wall enclosing or intended to enclose any land or space and signs and outdoor display structures. Tents, *Shamianahs*, tarpaulin shelters, etc erected for temporary and ceremonial occasions with the permission of the Authority should not be considered as building.

2.6 Building, Height of — For the purposes of fire safety, the height of the multistoried building may be measured up to the floor level of the last occupiable floor from the grade level (where the fire tender/rescue vehicle will be located). In cases when the building height is measured up to the roof of the top-most floor, the following depictions may be considered. *See* Fig. 1.



(1A) 1-STORIED BUILDING (1B) DOOR ON EAVES WALL (1C) DOOR ON GABLE WALL

NOTES

1 Where a building is located in sloped terrain, height should be determined from the lowest level (that is approachable by the fire service vehicle) to the roof level.

2 The heights for design or sprinkler systems should be as per good practice [F(20)].

FIG. 1 BUILDING HEIGHT

2.7 Combustible Material — A material which either burns itself or adds heat to a fire, when tested for non-combustibility in accordance with accepted standard [F(1)].

2.8 Common Path of Travel — That portion of the exit access which the occupants are required to traverse before two (or more) separate and distinct routes to two (or more) exits become available. Common paths of travel are part of the travel distance. *See* Fig. 2.

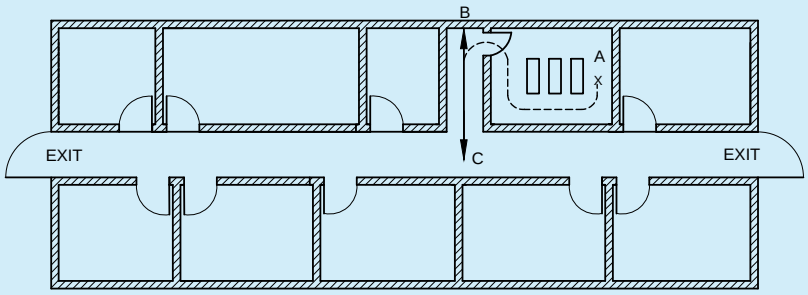


FIG. 2 COMMON PATH OF TRAVEL (A TO C) AND DEAD END (C TO B)

2.9 Covered Area (*also* Built-up Area)— Ground area covered by the building immediately above the plinth level. The area covered by the following in the open spaces is excluded from covered area:

a) Garden, rockery, well and well structures, plant nursery, water pool, swimming pool (if uncovered), platform a round a tree, tank, fountain, bench, *Chabutara* with open top and unenclosed on sides by walls and the like;

b) Drainage culvert, conduit, catch-pit, gully pit, chamber, gutter, and the like;

c) Compound wall, gate, unstoreyed porch and portico, slide, swing, uncovered staircases, ramp areas covered by *Chhajja* and the like; and

d) Watchman's booth, pump house, garbage shaft, electric cabin or substations, and such other utility structures meant for the services of the building under consideration.

NOTE — For the purpose of this Part, covered area equals the plot area minus the area due for open spaces in the plot.

2.10 Down-comer — An arrangement of firefighting within the building by means of down-comer pipe connected to terrace tank through terrace pump, gate valve and non-return valve and having mains not less than 100 mm internal diameter with landing valves on each floor/landing. It is also fitted with inlet connections at ground level for charging with water by pumping from fire service appliances and air release valve at roof level to release trapped air inside.

2.11 Dry Riser — An arrangement of firefighting within the building by means of vertical rising mains not less than 100 mm internal diameter with landing valves on each floor/landing which is normally dry but is capable of being charged with water usually by pumping from fire service appliances.

2.12 Emergency Lighting — Lighting provided for use when the supply to the normal lighting fails.

2.13 Emergency Lighting System — A complete but discrete emergency lighting installation also fed from the standby power source to the emergency lighting lamp(s), for example, self-contained emergency luminaire or a circuit from central battery (with or without monitoring system) connected through wiring to several escape lighting luminaries.

2.14 Escape Lighting — That part of the emergency lighting which is provided to ensure that the escape route is illuminated at all material times, for example, at all times when persons are on the premises, or at times the main lighting is not available, either for the whole building or for the means of egress.

2.15 Evacuation Lift — Lift that can be used, during an emergency, for self-evacuation.

2.16 Fire Exit — That unobstructed component of means of egress which is between the exit access and the exit discharge or public way. Exit components include exterior exit doors at the level of exit discharge, interior exit stairways (pressurised), exit stairway with external wall (pressurized or natural ventilated), exterior exit stairways, exit passageways, and exterior exit ramps (*see* Fig. 3). Fire exits should be provided with panic bar as applicable to facilitate entry of occupant into it.

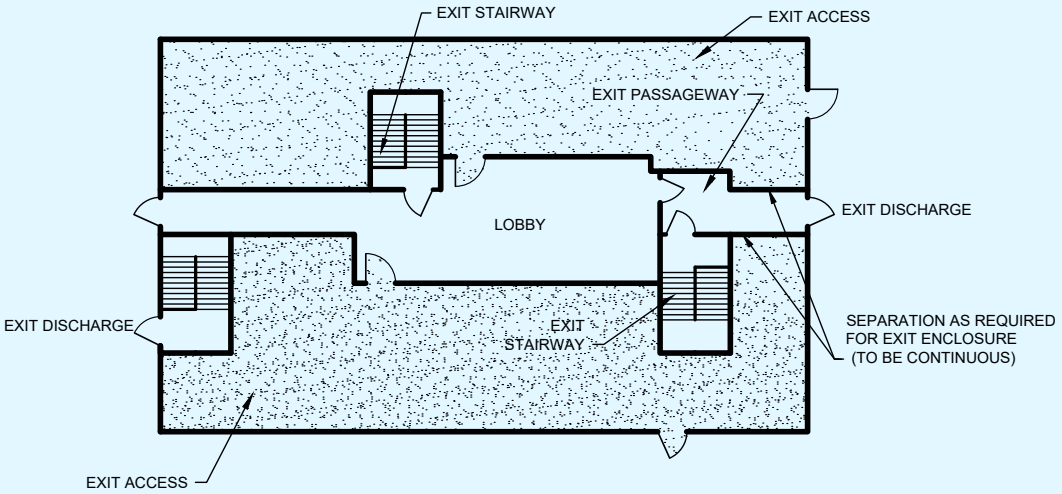


FIG. 3 COMPONENTS OF MEANS OF EGRESS

2.17 Exit Access — That portion of a means of egress that leads to fire exit (for example, habitable floor area, doorways, staircase lobby, ramps, veranda, corridor, or passageway leading to an exit) (*see* Fig. 3).

2.18 Exit Access Corridor — A corridor in exit access which may not necessarily have the requirement of exits being met.

2.19 Exit Discharge — The component of a means of egress between the termination of an exit and a public way (*see* Fig. 3).

2.20 Fire Barrier (or Fire Resisting Barrier) — A fire barrier is a vertically or horizontally aligned member such as a wall or a fire curtain, or a floor. These may be with discontinuities created by openings with a specified fire resistance rating, where such members are designed and constructed with a specified fire resistance rating to limit the spread of fire that also restricts the movement of smoke.

2.21 Fire Compartment — A space within a building that is enclosed by fire barrier or fire resistant walls on all sides, including the top and bottom.

2.22 Fire Door and Fire Door Assembly — Any combination of fire door, frame, hardware and other accessories that together provide a specific fire resistant rating to the opening in terms of its stability, integrity and insulation properties, when installed in the openings in fire separation walls. Fire door {*see* accepted standard [F(33)]} is a component of fire door assembly.

NOTES

1 Wherever reference has been made to fire door or fire check door in this Part, the same should be construed as fire door assembly.

2 Fire doors in exits should have fire rating as required in this Part to meet the requirement of integrity and stability; and the minimum insulation criteria should be 30 min.

3 Fire doors in exits should be provided with intumescent seal or such other globally accepted technologies/ devices (that expand upon contact with heat/hot gases, thereby forming an effective seal and aiding in integrity).

4 Fire doors in exits should not be allowed to be on hold open position and kept closed and to close by 'door closure - spring mechanism'.

5 Fire curtains should not be allowed as fire exits. If so provided for compartmentation, independent fire door should be provided meeting the requirement for fire door in exits as above (of the width as required) within the prescribed travel distance requirement.

6 Fire doors provided with panic bar should also be provided with the door handle on the other side on those levels to permit re-entry in designated floors.

2.23 Exit — A way out leading from exit access towards fire exit (fire exit is basically a protected staircase, *see* **2.16**). Exits not leading to fire exits should be displayed with signage as 'NOT A FIRE EXIT'.

2.24 Firefighting Shaft (Fire Tower) — An enclosed shaft having a protected area of 120 min fire resistance rating comprising a protected lobby, staircase, and fireman's lift, connected directly to the exit discharge or

through an exit passageway with 120 min fire resistant wall at the level of exit discharge to exit discharge. These should also serve the purpose of exit requirement/strategy for the occupants. The lobby space should have arrangement to accommodate minimum two wheel chairs, and a minimum specified area for respective occupancy. The respective floors should be approachable from firefighting shaft enabling the fire fighters to access the floor and also enabling the fire fighters to assist in evacuation through fireman's lift. The firefighting shaft should be equipped with 120 min fire doors. The firefighting shaft should be equipped with firemen talk back, wet riser and landing valve in its lobby, to fight fire by fire fighters (*see* Fig. 4 for a typical firefighting shaft).

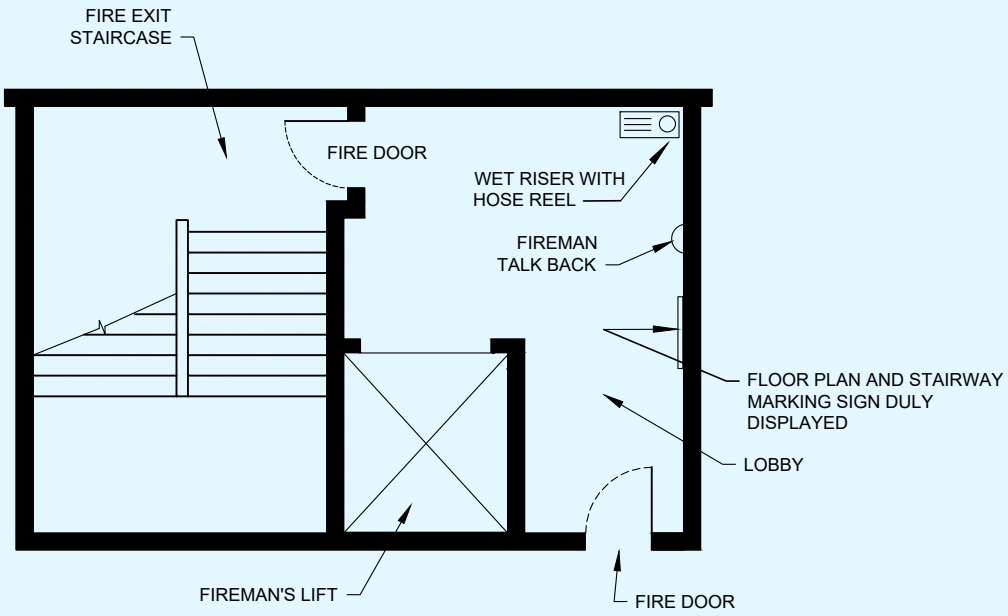


FIG. 4 TYPICAL FIREFIGHTING SHAFT

2.25 Fire Load — The total amount of energy that could be released during a fire in a given compartment, floor or building; usually expressed in Mega Joules (MJ) (or equivalent units).

2.26 Fire Load Density — Fire load per unit area of the compartment, floor or building concerned. It is obtained by dividing the fire load by the floor area of the concerned compartment, floor or building. It is usually expressed in megajoule (MJ) per m^2, or equivalent units with respect to wood, as below:

Sl No.	*Building Type*	*Fire Load Density (Expressed as Wood Equivalent kg/m^2)*
(1)	(2)	(3)
i)	Residential (A)	25
ii)	Institutional (B) and Educational (C)	25
iii)	Assembly (D)	25 to 50
iv)	Business (E)	25 to 50
v)	Mercantile (F)	Up to 250
vi)	Industrial (G)	Up to 150
vii)	Storage (H) and Hazardous (J)	Up to 500

2.27 Fireman's Lift — A lift or a group of lifts invariably associated with all the features and requirements of a firefighting shaft. Such lift(s) are installed to enable fire services personnel to reach different floors with minimum delay, and meets the additional features as required in accordance with this Part. This lift also serves the purpose of meeting the requirement of evacuation lift for assisted evacuation.

NOTES

1 Lifts in firefighting shaft and fireman's lift are required to go to basements and the lobby should be pressurized.

2 Regular lifts serving floors above should terminate at the level of exit discharge. Lifts serving basements should be separate. In the case of lift bank, it is preferred to have all the lifts as fireman's lift instead of one or few lifts.

3 Lifts in the firefighting shaft should reach the terrace level, in the case of habitable spaces in terrace.

2.28 Fire Resistance — Fire resistance is a property of an element of building construction and is the measure of its ability to satisfy for a stated period, some, or all of the following criteria:

a) *Load bearing capacity* (*Stability*) (*R*) – The ability of a load bearing element to withstand fire exposure without any loss of structural stability.

b) *Integrity* (*E*) – Resistance to penetration of flame and hot gases.

c) *Insulation* (*I*) – Resistance to temperature rise on the unexposed face up to a maximum of 180 °C at any single point and average temperature of 140 °C.

NOTE — Radiation (W) can be used as one of the criteria for glass used in building, which refers to the ability to resist the passage of heat from one side to another.

2.29 Fire Resistance Rating — The time that a material or construction will withstand the standard fire exposure as determined by fire test done in accordance with the standard methods of fire tests of materials/structures as per the accepted standard [F(2)].

NOTES

1 The requirement of rating of various building elements as given in this Part should be applicable in accordance with the provisions given in the accepted standard [F(2)].

2 The fire resistance rating should be specified in terms of minutes.

3 Fire resistance rating for non-structural material/assembly should bear a label of compliance to such rating as per the approval of competent authority based on testing and evaluation. The label should be permanently affixed to the material/assembly and may carry other relevant details such as name and type of the product, and manufacturer's details.

2.30 Fire Resistant Wall — Fire resistance rated wall, having opening(s) with specified fire resistant rating, which restricts the spread of fire from one part of a building to another part of the same building.

2.31 Fire Separation — The distance in metre, measured from the external wall of the building concerned to the external wall of any other building on the site, or from other site, or from the opposite side of street or other public space for the purpose of preventing the spread of fire.

2.32 Fire Stop — A fire resistant material, or construction, having a fire resistance rating of not less than the fire separating elements, installed in concealed spaces or between structural elements of a building to prevent the spread/propagation of fire and smoke through walls, ceilings, and the like as per the laid down criteria. See accepted standard [F(34)].

NOTES

1 Fire stop assembly for through penetrations is a combination of firestop compatible for use with the penetrant, penetration items such as cables, cable tray, conduits, ducts, pipes, etc, and their means of support through the wall or opening that together restores the fire resistance rating of the fire separating elements in terms of its integrity and/or insulation properties.

2 Fire stop assembly for joints is the one where fire stop with movement capability is used to seal the linear joints between adjacent fire separating elements, to maintain the fire resistance of the separating elements, which should be installed within its tested design limits with regard to size of the joint, type of assembly, and anticipated compression and extension of the joint.

2.33 Fire Suppression Systems

a) *Gas Based Systems* — Systems that use gaseous agents as fire suppression media, such as, all agents alternate to halon gases, as conforming to relevant Indian Standards; other methods/types of gas based systems where their protection is equal to or better than what is suggested above for the type of application subject to the acceptance of Authorities concerned may also fall under such systems; and

b) *Water Based Systems* — Systems that use mainly water as firefighting media such as hydrant system, sprinkler system, water spray system, foam system and water mist system.

2.34 Fire Wall or Fire Separating Wall — A fire resistance rated wall having fire protected openings, which restricts the spread of fire and extends continuously from the foundation to the roof (and through the roof at least 1 m above the roof in case of combustible roof), with sufficient structural stability under fire conditions to allow collapse of construction on one side or either side without collapse of the wall.

2.35 Floor Area (Gross) — The area of the floor within the inside perimeter of the outside walls of the floor of the building under consideration with no deductions for corridors and passage-ways, stairs, closets, thickness of interior walls, columns, lifts and building shafts or other features. Typically used for low density occupant load calculations.

2.36 Floor Area (Net) –The area of the floor within the inside perimeter of the outside walls of the floor of the building under consideration obtained after deducting the areas of corridors and passage-ways, stairs, closets (toilets and bathrooms), thickness of interior walls, columns, lifts, building shafts, services (floor mounted AHU, electrical, and the like), area of atrium, and escalator cut out. Typically used for high density occupant load calculations thus, net floor area is not the carpet area.

2.37 Floor Area Ratio (FAR) — The quotient obtained by dividing the total covered area (plinth area) on all floors by the area of the plot:

$$\text{FAR} = \frac{\text{Total covered area of all floors}}{\text{Plot area}}$$

2.38 Fire Exit Hardware — A door-latching assembly incorporating an actuating member or panic bar that releases the latch bolt upon the application of a force in the direction of egress travel, provided on exits.

2.39 High Rise Building — A building 24 m or above in height (irrespective of its occupancy).

2.40 Horizontal Exit — A defend in place or a staging arrangement, providing safety from fire and smoke originating from the area of incidence, by allowing alternative egress from a compartment to an area of refuge or another compartment at or near the same level. This also includes such egress from a compartment to an adjoining building. A horizontal exit is thus through a fire door of 120 min rating in a fire-resistant wall. Horizontal exit requires separation from the refuge area or adjoining compartment through 120 min fire barrier. The adjoining compartment of the horizontal exit should allow for unlocked and ease of egress and exits for the occupants using defend in place strategy.

2.41 Internal (Interior) Exit Stairway – A stairway that is enclosed with a fire-rated enclosure (towards building occupancy) in order to provide a protected path between the exit access and exit discharge. This enclosure must extend directly to the exterior at grade; extend through an exit passageway to grade; or comply with one of the allowances for exit discharge through a lobby, vestibule or horizontal exit.

2.42 External (Exterior) Exit Stairway – A stairway that is located on an exterior wall of the building, is open to external environment on at least one side and meets the requirements for openness as specified under 4.4.2.4.3.4, and is separated from the interior of the building by construction with the fire resistance rating required for enclosed stairs. The external exit stair leads directly to an open courtyard or public way at the level of exit discharge.

2.43 Lift Lobby — A space from which people directly enter a lift car(s) and into which people directly enter upon exiting a lift car(s).

2.44 Means of Egress — A continuous way of travel from any point in a building or structure to a public way, consisting of three separate and distinct parts, that is, exit access, exit, and exit discharge.

2.45 Means of Escape — A way out of a building or structure that does not conform to the strict definition of 'means of egress' but does provide an alternate way out.

2.46 Metro Station

2.46.1 *Concourse* — Intermediate level(s) or area(s) connecting a station platform(s) to a public way through stairs, escalators, or corridors.

2.46.2 *Crush Train Load* — The number of passengers inside a train when it is filled to maximum capacity permissible by rolling stock design.

2.46.3 *Entraining Load* —The number of passengers boarding a train at a platform.

2.46.4 *Headway* — The interval of time between the arrivals of consecutive trains at a platform in a station.

2.46.5 *Mass Rapid Transit* — Any station building or part thereof, permanent, or temporary, through which people transit for the duration of time required to enter the building and board the train to depart the station platform or to alight from the train and depart from the station building.

2.46.6 *Non-transit Occupancy* — Occupancy not under the control of the system operating authority.

2.46.7 *Point of Safety* — One of the following: (a) An enclosed exit that leads to a public way or safe location outside the station, trainway, or vehicle, (b) An at-grade point beyond the vehicle, enclosing stations, or trainway, (c) A point on open track beyond the open or enclosed station or enclosed train-way, and (d) Any other location approved by the Authorities concerned.

2.46.8 *Station* — A place designated for the purpose of loading and unloading passengers, including service area and ancillary spaces associated with the same structure.

2.46.8.1 *Composite station* — A transit station that is constructed contiguous with non-transit occupancy.

2.46.8.2 *Enclosed station* — A station or portion thereof that does not meet the definition of an open station.

2.46.8.3 *Open station* — A station that is constructed such that it is directly open to the atmosphere, and smoke and heat are allowed to disperse directly into the surrounding open atmosphere.

2.46.9 *Station Platform* — The area of a station immediately adjacent to a guideway, used primarily for loading and unloading passengers.

2.46.10 *Link Load* — The number of passengers travelling between two stations on board a train or trains during peak headway.

2.46.11 *Incidental Occupancy within Station* — An occupancy within a station that provides additional services which are not directly related to transportation operation or transportation services.

2.47 Mixed Occupancy — A multiple occupancy where the occupancies are intermingled.

2.48 Multiple Occupancy — A building or structure in which two or more classes of occupancy exist.

2.49 Occupancy or Use Group — The principal occupancy for which a building or a part of a building is used or intended to be used. For the purpose of classification of a building according to the occupancy, an occupancy should be deemed to include subsidiary occupancies which are contingent upon it.

2.50 Occupant Load — Maximum number of persons that might occupy a building or portion thereof at any one time.

2.51 Place of Comparative Safety — Places within a building where people can stay little longer until evacuation, for example, refuge areas, terraces, fire/smoke separated compartments, etc.

2.52 Pressurization — The establishment of a pressure difference across a barrier to protect exit, stairway, lobby, exit passageway or room of a building from smoke penetration.

2.53 Performance Based Design — An engineering approach to fire protection design based on (1) agreed upon fire safety goals and objectives, (2) deterministic and/or probabilistic analysis of fire scenarios, and (3) quantitative assessment of design alternatives against the fire safety goals and objectives using accepted engineering tools, methodologies, and performance criteria.

2.54 Pressurization Level — The pressure difference between the pressurized space and the adjoining area served by the pressurized space expressed in Pascal (Pa).

2.55 Public Way — A street, alley, or other similar parcel of land essentially open to the outside air, dedicated,

or otherwise permanently appropriated to the public for public use and having a clear width and height of not less than 3 m.

2.56 Ramp — The construction, in the form of an inclined plane that is steeper than or equal to 1 : 20 (5 percent) from the horizontal, together with any intermediate landing, that makes it possible to pass from one level to another.

2.57 Refuge Area — An area within the building for a temporary use during egress. It generally serves as a staging area which is protected from the effect of fire and smoke. The lift lobby spaces provided with adequate area (called refuge spaces) on all floors within the firefighting shaft can also serve as an alternate to refuge areas.

NOTE — Such refuge areas/spaces on every floor of firefighting shaft's lift lobby provide staging opportunity to those persons residing on any floor and are incapable of rescuing out of the building themselves.

2.58 Roof Exits — A means of escape on to the roof of a building, where the roof has access to it from the ground through alternative staircase or adjacent building.

2.59 Separated Occupancy — A multiple occupancy where the occupancies are separated by fire resistance–rated assemblies.

NOTE — Separate occupancy of a building is not incidental to the principal/main occupancy of that building.

2.60 Site (Plot) — A parcel (piece) of land enclosed by definite boundaries.

2.61 Smoke Barrier — A continuous membrane, or a membrane, where such membrane is designed and constructed to restrict the movement of smoke.

2.62 Smoke Compartment — A space within a building enclosed by smoke barriers on all sides.

2.63 Stack Pressure — Pressure difference caused by a temperature difference creating an air movement within a duct, chimney, or enclosure.

2.64 Travel Distance — The distance to be travelled from any point in a building to a protected exit or external escape route or final exit measured along the line of travel.

2.65 Ventilation — Supply of outside air into, or the removal of inside air from, an enclosed space.

2.66 Venting Fire — The process of facilitating heat and smoke to leave a building as quickly as possible by such paths so that lateral spread of fire and heat is checked, firefighting operations are facilitated, and minimum fire damage is caused.

2.67 Visual Strobes/Flashing — It is an audio-visual fire alarm for alerting persons with hearing impairment with flashing light. The strobe frequency should be from 0.5 Hz to 4.0 Hz, or as may be decided by the State Fire Authority, subject to performance required in smoke scenario.

NOTE — Care should be taken to ensure that overlapping strobes do not combine to result in a higher frequency of flashing.

2.68 Volume to Plot Area Ratio (VPR) — The ratio of volume of building measured in cubic metre to the area of the plot measured in square metre and expressed in metre.

2.69 Water Based Systems

2.69.1 *Hydrant System* — A distribution system having a network of piping installed underground/above-ground around and/or through inside of a building with internal and/or external hydrants fitted with landing valves at regular intervals according to the occupancy. The distribution system is connected to water supply system for firefighting.

2.69.2 *Automatic Sprinkler System* — A system of water pipes fitted with sprinkler heads at suitable intervals and heights and designed to actuate automatically, control and extinguish a fire by the discharge of water.

2.69.3 *Automatic Water Spray Systems* — A special fixed pipe system connected to a reliable source of fire protection water supply and equipped with water spray nozzles for specific water discharge and distribution over the surface or area to be protected. The piping system is connected to the water supply through an automatically actuated deluge valve which initiates flow of water. Automatic actuation is achieved by operation of automatic detecting equipment installed along with water spray nozzles. There are two types of systems namely high

velocity and medium velocity systems.

2.69.4 *Water Mist Systems* — A distribution system connected to a pumping and water supply system that is equipped with nozzles capable of delivering water mist to the part/entire enclosure or area, intended to control, suppress, or extinguish fire and is capable of meeting the specified performance requirements.

2.69.5 *Foam Protection System* — Firefighting systems where foam is made by mechanically mixing air with a solution consisting of fresh water to which a foaming agent (liquid concentrate) has been added. Firefighting foam is a stable aggregation of small bubbles of density lower than oil or water, and shows tenacious qualities for covering horizontal surfaces. There are three types of foam applications, that is, low, medium, and high expansion foams depending upon the application.

2.70 Wet Riser — An arrangement for firefighting within the building by means of vertical rising mains not less than 100 mm nominal diameter with landing valves on each floor/landing for firefighting purposes and permanently charged with water from a pressurized supply.

NOTE — For definition of other terms, reference be made to accepted standards [F(3)].

3 FIRE PREVENTION

3.1 Classification of Buildings Based on Occupancy

3.1.1 *General Classification*

All buildings, whether existing or hereafter erected, should be classified according to use or the character of occupancy in one of the following groups:

Group A: Residential

Group B: Educational

Group C: Institutional

Group D: Assembly

Group E: Business

Group F: Mercantile

Group G: Industrial

Group H: Hazardous

Group J: Storage

Group K: Mixed use

The details of each occupancy and example of buildings in each group are given in **3.1.2** to **3.1.11**.

3.1.1.1 *Minor occupancy*

This is purely incidental to operations in a main occupancy, which should be considered as part of the main occupancy and should be classified under the relevant group for the main occupancy. Minor occupancy should not exceed 30 percent of the floor area. When the area exceeds 30 percent, it should be categorized as mixed occupancy (**3.1.11**).

3.1.1.2 *Mixed occupancy*

Where two or more types of occupancies intermingle in the same building, the entire building should be treated as mixed occupancy and the same should comply with **3.1.11**.

3.1.2 *Group A*: *Residential Buildings*

These include any building in which sleeping accommodation is provided for normal residential purposes with or

without cooking or dining or both facilities, except any building classified under Group C.

Buildings and structures under Group A are subdivided as follows:

a) *Subdivision A*-I *Lodging and rooming houses* — These include any building or group of buildings under the same management, in which separate sleeping accommodation on a transient or permanent basis, with or without dining facilities but without cooking facilities for individuals is provided. This includes inns, clubs, motels, and guest houses. If sleeping accommodation for more than 20 persons is provided in any one residential building, it is classified here OR as a building in Subdivision A-III as the case may be.

NOTE — A lodging or rooming house is classified as a one or two family dwelling, if no room in any of its private dwelling units is rented to more than three persons.

b) *Subdivision A*-II *Dormitories* — These include any building in which group sleeping accommodation is provided, with or without dining facilities for persons who are not members of the same family, in one room or a series of closely associated rooms under joint occupancy and single management, for example, school and college dormitories, students, and other hostels and military barracks.

c) *Subdivision A*-III *Apartment houses* — These include any building or structure in which living quarters are provided for three or more families, living independently of each other and with independent cooking facilities, for example, apartment houses, mansions and Chawls.

d) *Subdivision A*-IV *Hotels* — These include any building or group of buildings under single management, in which sleeping accommodation is provided, with or without dining facilities for hotels classified up to Four Star Category.

e) *Subdivision A*-V *Starred hotels* — These include the hotels duly approved by the concerned authorities as Five Star and above hotels.

3.1.3 *Group B*: *Educational Buildings*

These include any building used for school, college, other training institutions involving assembly for instruction, education, or recreation for not less than 20 students.

In the case of temporary buildings/structures which are utilized for educational purposes, the provisions of **3.2.3** apply.

If residential accommodation is provided in the schools/institutions, that portion of occupancy should be classified as a building in Subdivision A-II.

3.1.4 *Group C*: *Institutional Buildings*

These include any building which is used for purposes, such as medical or other treatment or care of persons suffering from physical or mental illness, disease, or infirmity; care of infants, convalescents, or aged persons and for penal or correctional detention in which the liberty of the inmates is restricted. Institutional buildings ordinarily provide sleeping accommodation for the occupants.

Buildings and structures under Group C are further subdivided as follows:

a) *Subdivision C*-I *Hospitals and sanatoria* — This subdivision includes any building or a group of buildings under single management, which is used for housing persons suffering from physical limitations because of health or age and those incapables of self-preservation, for example, hospitals, infirmaries, sanatoria, and nursing homes;

b) *Subdivision C*-II *Custodial institutions* — This subdivision includes any building or a group of buildings under single management, which is used for the custody and care of persons, such as children, convalescents and the aged who are incapable of self-preservation, for example, homes for the aged and infirm, convalescent homes and orphanages; and

c) *Subdivision C*-III *Penal and mental institutions* — This subdivision includes any building or a group of buildings under single management, which is used for housing persons under restraint, or who are detained for penal or corrective purposes, in which the liberty of the inmates is restricted, for example, jails, prisons, mental hospitals, mental sanatoria and reformatories.

3.1.5 *Group D*: *Assembly Buildings*

These include any building where not less than 50 persons congregate or gather for amusement, recreation, social, religious, patriotic, civil, travel and similar purposes, for example, shopping malls, theatres/multiplexes, motion picture houses; assembly halls; auditoria; exhibition halls; museums; skating rinks; gymnasiums; restaurants/food courts; places of worship; dance halls; club rooms; passenger stations and terminals of air, surface and marine public transportation services; stadia; and underground and elevated railways.

3.1.6 *Group E*: *Business Buildings*

These include any building which is used for transaction of business for keeping of accounts and records and similar purposes, professional establishments, service facilities, etc, city halls, town halls, courthouses and libraries are classified in this group so far as the principal function of these is transaction of public business and keeping of books and records. These occupancies also include laboratories, outpatient clinics, research establishments, libraries, test houses, electronic data processing centres, computer installations, information technology parks and call centres; telephone exchanges; broadcasting stations, T.V. stations, and air traffic control towers; and datacentres.

Buildings under Group E are further subdivided as follows:

a) Subdivision E-I Business buildings (human occupied); and

b) Subdivision E-II Datacentres (machine environment).

3.1.7 *Group F Mercantile Buildings*

These include any building which is used as shops, stores, market, for display and sale of merchandise, either wholesale or retail.

Mercantile buildings are further subdivided as follows:

a) Subdivision F-I Shops, stores, departmental stores, markets; and

b) Subdivision F-II Underground shopping centres.

3.1.8 *Group G*: *Industrial Buildings*

These include any building or structure, in which products or materials of all kinds and properties are fabricated, assembled, manufactured, or processed, for example, assembly plants, industrial laboratories, dry cleaning plants, power plants, generating units, pumping stations, fumigation chambers, laundries, buildings or structures in gas plants, refineries, dairies and saw-mills, etc.

Buildings under Group G are further subdivided as follows:

a) Subdivision G-I Buildings used for low hazard industries;

b) Subdivision G-II Buildings used for moderate hazard industries; and

c) Subdivision G-III Buildings used for high hazard industries.

The hazard of occupancy, for the purpose of this NBCS, should be the relative danger of the start and spread of fire, the danger of smoke or gases generated, the danger of explosion or other occurrences potentially endangering the lives and safety of the occupants of the buildings.

Hazard of occupancy should be determined by the Authority on the basis of the fire loads of the contents, and the processes or operations conducted in the building, provided, however, that where the combustibility of the material, the flame spread rating of the interior finish or other features of the building or structure are such as to involve a hazard greater than the occupancy hazard, the greater degree of hazard should govern the classification.

For determination of fire loads for arriving at the classification of occupancy hazard, guidance on calorific values of some common materials is given at Annex A.

A broad classification of industrial occupancies based on ‘fire hazard only’ into low, moderate, and high hazard

classes is given at Annex B, for guidance. Any occupancy not covered in Annex B, should be classified in the most appropriate class depending on the degree of hazard.

NOTE — This Annex B is only based on 'fire hazard'. Other classification of industries based on chemical hazard, pollution, etc, are not addressed in this NBCS.

Where different degrees of hazard of occupancy exist in different parts of a building, the most hazardous of those should govern the classification for the purpose of this NBCS, except in cases where hazardous areas are segregated or protected as specified in this NBCS.

a) *Subdivision G*-I — This subdivision includes any building in which the contents are of such comparative low combustibility and the industrial processes or operations conducted therein are of such a nature that there is hardly any possibility for any self-propagating fire to occur and the only consequent danger to life and property may arise from panic, fumes or smoke, or fire from some external source;

b) *Subdivision G*-II — This subdivision includes any building in which the contents or industrial processes or operations conducted therein are liable to give rise to a fire which will burn with moderate rapidity or result in other hazardous situation and may give off a considerable volume of smoke, but from which neither toxic fumes nor explosions are to be feared in the event of fire; and

c) *Subdivision G*-III — This subdivision includes any building in which the contents or industrial processes or operations conducted therein are liable to give rise to a fire which will burn with extreme rapidity or result in other hazardous situation or from which poisonous fumes or explosions are to be feared in the event of a fire.

3.1.9 *Group H*: *Storage Buildings*

These include any building primarily for the storage or sheltering (including servicing, processing or repairs incidental to storage) of goods, ware or merchandise (except those that involve highly combustible or explosive products or materials), vehicles or animals, for example, warehouses, cold storages, freight depots, transit sheds, storehouses, truck and marine terminals, garages, hangars, grain elevators, barns and stables. Storage properties are characterized by the presence of relatively small number of persons in proportion to the area. Any new use which increases the number of occupants to a figure comparable with other classes of occupancy should change the classification of the building to that of the new use, for example, hangars used for assembly purposes, warehouses used for office purposes, garage buildings used for manufacturing.

3.1.10 *Group J*: *Hazardous Buildings*

These include any building which is used for the storage, handling, manufacture or processing of highly combustible or explosive materials or products which are liable to burn with extreme rapidity and/or which may produce poisonous fumes or explosions for storage, handling, manufacturing or processing which involve highly corrosive, toxic or noxious alkalis, acids or other liquids or chemicals producing flame, fumes and explosive, poisonous, irritant or corrosive gases; and for the storage, handling or processing of any material producing explosive mixtures of dust which result in the division of matter into fine particles subject to spontaneous ignition. Examples of buildings in this class are those buildings which are used for,

a) storage, under pressure of more than 0.1 N/mm^2 and in quantities exceeding 70 m^3, of acetylene, hydrogen, illuminating and natural gases, ammonia, chlorine, phosgene, sulphur dioxide, carbon dioxide, methyl oxide and all gases subject to explosion, fume or toxic hazard, cryogenic gases, etc;

b) storage and handling of hazardous and highly flammable liquids, liquefiable gases like LPG, rocket propellants, etc;

c) storage and handling of hazardous and highly flammable or explosive materials (other than liquids); and

d) manufacture of artificial flowers, synthetic leather, ammunition, explosives, and fireworks.

NOTE — A list of hazardous substances giving quantities, for which or exceeding which owners handling such substances are required to be covered under The *Public Liability Insurance Act*, 1991, has been notified under the 'Rules on Emergency Planning, Preparedness and Response for Chemical Accidents' by the Government of India, Ministry of Environment and Forests Notification No. G.S.R. 347(E) dated 01 August 1996.

3.1.11 *Group K*: *Mixed Occupancy*

3.1.11.1 These include any building having multiple occupancy where the occupancies are intermingled. The following table guides on the possible mixing of occupancies (two or more occupancies may be mixed) in a building.

Sl No.	*Occupancy to be Mixed with*	*Minimum Required Fire Resistance Rating for the Separation between Any Two Occupancies* in min										
		Residential	**Educational**	**Institutional**	**Assembly**	**Business**	**Mercantile**	**Industrial**			**Storage**	**Hazardous**
								Low (G-1)	**Moderate (G-2)**	**High (G-3)**		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
i)	**Residential**	–	120	120	120	120	120	120	NP	NP	NP	NP
ii)	**Educational**	120	–	120	120	120	120	NP	NP	NP	NP	NP
iii)	**Institutional**	120	120	–	120	120	120	NP	NP	NP	NP	NP
iv)	**Assembly**	120	120	120	–	120	120	120	120	NP	NP	NP
v)	**Business**	120	120	120	120	–	120	120	120	240	NP	NP
vi)	**Mercantile**	120	120	120	120	120	–	120	120	NP	120	NP
vii)	**Industrial – Low (G-1)**	120	NP	NP	120	120	120	–	120	240	120	NP
viii)	**Industrial – Moderate (G-2)**	NP	NP	NP	120	120	120	120	–	240	180	240
ix)	**Industrial – High (G-3)**	NP	NP	NP	NP	240	NP	240	240	–	240	240
x)	**Storage**	NP	NP	NP	NP	NP	120	120	180	240	–	240
xi)	**Hazardous**	NP	NP	NP	NP	NP	NP	NP	240	240	240	–
NP – Not permitted, being highly dangerous/vulnerable.												

3.1.11.2 For mixed occupancy building typology as above, if these co-exist in a building (such as large retail occupancy and business occupancy), in so far as fire protection is concerned, the entire building should be governed by the most restrictive provisions of this NBCS among those applicable for individual occupancies. However, the exits can be shared between mixed occupancies provided its aggregate provision meets the requirement of the mixed occupancy, and should be permitted if such exits are with unrestricted egress of the occupants based on the business operational hours of the occupancies sharing such exits. If such unrestricted egress of the mixed-use occupancy is not planned, each occupancy should be provided with its independent exits.

Exits in such mixed occupancy should be so arranged as to ensure that means of egress is not decreased in the direction of egress travel.

Further, in such mixed occupancies, the occupancies are also required to be separated (horizontally and/or vertically as the case may be) by fire resistance rating, *see* 3.1.11.1.

3.1.12 Where change in the occupancy of any building places it in a different group or in a different subdivision of the same group, such building should be made to comply with the requirements of this NBCS for the new group or its subdivision.

3.1.13 Where the new occupancy of a building is less hazardous, based on life and fire risk, than its existing occupancy, it should not be necessary to conform to the requirements of this NBCS for the new group or its subdivision.

3.1.14 A certificate of occupancy should be necessary, before any change is effected in the character of occupancy of any building.

3.2 Temporary Buildings or Structures

3.2.1 Temporary buildings and structures may be permitted according to the purpose for which these are to be used, by special permit from the Authority for a limited period and subject to such conditions as may be imposed in the permit.

3.2.2 Such buildings and temporary structures should be completely removed on the expiry of the period specified in the permit.

3.2.3 Adequate fire precautionary measures in the construction of temporary structures and *Pandals* should be taken in accordance with good practice [F(4)].

3.3 Existing Buildings

The existing buildings need not be required to comply with the requirements of this part unless these are altered, or in the opinion of the Local Authority, such building constitutes a hazard to the safety of the adjacent property or to the occupants of the building itself or is an unsafe building. In the event of alteration, it should be necessary to obtain permission of the Authority for such alteration consistent with fire hazard.

Alterations/modifications/renovations should be accomplished so as to ensure conformity with all the safety requirements of the new buildings. Such alterations should not in any way bring down level of fire and life safety below that which existed earlier. Any addition or alterations or construction of cubicles or partitioning (that will effect/increase the travel distance requirement), changes in the typology of the occupancy or densification of an existing occupancy for floor area exceeding 1 000 m^2 should be with the approval of local fire authority.

3.4 Types of Construction

3.4.1 The design of any building and the type of materials used in its construction are important factors in making the building resistant to a complete burn-out and in preventing the rapid spread of fire, smoke, or fumes, which may otherwise contribute to the loss of lives and property.

The fire resistance of a building or its structural and non-structural elements is expressed in minutes against a specified fire load which is expressed in kcal/m^2, and against a certain intensity of fire. The fire-resistance test for structural element should be done in accordance with accepted standards [F(2)]. For the purpose of this Part, the types of construction according to fire resistance should be classified into four categories, namely, Type 1 Construction, Type 2 Construction, Type 3 Construction and Type 4 Construction. The minimum fire resistance ratings of structural and non-structural members for various types of construction is given in Table 1.

Non-combustible materials should be used for construction of buildings, and the internal walls of staircase enclosures should be of brick work or reinforced concrete or any other material of construction with minimum of 120 min rating. The walls for the chimney should be of Type 1 or Type 2 Construction depending on whether the flue gas temperature is above 200 °C or less, respectively.

3.4.2 It is required that a structural and/or non-structural element/component to have the requisite fire resistance rating as per Table 1. The fire resistance rating for the structural and non-structural elements are based on guidelines as per approved and accepted standards. The fire rating should be validated and certified with a view to meeting the requirements of Table 1. In the absence of any validated/certified rating, guidance may be obtained from the information available in Annex C.

3.4.3 Load bearing steel beams and columns of buildings having total covered area of 500 m^2 and above need to be protected against failure/collapse of structure in case of fire. This could be achieved by use of appropriate

methodology using suitable fire resistance rated materials along with suppression system (*see* Annex C, Table 25, and Table 26).

3.4.4 The false ceiling, including all fixtures used for its suspension, need to be of non-combustible material. To provide adequate fire resistance to the ceiling in order to prevent spread of fire across ceiling.

3.5 General Requirements of All Individual Occupancies

3.5.1 *General*

All buildings should satisfy certain requirements, which contribute, individually and collectively, to the safety of life from fire, smoke, fumes, and panic arising from these or similar causes. There are, however, certain general principles and common requirements, which are applicable to all or most of the occupancies.

Table 1 Fire Resistance Ratings of Structural and Non-Structural Elements (in minutes)

(*Clauses* 3.4.1, 3.4.2, 3.5.9.1, 3.5.9.2 *and* F-2.1)

Sl No.	Structural/Non-Structural Element	Fire Resistance Ratings (min) for Type of Construction			
		Type 1	Type 2	Type 3	Type 4
(1)	(2)	(3)	(4)	(5)	(6)
i)	Exterior walls:				
	a) Fire separation less than 3.7 m:				
	1) Bearing	240	120	120	60
	2) Non-bearing	120	90	60	60
	b) Fire separation of 3.7 m or more but less than 9 m:				
	1) Bearing	240	120	120	60
	2) Non-bearing	90	60	60	60
	c) Fire separation of 9 m or more:				
	1) Bearing	240	120	120	60
	2) Non-bearing	60	60	60	60
ii)	Fire separation assemblies (like fire check doors)	120	120	120	120
iii)	Fire enclosures of exits	120	120	120	120
iv)	Shafts for services, lift hoistway and refuse chutes	120	120	120	120
v)	Vertical separation between adjacent tenant spaces	60	60	60	60
vi)	Dwelling unit separation:				
	a) Load bearing	120	120	60	60
	b) Non-load bearing	60	60	30	30
vii)	Interior bearing walls, bearing partitions, columns, beams, girders, trusses (other than roof trusses) and framing				
	a) Supporting more than one floor	240	120	120	120
	b) Supporting one floor only	180	90	60	60
	c) Supporting a roof only	180	90	60	60

Sl No.	Structural/Non-Structural Element	Fire Resistance Ratings (min) for Type of Construction			
		Type 1	Type 2	Type 3	Type 4
(1)	(2)	(3)	(4)	(5)	(6)
viii)	Walls supporting structural members	180	90	60	60
ix)	Floor construction	120	90	60	60
x)	Roof construction:				
	a) 5 m or less in height to lowest member	120	90	60	60
	b) More than 5 m but less than 6.7 m in height to lowest member	60	60	60	60
	c) 6.7 m or more in height to lowest member	0 60*	0 60*	0 60*	0 60*
* 60 min should be adopted when associated building services/cables are running at higher levels and supported from/near the roof, like in airports.					

3.5.2 *Exceptions and Deviations*

Exceptions and deviations to the general provisions of requirements of individual occupancies are given as applicable to each type of occupancy in 6.1 to 6.9. In case of practical difficulty or to avoid unnecessary hardship, without sacrificing reasonable safety, local head, fire services may consider exemptions from this Part.

3.5.3 *Occupation of Buildings under Construction*

3.5.3.1 A building or portion of the building may be occupied during construction, repairs, alterations, or additions only if all means of exit and fire protection measures are in place and continuously maintained for the occupied part of the building.

3.5.3.2 A high rise building during construction should be provided with the following fire protection measures, which should be maintained in good working condition at all the times:

a) Dry riser of minimum 100 mm diameter pipe with hydrant outlets on the floors constructed with a fire service inlet to boost the water in the dry riser and maintenance should be in accordance with good practice [F(5)].

b) Drums of 2 000 litre capacity filled with water with two fire buckets on each floor;

c) A water storage tank of minimum 20 000 litre capacity, which may be used for other construction purposes also.

3.5.4 *Openings in Fire Resistant Walls and Floors*

3.5.4.1 At the time of designing openings in fire-resistant walls and floors, particular attention should be paid to all such factors which limit fire spread through these openings and maintain fire rating of the structural members.

3.5.4.2 For Types 1 to 3 constructions, a doorway or opening in a fire resistant wall on any floor should be limited to 5.6 m^2 in area with a maximum height/width of 2.75 m. Every wall opening should be protected with fire-resisting doors, having the fire rating of not less than 120 min. The openings in the floors should be protected by vertical enclosures extending above and below such openings, such enclosures having a fire resistance of not less than 120 min and all openings therein being protected with a fire-resisting assembly as specified in 3.5.4.6.

For escalator-like openings, the smoke spill should be avoided by provision of smoke barrier (of 450 mm to 600 mm) thereby creating smoke compartment. Further, the protection should be ensured through installation of sprinklers on all sides of the cut out opening on each floor (*see* Fig. 5 for details).

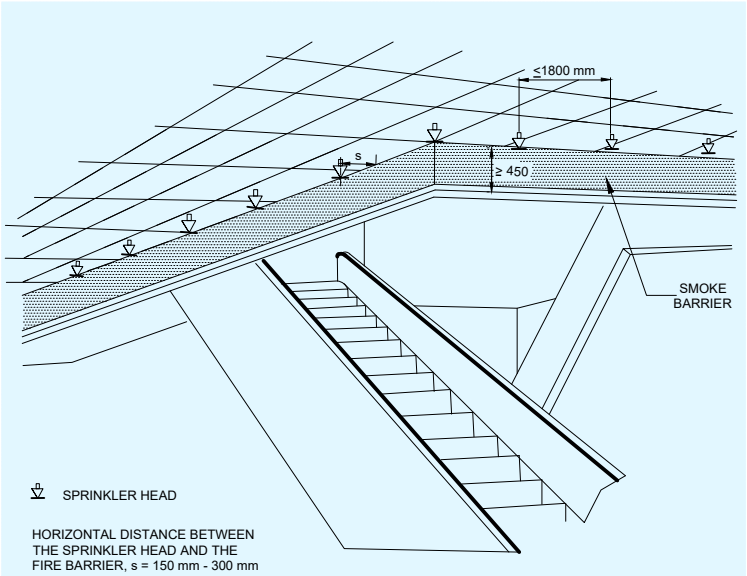


FIG. 5 SPRINKLERS AROUND ESCALATOR OPENING

3.5.4.3 For Type 4 construction, openings in the fire separating walls or floors should be fitted with 120 min fire-resistance rated assemblies.

3.5.4.4 *Service ducts and shafts*

Openings in walls or floors which are necessary to be provided to allow passages of all building services like cables, electrical wirings, telephone cables, plumbing pipes, etc, should be protected by enclosure in the form of ducts/shafts having a fire resistance not less than 120 min. The inspection door for electrical shafts/ducts should be not less than 120 min, with 30 min insulation. Further, medium, and low voltage wiring running in shafts/ducts, should either be armoured type or run through metal conduits.

The space between the electrical cables/conduits and the walls/slabs should be filled in by a fire stop material {see accepted standard [F(34)]} having fire resistance rating of not less than 120 min. This should exclude requirement of fire stop sealing for low voltage services shaft.

For plumbing shafts in the core of the building, with shaft door opening inside the building, the shafts should have inspection doors having fire resistance rating not less than 30 min.

For plumbing shafts doors which open in wet areas or in naturally ventilated areas or on external wall of the building, the shafts may not require doors having any specified fire rating.

NOTE — In the case of buildings where it is necessary to lower or lift heavy machinery or goods from one floor to the other, it may be necessary to provide larger openings in the floor. Such openings should be provided with removable covers which should have the same strength and fire resistance as the floor.

3.5.4.5 *Refuse chutes*

Refuse chutes, if any provided in a building, should have opening at least 1 m above roof level for venting purpose and they should have an enclosure wall of non-combustible material with fire resistance of not less than 120 min. They should not be located within the staircase enclosure or service shafts, or air conditioning shafts. Refuse chutes inspection panel and doors should be tight fitting with 60 min fire resistance. Sprinkler protection system should be provided for the refuse chutes. Refuse chutes should be at least 3 m away from exits.

3.5.4.6 *Vertical opening*

Every vertical opening between the floors of a building should be suitably enclosed or protected, as necessary, to provide the following:

a) Reasonable safety to the occupants while using the means of egress by preventing spread of fire, smoke,

or fumes through vertical openings from floor to floor to allow occupants to complete their use of the means of egress. Further it should be ensured to provide a clear height of 2 100 mm in the exit access.

b) Limitation of damage to the building and its contents.

3.5.5 *Electrical Installation*

3.5.5.1 For requirements regarding electrical installations from the point of view of fire safety, reference may be made to good practice [F(6)] and Part D 'Building Services, Section 2 Electrical and Allied Installations' of this NBCS.

In general, it is desirable that the wiring and cabling are with flame retardant property. Medium and low voltage wiring running in shafts, and within false ceiling should run in metal conduit. Any 230 V wiring for lighting or other services, above false ceiling, should have 660 V grade insulation. See also Part D/Sec 2 for wires having options of fire resistance.

The electric distribution cables/wiring should be laid in a separate shaft. The shaft should be sealed at every floor with fire stop materials, see accepted standard [F(34)] having the same fire resistance as that of the floor. High, medium, and low voltage wiring running in shaft and in false ceiling should run in separate shaft/conduits.

Water mains, gas pipes, telephone lines, intercom lines or any other service line should not be laid in the duct for electrical cables; use of bus ducts/solid rising mains instead of cables is preferred.

All metallic items like steel structural members, etc, should be bonded properly to the earthing system.

3.5.5.2 *Emergency power for fire and life safety systems*

Emergency power supplying distribution system for critical requirement for functioning of fire and life safety system and equipment should be planned for efficient and reliable power and control supply to the following systems and equipment where provided:

a) Fire pumps;

b) Pressurization and smoke venting; including its ancillary systems such as dampers and actuators;

c) Fireman's lifts (including all lifts);

d) Exit signage lighting;

e) Emergency lighting;

f) Fire alarm system;

g) Public address (PA) system (relating to emergency voice evacuation and annunciation);

h) Magnetic door hold open devices; and

j) Lighting in fire command centre and security room.

Power supply to these systems and equipment should be from normal and emergency (standby generator) power sources with changeover facility (*see* Fig. 6A and Fig. 6B indicating options). If power supply is from HV source and HV generation, the transformer should be planned in standby capacity to ensure continuity of power to such systems. Wherever transformers are installed at higher levels in buildings and backup DG sets are of higher voltage rating, then dual redundant cables should be taken to all transformers. The generator should be capable of taking the starting current of all the fire and life safety systems and equipment as above. Where a parallel HV/LV supply from a separate substation fed from a different grid is provided with an appropriate transformer for emergency, the provision of generator may be waived in consultation with the Authority.

The power supply to the panel/distribution board of these fire and life safety systems should be through fire proof enclosures (tested and certified) or fire survival cables or through alternate route in the adjoining fire compartment to ensure supply of power is reliable to these systems and equipment. It should be ensured that the cabling from the adjoining fire compartment is protected within the compartment of vulnerability. The location of the panel/ distribution board feeding the fire and life safety system should be in fire safe zone ensuring supply of power to these systems.

Circuits of such emergency system should be protected at origin by an automatic circuit breaker with its no-volt coil removed. Master switches controlling essential service circuits should be clearly labelled.

Cables for fire alarm and PA system should be laid in metal conduits or armoured to provide physical segregation from the power cables.

3.5.5.3 *Substation/Transformers*

Areas in substation should not be used as storage/dump areas or for other utility purposes other than those required for the functioning of the substation.

The substation area should be adequately ventilated.

An independent, ventilated or air conditioned electrical substation and LT panel room/area should be provided on the ground level or first basement. They should be provided with access from outside (or through exit passageway accessible from outside). The electrical substation and LT panel room/area should be provided with fire resistant walls and doors of fire resistance of not less than 120 min.

If the licensees agree to provide meters on upper floors, the licensees' cables should be segregated from consumers' cables by providing a partition in the shaft. Meter rooms on upper floors should not open into staircase enclosures and should be ventilated directly to open air outside or in electrical room of 120 min fire resistant walls.

Electrical MV main distribution panel and lift panels should be provided with CO_2/inert gas flooding system for all panel compartments with a cylinder located beside the panel.

3.5.5.3.1 *Oil filled substation*

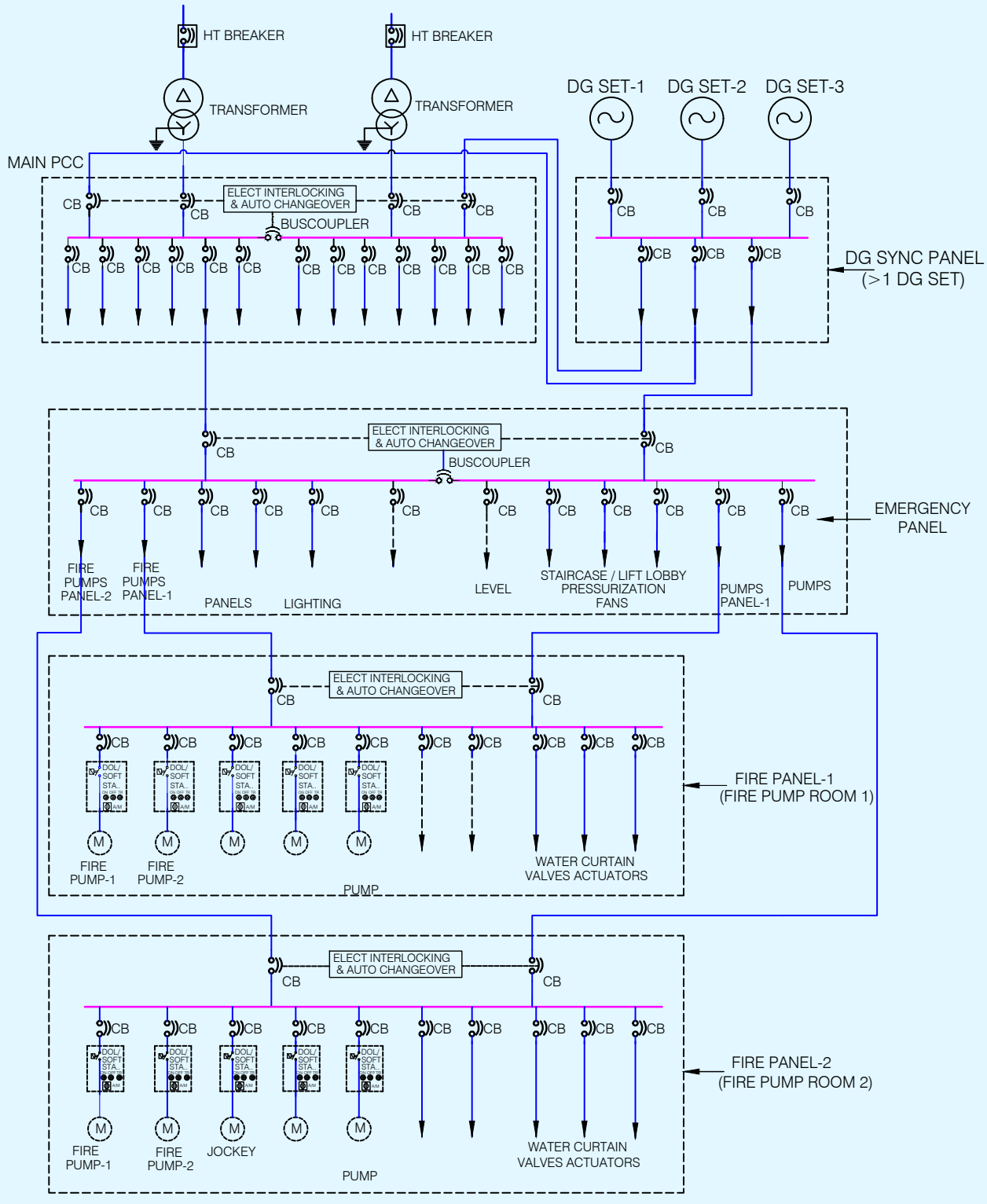
A substation or a switch-station with oil filled equipment should be limited to be installed in utility building or in outdoor location. Such substation/utility building should be at least 6 m away (or as per local requirements/actual width of fire driveway) from the adjoining building(s).

Substation equipment (exceeding aggregate oil capacity of 2 000 litre) in utility building should have fire rated baffle walls of 240 min rating constructed between such equipment, raised to at least 600 mm above the height of the equipment (including height of oil conservators/explosion vents) and exceeding 300 mm on each side of the equipment.

All transformers where capacity exceeds 10 MVA should be protected by high velocity water spray systems/ high pressure water mist system. In addition, nitrogen injection systems may also be provided where applicable.

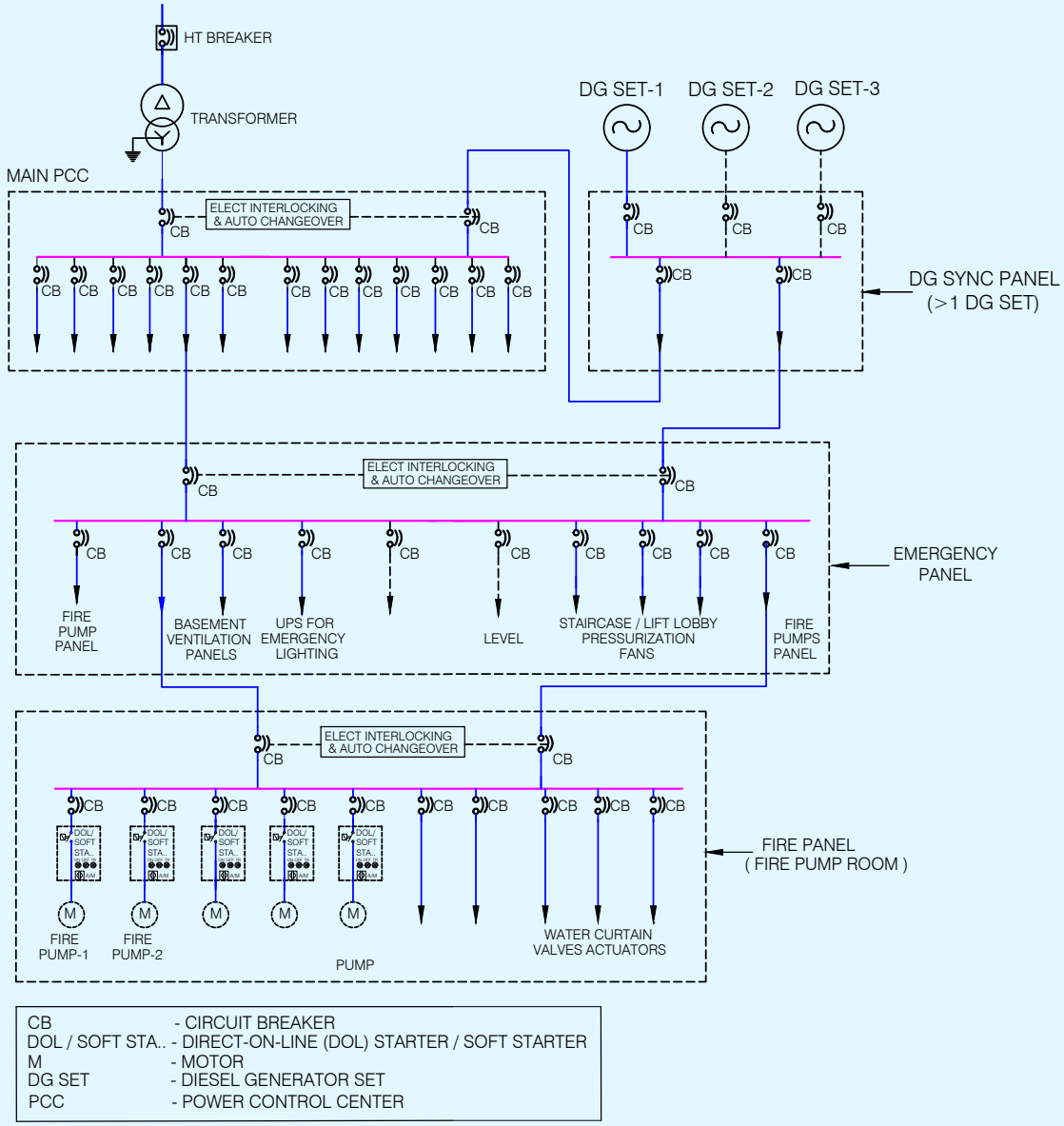
3.5.5.3.2 *Dry type substation*

Transformers located inside a building should be of dry type and all substation/switch room walls, ceiling, floor, opening including doors should have a fire resistance rating of 120 min. Access to the substation should be provided from the nearest fire exit/exit staircase for the purpose of electrical isolation.



CB	- CIRCUIT BREAKER
DOL / SOFT STA..	- DIRECT-ON-LINE (DOL) STARTER / SOFT STARTER
M	- MOTOR
DG SET	- DIESEL GENERATOR SET
PCC	- POWER CONTROL CENTER

6A FIRE PUMP CIRCUIT DEPICTING DISTRIBUTION SCHEME WITH MULTIPLE TRANSFORMERS AND DG SETS



6B FIRE PUMP CIRCUIT DEPICTING DISTRIBUTION SCHEME WITH SINGLE TRANSFORMER AND DG SETS

FIG. 6 FIRE PUMP CIRCUIT DRAWINGS

3.5.5.4 *Standby supply*

Diesel generator set(s) should not be installed at any floor other than ground/first basement. If the same are installed indoors, proper ventilation and exhaust should be planned. The DG set room should be separated by 120 min fire resistance rated walls and doors.

The oil tank for the DG sets (if not in the base of the DG) should be provided with a dyked enclosure having a volumetric capacity of at least 10 percent more than the volume of the oil tank. The enclosure should be filled with sand for a height of 300 mm.

See Table 9 for specific fire protection guidelines. For detailed information regarding fire safety requirements for hazardous petroleum products, reference may be made to *The Petroleum Act*, 1934 and the Rules framed thereunder.

3.5.5.5 *Lightning protection of buildings*

Routing of down conductors (insulated or uninsulated) of lightning protection through electrical or other service shafts are not allowed as it can create fire and explosion during lightning. For details, *see* Part D 'Building Services, Section 2 Electrical and Allied Installations' of this NBCS.

3.5.6 *Escape Lighting and Exit Signage*

Exit access, exits, and exit discharge should be properly identified, with adequate lighting maintained in the elements of the egress systems so that all occupants should be able to leave the facility safely.

3.5.6.1 *Lighting*

a) The exit, exit access and exit discharge systems should be illuminated continuously. The floors of the means of egress should be illuminated at all points, including angles and intersections, in corridors and passageways, stairwells, landings of stairwells and fire exit;

b) Emergency lighting should be powered from a source independent of that supplying the normal lighting;

c) Escape lighting should be capable of,

   1) indicating clearly and unambiguously the escape routes;

   2) providing adequate illumination along such routes to allow safe movement of persons towards and through the fire exits; and

   3) ensuring that fire alarm call points and firefighting equipment provided along the escape routes can be readily located.

d) The horizontal luminance at floor level on the centreline of an escape route should not be less than 10 lumen/m^2. In addition, for escape routes up to 2 m wide, 50 percent of the route width should be lit to a minimum of 5 lumen/m^2. In auditoriums, theatres, concert halls and such other places of assembly, the illumination of floor exit/access may be reduced during period of performances to values not less than 2 lux;

e) Required illumination should be arranged such that the failure of any single lighting unit, such as the burning out of one luminaire, will not leave any area in darkness and does not impede the functioning of the system further;

f) The emergency lighting should be provided to be put on within 5 s of the failure of the normal lighting supply. Also, emergency lighting should be able to maintain the required illumination level for a period of not less than 90 min in the event of failure of the normal lighting even for smaller premises;

g) Battery pack emergency lighting, because of its limited duration and reliability, should not be allowed to be used in lieu of a diesel engine driven emergency power supply;

h) Escape lighting luminaires should be sited to cover the following locations:

   1) Near each intersection of corridors,

   2) At exits and at each exit door,

   3) Near each change of direction in the escape route,

   4) Near each staircase so that each flight of stairs receives direct light,

   5) Near any other change of floor level,

   6) Outside each final exit and close to it,

   7) Near each fire alarm call point,

   8) Near firefighting equipment, and

   9) To illuminate exit and safety signs as required by the enforcing authority.

   NOTE — For the purpose of this clause 'near' is normally considered to be within 2 m measured horizontally.

j) The luminaires should be mounted as low as possible, but at least 2 m above the floor level; and

k) Signs are required at all exits, emergency exits and escape routes, which should comply with the graphic requirements of the relevant Indian Standards.

3.5.6.2 Exit passageway and staircase lighting should also be connected to alternative supply. The alternative source of supply may be provided by battery continuously trickle charged from the electric mains. Suitable arrangements should be made by installing double throw switches to ensure that the lighting installed in the staircase and the corridor does not get connected to two sources of supply simultaneously. Double throw switch should be installed in the service room for terminating the stand-by supply.

3.5.6.3 The emergency lighting system should be well maintained by periodical inspections and tests so as to ensure their perfect serviceability at all times.

3.5.6.4 *Exit signage*

Where exit access is provided through corridors/paths, the occupants should be able to easily identify the way to exits. Exit signs should be provided such that no point in an exit access is more than 30 m from a visible exit directional sign. An exit sign indicating the direction to an exit should be provided at all changes in direction.

Exits should be clearly visible and the route to reach the exits should be clearly marked and signs posted to guide the occupants of the floor concerned. Signs should be illuminated and wired to an independent electrical circuit on an alternative source of supply. The sizes and colours of the exit signs should be in accordance with good practice [F(7)]. The colour of the exit signs should be green.

NOTE — This provision should not apply to A-II and A-IV occupancies less than 15 m in height.

The exit sign with arrow indicating the way to the escape route should be provided at a suitable height from the floor level on the wall and should be illuminated by electric light connected to corridor circuits. All exit way marking signs should be so installed that no mechanical damage should occur to them due to moving of furniture or other heavy equipment. Further, all landings of floor should have floor indicating boards prominently indicating the number of the floor.

Photo luminescent markings should be pasted at internal hydrant boxes.

3.5.7 *Air Conditioning, Ventilation and Smoke Control*

3.5.7.1 Air conditioning and mechanical ventilation requirements of different rooms or areas in any occupancy should be as given in Part D ‘Building Services, Section 1 Lighting and Natural Ventilation' and ‘Section 3 Air conditioning, Heating and Mechanical Ventilation’ of this NBCS.

Air conditioning and ventilating systems should be so installed and maintained as to minimize the danger of spread of fire, smoke, or fumes from one floor to another or from outside to any occupied building or structure.

Many high-rise buildings integrate smoke management systems into their conventional HVAC systems. In such installation, it requires special design considerations, including safe and adequate controls, acceptable and documented testing, and regular maintenance systems.

Wherever batteries are provided, the same should be segregated by 120 min fire rated construction. Ventilation to the room should be provided as per manufacturer's instructions.

3.5.7.2 *Air handling unit*

3.5.7.2.1 From fire safety point of view, separate air handling units (AHU) for each floor should be provided so as to avoid the hazards arising from spread of fire and smoke through the air conditioning ducts. The air ducts should be separate from each AHU to its floor and in no way should interconnect with the duct of any other floor. Within a floor it would be desirable to have separate air handling unit provided for each compartment.

Air handling unit should be provided with effective means for preventing circulation of smoke through the system in the case of a fire in air filters or from other sources drawn into the system, and should have smoke sensitive devices for actuation in accordance with the accepted standard [F(8)] and control.

3.5.7.2.2 Shafts or ducts, if penetrating multiple floors, should be of masonry construction with fire damper in connecting ductwork or should have fire rated ductwork with fire dampers at floor crossing. Alternatively, the duct and equipment may be installed in room having walls, doors and fire damper in duct exiting/entering the room of 120 min fire resistance rating. Such shafts and ducts should have all passive fire control meeting 120 min fire resistance rating requirement to meet the objective of isolation of the floor from spread of fire to

upper and lower floors through shaft/duct work.

NOTE — Zoned and compartmented HVAC systems are encouraged with an approach to avoid common exhaust shafts and fresh air intake shafts which will limit the requirement of such passive measure and fire rated duct work and dampers.

3.5.7.2.3 The air filters of the air handling units should be made of non-combustible materials.

3.5.7.2.4 The air handling unit room should not be used for storage of any combustible materials.

3.5.7.3 *Duct work*

3.5.7.3.1 Air ducts serving main floor areas, corridors, etc, should not pass through the fire exits/exit passageway/ fire exit enclosure. Fire exits and lift lobbies, etc, should not be used as return air passage.

3.5.7.3.2 As far as possible, metallic ducts (of suitable rating) should be used even for the return air instead of space above the false ceiling.

3.5.7.3.3 Wherever the ducts pass through fire walls or floors, the opening around the ducts should be sealed with materials having fire resistance rating of the compartment {*see* accepted standard [F(34)]}. Such duct should also be provided with fire dampers at all fire walls and floors unless such ducts are required to perform for fire safety operation; and in such case fire damper may be avoided at fire wall and floor while integrity of the duct should be maintained with 120 min fire resistance rating to allow the emergency operations for fire safety requirements.

3.5.7.3.4 The ducting within compartment would require minimum fire resistance rating of 30 min. Such ducting material in substantial gauge should be in accordance with good practice [F(9)]. If such duct crosses adjacent compartment/floor and not having fire dampers in such compartment/floor, it would require fire resistance duct work rating of 120 min. The requirements of support of the duct should meet its functional time requirement as above.

3.5.7.3.5 The materials used for insulating the duct system (inside or outside) should be of non-combustible type. Any such insulating material should not be wrapped or secured by any material of combustible nature.

3.5.7.3.6 Inspection panels should be provided in the ductwork to facilitate the cleaning of accumulated dust in ducts and to obtain access for maintenance of fire dampers.

3.5.7.4 *Fire or fire/smoke dampers*

3.5.7.4.1 These dampers should be evaluated to be located in supply air ducts, fresh air and return air ducts/ passages at the following points:

a) At the fire separation wall,

b) Where ducts/passages enter the vertical shaft,

c) Where the ducts pass through floors, and

d) At the inlet of supply air duct and the return air duct of each compartment on every floor.

3.5.7.4.2 Damper should be of motorized type/fusible link. Damper should be so installed to provide complete integrity of the compartment with all passive fire protection sealing. Damper should be accessible to maintain, test and also replace, if so required. Damper should be integrated with fire alarm panel and should be sequenced to operate as per requirement and have interlocking arrangement for fire safety of the building. Manual operation facilities for damper operation should also be provided. Tested and certified dampers for dynamic condition are preferable.

3.5.8 *Heating*

3.5.8.1 Installation of chimney and heating apparatus should be in accordance with good practice [F(10)].

3.5.8.2 *Boiler rooms*

3.5.8.2.1 Provisions of boiler and boiler rooms should conform to *The Boilers Act*, 1923.

3.5.8.2.2 Further, the following additional aspects may be taken into account in the location of boiler room:

a) The boilers should be installed in a fire resisting room of 180 min fire resistance rating;

b) Entry to this room should be provided with a composite door of 120 min fire resistance rating;

c) The boiler room should be provided with its dedicated natural or mechanical ventilation system. Mechanical ventilation system for the boiler room would be accepted with 120 min fire resistance rating ductwork if it has interface with other mechanical areas. Ventilation system should not be allowed to be routed through electrical room area or through exit corridor/exits; and

d) The oil tank for the boiler should be provided with a dyked enclosure having a volumetric capacity of at least 10 percent more than the volume of the oil tank. The enclosure should be filled with sand for a height of 300 mm.

3.5.9 *Glazing*

3.5.9.1 The glazing should be in accordance with Part C 'Structural Design, Section 8 Glass and Glazing' of this NBCS. The entire glazing assembly should be rated to that type of construction as given in Table 1. This should be applicable along with other provisions of this Part related to respective uses as specified therein. The use of glass should not be permitted for enclosures of exits and exit passageway.

3.5.9.2 Glass facade should be in accordance with the following:

a) For fully sprinklered buildings having fire separation of 9 m or more, tempered glass in a non-combustible assembly, with ability to hold the glass in place, should be provided. It should be ensured that sprinklers are located within 600 mm of the glass facade providing full coverage to the glass. Where the fire separation is less than 9 m, additional protection such as using a minimum 900 mm spandrel panel of 1 h fire resistance rating should be provided;

NOTE — In case of all other buildings, fire resistance rating of glass facade should be in accordance with Table 1.

b) All gaps between floor-slabs and facade assembly should be sealed at all levels by approved fire resistant sealant material of equal fire rating as that of floor slab to prevent fire and smoke propagation from one floor to another. *See also* accepted standard [F(35)]; and

c) Openable panels should be provided on each floor and should be spaced not more than 10 m apart measured along the external wall from centre-to-centre of the access openings. Such openings should be operable at a height between 1.2 m and 1.5 m from the floor, and should be in the form of openable panels (fire access panels) of size not less than 1 000 mm × 1 000 mm opening outwards. The wordings, 'FIRE OPENABLE PANEL — OPEN IN CASE OF FIRE, DO NOT OBSTRUCT' of at least 25 mm letter height should be marked on the internal side. Such panels should be suitably distributed on each floor based on occupant concentration. These should not be limited to cubicle areas and should be also located in common areas/corridors to facilitate access by the building occupants and fire personnel for smoke exhaust in times of distress.

3.5.10 *Surface Interior Finishes*

3.5.10.1 The use of combustible surface finishes on walls (including facade of the building) and ceilings affects the safety of the occupants of a building. Such finishes tend to spread the fire and even though the structural elements may be adequately fire resistant, serious danger to life may result. It is, therefore, essential to have adequate precautions to minimize spread of flame on wall, facade of building and ceiling surfaces. The finishing materials used for various surfaces and decor should be such that it should not generate toxic smoke/fumes.

3.5.10.2 The susceptibility of various types of wall surfaces to fire is determined in terms of the rate of spread of flame. Based on the rate of spread of flame, surfacing material should be considered as divided into four classes as follows {*see* also good practice [F(11)]}:

a) Class 1 Surfaces of very low flame spread;

b) Class 2 Surfaces of low flame spread;

c) Class 3 Surfaces of medium flame spread; and

d) Class 4 Surfaces of rapid flame spread.

3.5.10.3 The uses for which surface materials falling into various classes should be adopted in building construction are given below:

Class 1	*Class 2*	*Class 3*
(1)	(2)	(3)
May be used in any situation	May be used in any situation, except on walls, facade of the building, staircase, and corridors	May be used only in living rooms and bed rooms (but not in rooms on the roof) and only as a lining to solid walls and partitions; not on staircases or corridors or facade of the building.

NOTE — Panelling (lining) may be permitted in a limited area; and is not to be permitted in a vestibule.

3.5.10.4 Materials of Class 4 which include untreated wood fibreboards may be used with due fire-retardant treatment as ceiling lining, provided the ceiling is at least, 2.4 m from the top surface of the floor below, and the wall surfaces conform to requirements of the class [*see* Note under **3.5.10.3**]. Class 4 materials should not be used in kitchens, corridors, and staircases. Some materials contain bitumen and, in addition to risk from spread of fire, emit dense smoke on burning; such materials should be excluded from use under these conditions and should also not be used for construction of ceiling where the plenum is used for return air in air-conditioned buildings.

3.5.10.5 When frames, walls, partitions, or floors are lined with combustible materials, the surfaces on both sides of the materials should conform to the appropriate class, because there is considerable danger from fire starting and rapidly spreading within the concealed cavity unknown to the occupants whose escape may be hampered thereby. For detailed information on materials and details of construction with their fire resistance rating, reference may be made to good practice [F(12)].

3.5.10.6 The use of aluminium composite panels as external facade of the buildings should be avoided; if used, such panels should have a minimum of 70 percent mineral core and pass the tests as in accepted standards (*see* Note 2).

NOTES

1 When combustible materials are used for lining frames, walls, partitions, or floors, the surfaces on both sides of the materials must meet the required fire resistance class. This precaution helps mitigate the risk of fire spreading within concealed cavities, which may not be immediately visible to occupants and can hinder evacuation.

2 Accepted standards can be ISO 3957 or ISO 13785 (Part 1 and Part 2).

3.5.11 *Fire Command Centre* (*FCC*)

a) Fire command centre should be on the entrance floor of the building having direct access. The control room should have the main fire alarm panel with communication system (suitable public address system) to aid floors and facilities for receiving the message from different floors;

b) Fire command centre should be constructed with 120 min rating walls with a fire door and should be provided with emergency lighting. Interior finishes should not use any flammable materials. All controls and monitoring of fire alarm systems, pressurization systems, smoke management systems should happen from this room. Monitoring of integrated building management systems, CCTVs or any other critical parameters in building may also be from the same room.

c) Details of all floor plans along with the details of firefighting equipment and installations (2 sets laminated and bound) should be maintained in fire command centre. The fire staff in charge of the fire command centre should be responsible for the maintenance of the various services and firefighting equipment and installations in coordination with security, electrical and civil staff of the building.

NOTE — Panelling (lining) should be permitted in a limited area. It should not be permitted in a vestibule.

4 LIFE SAFETY

4.1 General

Every building should be so designed, constructed, equipped, maintained, and operated as to provide adequate means of egress to avoid undue danger to the life and safety of the occupants from fire, smoke, fumes, or panic during the time period necessary for escape.

For high occupancy areas, it may be required to have annunciation, announcements, and voice guided/aided system to direct the occupants towards safe egress routes, areas of comparative safety or exits, and to avoid situation of panic during distress.

Every main occupancy may have certain occupancies which may be incidental to the main occupancy. The exit requirements pertaining to such incidental occupancies from the floor of the occupancy to the level of exit discharge should be calculated to meet the requirement of the actual occupancy of such type, to ensure adequate means of egress of the occupants.

See also good practice [F(31)] for accessibility for elderly and persons with disabilities, for various requirements for enabling a smooth and safe egress.

4.2 General Exit Requirements

4.2.1 Fire exits are unobstructed component of means of egress which is between the exit access and the exit discharge or public way. Exit components include exterior exit doors at the level of exit discharge, interior exit stairways (pressurised), exit stairway with external wall (pressurised or naturally ventilated), exterior exit stairways, exit passageways, and exterior exit ramps. Fire exits should be provided with panic bar to facilitate entry of occupant into fire exit.

An exit may also include a horizontal exit leading to an adjoining building/fire compartment having its further access to unlocked/public exit at the same level.

4.2.2 Unless otherwise specified, lifts, escalators, moving walks and revolving doors should not be considered as fire exits and should not constitute any part of the required fire exit.

4.2.3 Every fire exit, exit passageway and exit discharge should be continuously maintained free of all obstructions or impediments to full use in the case of fire or other emergency.

4.2.4 Every building having human occupancy should be provided with fire exits sufficient to permit safe egress of occupants, in case of fire or other emergency.

4.2.5 In every building or structure, fire exits should comply with the minimum requirements of this Part, except those not accessible for general public use.

4.2.6 No building should be so altered as to reduce the number, width, or protection of fire exits to less than that required.

4.2.7 For non-naturally ventilated areas (that is, pressurized areas), fire doors with 120 min fire resistance rating should be provided and particularly at the entrance to lift lobby and stair well where a 'funnel or flue effect' may be created, inducing an upward spread of fire, to prevent spread of fire and smoke.

4.2.8 Fire exits should be so arranged that they may be reached without passing through another occupied unit/passage in others control if they pose challenge or restriction in means of egress.

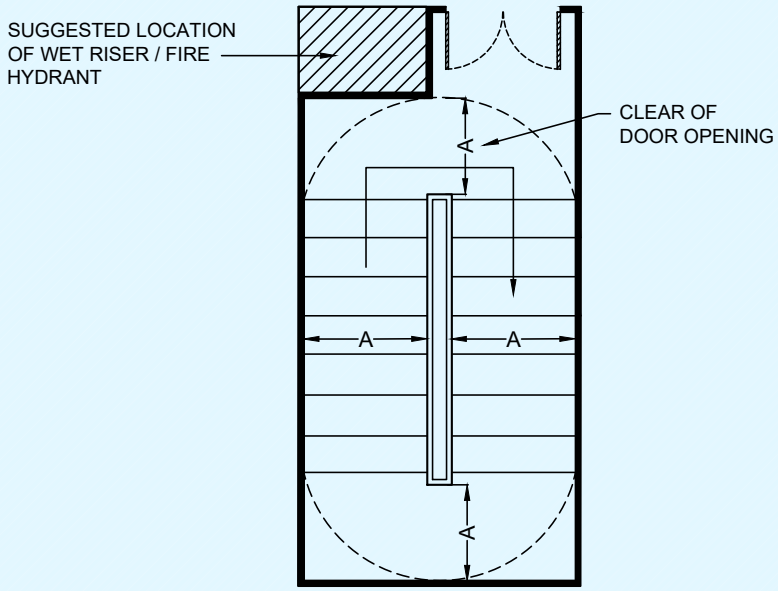
4.2.9 Doors in fire exits should open in the direction of exit. In case of assembly buildings (Group D) and institutional buildings (Group C-1), exit door should not open immediately upon a flight of stair and all such entries to the stair should be through a landing, so that such doors do not impede movement of people descending from a higher floor when fully opened (*see* Fig. 7A). While for other occupancies, such doors should not reduce the pathway in the landing by more than half the width of such staircase (*see* Fig. 7B). Over- head or sliding doors should not be installed.

4.2.10 At least half of the required exit stairs from upper floors (rounded to the next higher number) should discharge directly to the exterior or through exit passageways. For buildings less than 60 m in height, firefighting

shaft should be planned having one side on the external wall and discharging directly to the exterior. In the case of tall buildings (60 m and above), where structural design requires the location of firefighting shaft along with the structural core members, firefighting shaft(s) in the building should discharge directly to the exterior (through exit passageway).

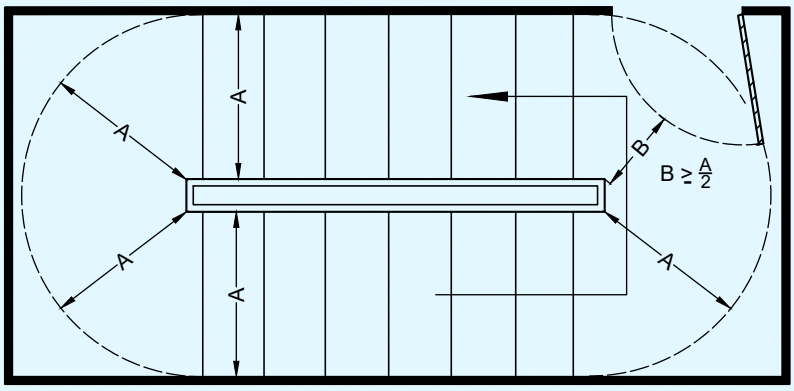
4.2.11 Unless otherwise specified, all the fire exits and exit passageways to exit discharge should have a clear ceiling height of at least 2.4 m. However, the height of fire exit door should be at least 2.0 m (*see* Fig. 8).

4.2.12 Where changes in elevation of more than 300 mm are encountered in the exits, ramps or sloped surfaces should be used with handrails and floor finish materials that contrast with the adjacent finish materials.



NOTE — DOOR WIDTH SHALL BE BASON TYPE OF OCCUPANCY

7A MINIMUM REQUIRED UNOBSTRUCTED CLEARANCE WITH DOOR LEAF ENCROACHING ON LANDING IN INSTITUTIONAL AND ASSEMBLY BUILDING



A - REQUIRED WIDTH

7B MINIMUM REQUIRED UNOBSTRUCTED CLEARANCE WITH DOOR LEAF ENCROACHING ON LANDING

FIG. 7 DOOR LOCATION AT LANDING IN FIRE EXITS

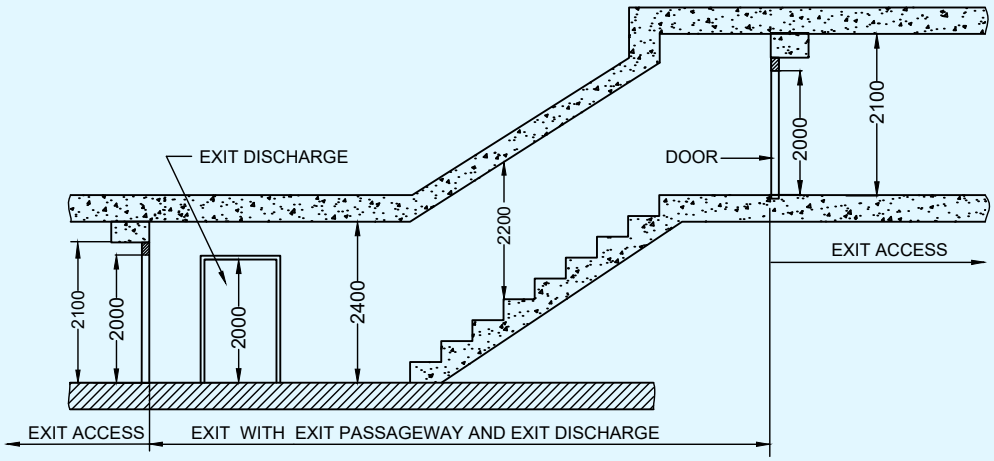


FIG. 8 MINIMUM HEAD ROOM MEASUREMENT

4.2.13 The capacity of the means of egress required from any storey of the building should-not be reduced along the path of egress travel until arrival to the exit discharge.

4.2.14 The lifts, escalators, moving walks, turnstiles and revolving doors should not be considered in determining the required capacity of means of egress for the individual floor(s) or the building.

4.2.15 Turnstiles or similar devices that restrict travel to one direction or that are used to restrict unauthorized entry should not be so placed as to obstruct any required means of egress. Alternative door openings of required exit width should be available within 3 m of such devices, if installed.

4.2.16 Suitable means should be provided so that all access-controlled exit doors, turnstiles, boom barriers and other such exits should automatically operate to open mode during emergencies like fire, smoke, acts of terrorism, etc, so that people can safely and quickly egress into safe areas outside. If required, a master controlling device may be installed at a strategic location to achieve this.

4.2.17 Penetrations into and openings through fire exit are prohibited except those necessary, like for the fire protection piping, ducts for pressurization and similar life safety services. Such openings as well as vertical passage of shaft through floors should be protected by passive systems, {see accepted standard [F(34)]}.

4.2.18 Walking surfaces in exit access should comply with the following requirements for smooth exit:

a) Walking surfaces should be nominally level;

b) The slope of walking surface in the direction of travel should not exceed 1 in 20 unless the ramp requirements are met (*see* **4.4.2.4.3.5**);

c) Slope perpendicular to the direction of travel should not exceed 1 in 48; and

d) Walking surfaces should be slip-resistant along the entire path of travel.

4.2.19 *Basement*

4.2.19.1 The basement should not be used for hazardous and vulnerable activities, like sleeping purposes, class rooms, hazardous industries, restaurant kitchen (*see also* **4.7.9**), battery rooms, UPS rooms, fuel oil storage, etc However, the State Authorities may prescribe the list of such activities based on their own assessment. Basements should have smoke ventilation systems, high-density sprinkler systems, and redundant/enclosed exits.

4.2.19.2 The fire exits in a basement should be sufficient to provide for the capacity of the basement occupancy as determined in accordance with **4.4.2.1**. In no case should there be fewer than two independent basement exits.

4.2.19.3 Basements with incidental occupancies to the main occupancy should be planned with exit requirements for the actual occupancy within the basement.

4.2.19.4 Where a basement is used for car parking and also there is direct approach from any occupancy above to the basement, door openings leading to the basement should be protected with fire doors with 120 min fire resistance rating, except for exit discharge doors from the basements.

4.2.19.5 Basements should have a minimum clear height of 3.4 m towards effective performance in the event of fire/smoke. Impulse or duct ventilation system needs to be designed to ensure removal of hot gases and smoke from each compartment to achieve reasonable visibility and heat reduction for firefighting operations.

4.3 Occupant Load

For determining the fire exits required, the number of persons within any floor area or the occupant load should be based on the actual number of occupants declared, but in no case less than that specified in Table 2. The occupant load of a mezzanine floor discharging to a floor below should be added to that floor occupancy and the capacity of the fire exits should be designed for the total occupancy load thus established.

The occupant load of each storey considered individually should be required to be used in computing the number of means of egress at each storey, provided that the required number of means of egress is not decreased in the direction of egress travel.

Table 2 Occupant Load

[*Clauses* 4.3, 4.4.2.1 *and* H-4.1(j)]

Sl No.	Building Occupancy	Net Occupant Load Factor (m^2/person) (*see* Note 7)	Gross Occupant Load Factor (m^2/person) (*see* Note 1)
(1)	(2)	(3)	(4)
i)	Group A: Residential	12.5	-
ii)	Group B: Educational	3.0	-
iii)	Group C: Institutional (*see* Note 2)		
	a) Nursing homes	-	12.0
	b) Clinic (daycare)	-	12.0
	c) Inpatient area in hospital (like ward, sleeping area)	11.0	-
	d) Outpatient area in hospital	7.0	-
iv)	Group D: Assembly		
	a) Concentrated use without fixed seating	0.65	-
	b) Less concentrated use without fixed seating such as pre-function, multipurpose hall)	1.40	-
	c) Fixed seating	*see* Note 4	-
	d) Dining areas and restaurants with seating and table	1.80	-
	e) Gymnasium, sports room, library and alike with equipment, stacks and the like. This includes performance stages, indoor badminton court, squash court with	4.6	-

Table 2 (*Continued*)

Sl No.	Building Occupancy	Net Occupant Load Factor (m^2/person) (*see* Note 7)	Gross Occupant Load Factor (m^2/person) (*see* Note 1)
(1)	(2)	(3)	(4)
	limited number of performers and player (while audience for the same if any should be under (c) as above).		
	f) Swimming pool		
	1) Water surface	3.5	-
	2) Deck	2.0	-
	g) Mall – Basement with sales floor	2.1	-
	h) Mall – Street floor	2.1	-
	j) Mall – Upper sales floor	4.3	-
	k) Mall – Food court	-	1.8
	m) Mall – Theatre screens	-	*see* Note 4
	n) Storage/warehouse, receiving and the like	14.3	-
v)	Group F: Mercantile		
	a) Street floor and above	-	2.1
	b) Below street floor	-	3.0
vi)	Group E: Business	7.1	-
vii)	Group E: For Datacentres	-	20.0
	a) Admin areas	-	10.0
	b) Data hall, server room, equipment room areas	- *see* Annex G	50.0 *see* Annex G
viii)	Group G: Industrial	-	
	a) Low hazard	-	20.0
	b) Moderate hazard	-	15.0
	c) High hazard	-	10.0
ix)	Group H: Storage (*see* Note 5)	-	30.0
x)	Group J: Hazardous	-	10.0

NOTES

1 Gross area is the floor area as defined in **2.35**.

2 Occupant load factor in dormitory portions of homes for the aged, orphanages, insane asylums, etc, where sleeping

Table 2 (*Concluded*)

Sl No.	Building Occupancy	Net Occupant Load Factor (m^2/person) (*see* Note 7)	Gross Occupant Load Factor (m^2/person) (*see* Note 1)
(1)	(2)	(3)	(4)

accommodation is provided, should be calculated at not less than 7.5 m^2 gross floor area/person.

3 Commercial kitchen in the above occupancies should be calculated at 9.3 m^2 net floor area/person.

4 In case of assembly occupancy having fixed seats, the occupant load should be determined by multiplying the number of seats by 1.2.

5 Car parking areas under occupancy other than storage should also be 30 m^2 per person.

6 Usable carpet area is the total of all corridors, passages, enclosed offices/rooms excluding rack and UPS/battery foot print

7 Net area is not the carpet area. *See* **2.36**.

* Gross area is highly recommended to be used than the net area, to avoid double counting. Net area is possible to be indicated for spaces having concentration of people is typical in certain occupancies; and other common spaces/areas in a floor plate may be used by the same set of occupants. Moreover, gross area provides a safer, more conservative occupant load for the entire floor, ensuring exits are sized for the maximum possible capacity. Further, net area is used for specific rooms (like classrooms or assembly halls) where the furniture and layout are predictable, but using it for an entire floor plate often underestimates the total population because it excludes corridors, closets, and wall thicknesses where people still circulate.

4.4 Egress Components

Egress components to be considered are the number of exits to which access is provided, capacity of exit access, travel distance to a fire exit, the obviousness of the direction to a fire exit, and any hindrance including due to security issues involved.

4.4.1 *Exit Access*

a) A common path of travel is desirable in exit access which leads to two independent directions to separate fire exits;

b) *Capacity of Exit Access* — The width of corridors, aisles or ramps required for exit access should be sufficient to ensure a smooth flow of occupants to the fire exit. Where a corridor is the only way of access to a fire exit, the corridor width should not be less than the calculated exit width;

c) Objects like tables, chairs or any other temporary/permanent structures in exit access corridors should be avoided as this may result in congestion and also impeding smooth flow of personnel during emergencies;

d) In order to ensure that each element of the means of egress can be effectively utilized, they should all be properly lit and marked. Lighting should be provided with emergency power back-up in case of power failures. Also, exit signs of adequate size, marking, location, and lighting should be provided so that all those unfamiliar with the location of the fire exits may safely find their way;

e) Exit access to fireman's lift and refuge area/spaces on the floor should be step free and clearly signposted with the international symbol of accessibility;

f) Exit access should not pass through storage rooms, closets or spaces used for similar purpose; and

g) The calculation of capacity of exit access should be in accordance with **4.4.2.4**.

4.4.2 *Exits*

4.4.2.1 *Number of fire exits*

The minimum required number of exits in a building should be determined based on occupant load (*see* Table 2) and width required per person (*see* Table 3) as appropriate to the type of exit for respective occupancies, subject to complying with maximum travel distance requirement (*see* Table 4).

4.4.2.2 *Arrangement of fire exits*

a) Fire exits should be so located that the travel distance on the floor should not exceed the distance given in Table 4.

b) Travel distance should be measured from the most remote point within a storey or a mezzanine floor along the natural and unobstructed path of horizontal or vertical egress travel to the door of a fire exit.

c) The dead-end corridor length in exit access should not exceed 6 m for educational, institutional and assembly occupancies. For other occupancies, the same should not exceed 15 m (*see* Fig. 9).

d) Fire exits should be placed as remote from each other as possible and should be arranged to provide direct access in separate directions from any point in the area served (*see* Fig. 10).

4.4.2.3 *Capacities of means of egress*

a) Exit capacity is the number of people that can pass through a stairway, and level components (door and corridor) and ramps. The total capacity of all the respective means of egress serving a floor should be sufficient to allow egress of the entire population of the floor.

b) The unit of exit width, used to measure the capacity of any exit, is 500 mm. A clear width of 250 mm needs to be counted as an additional half unit. Clear widths less than 250 mm need not be counted for exit width.

c) Width per person for stairways, and level components and ramps are to be determined using the capacity factors in accordance with Table 3.

   For example, if an exit doorway measures 1 000 mm in clear width its capacity factor being 6.5, it would be defined as providing exit capacity for 1 000/6.5 occupants, that is, 153 persons (say 150 persons) and number of such exit doorways can then be calculated depending on the occupant load.

d) When calculating stairways, level components and ramps and other exit means, the capacity of the entire system should have to be based upon the minimum capacity available from any part of the system. The corridor, if so provided, should also to be planned with consideration of exit access adequacy for the number of occupants. Further, consider the situation of doors opening to an exit stairway. If the stairway provides an exit capacity of 150 persons, and the doors leading into the stairway provide an exit capacity of 153 persons, the overall exit system would be considered to provide the minimum exit capacity of only 150 persons afforded by the stairway. The exit planning will be limited by the most restrictive exit calculation under the means of egress.

e) In the procedures for determining required egress capacity, the number of required means of egress is based on a floor-by-floor consideration, rather than the accumulation of the occupant loads of all the floors. However, the number of means of egress cannot decrease as an occupant proceeds along the egress path.

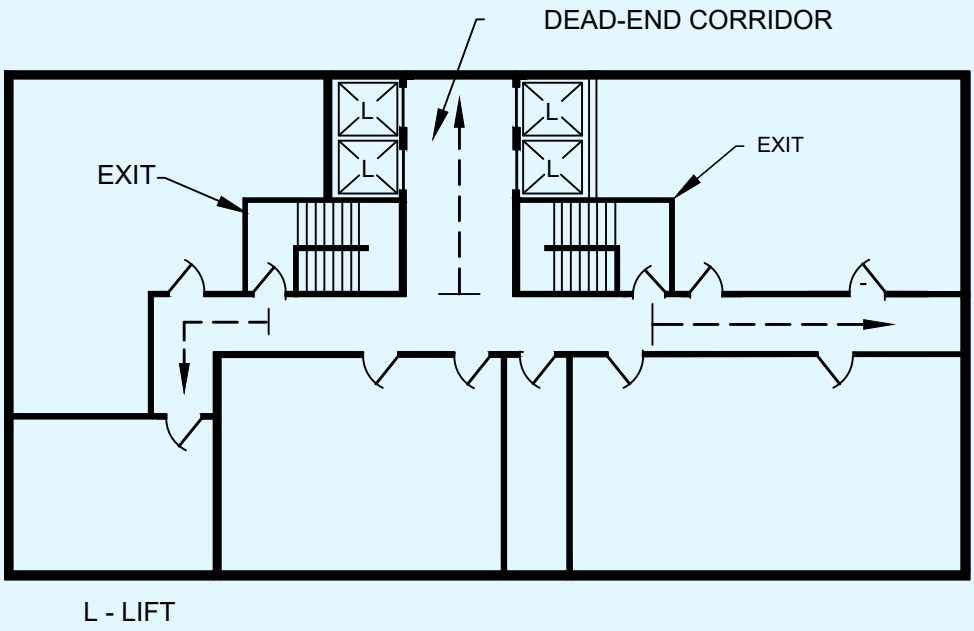
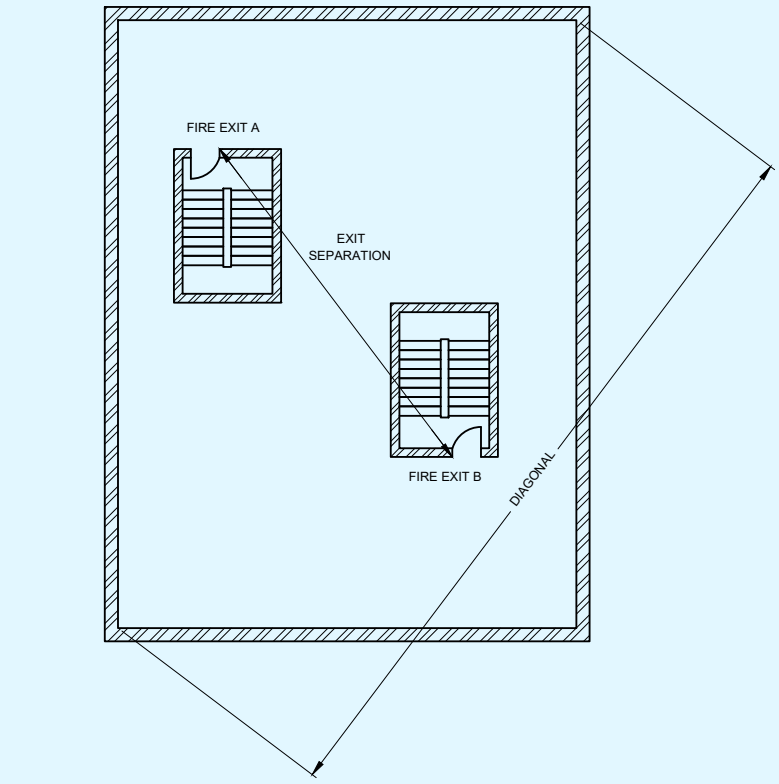


FIG. 9 DEAD END CORRIDOR



NOTE — MINIMUM EXIT SEPARATION = DIAGONAL/2 (FOR UNSPRINKLERED)
= DIAGONAL/3 (FOR SPRINKLERED)

FIG. 10 FIRE EXIT SEPARATION

Table 3 Capacity Factors

[*Clauses* 4.4.2.1, 4.4.2.3(c), 4.4.2.4.1(b), 4.4.2.4.2(a) *and* 4.4.2.4.3.5(a)]

Sl No.	Occupancy Group	Width per Person mm	
		Stairways	Level Components and Ramps
(1)	(2)	(3)	(4)
i)	Residential (Group A)	10	6.5
ii)	Educational (Group B)		
iii)	Institutional (Group C)	15	13
iv)	Assembly (Group D)	10	6.5
v)	Business (Group E)		
vi)	Mercantile (Group F)		
vii)	Industrial (Group G)		
viii)	Storage (Group H)		
ix)	Hazardous (Group J)	18	10

4.4.2.4 *Types of exit access and exits*

Various types of exit access and exits are doorways, corridors and passageways, horizontal exits, internal staircases, exit passageways, external staircases, and ramps.

4.4.2.4.1 *Doorways*

a) Every exit doorway should open into an enclosed stairway or a horizontal exit of a corridor or passageway providing continuous and protected means of egress (*see* Fig. 11 on unaccepted arrangement of doors in a stair).

b) No exit doorway should be less than 1 000 mm in width. Door width in exits should also meet requirement of level components given in Table 3 except assembly buildings, where door width should be not less than 2 000 mm (*see* Fig. 12). Doorways should be not less than 2 000 mm in height.

c) Exit doorways should be operable from the side which they serve, without the use of a key.

d) Mirrors should not be placed on exit doors and in exits, to avoid confusion regarding the direction of exit.

e) Revolving doors can be accepted as a component in a means of egress where the following requirements are fully complied with:

   1) Doors should be capable of collapsing to a book fold position with parallel egress paths, of width not less than 1 000 mm.

   2) Doors should not be located within 3 m of the foot or top of stairs or escalators. A dispersal area should be provided between the stairs or escalators and the doors.

   3) Each revolving door should be provided with a hinged door in the same wall within 3 m thereof, with same exiting capacity.

   4) Each revolving door should be considered as capable of exiting only 50 persons.

f) All fire rated doors and assembly should be provided with certificate and labels prominently indicating

the manufacturer's identification, door details covering door type, serial/batch number, month and year of manufacture, fire resistance rating, etc. The doors and assembly should be certified with all prescribed hardware such as hinges, locks, panic bars, door closers, and door viewers.

g) *Access controlled doors* — Access controlled doors and electromagnetic doors should fall under this category. These should meet the following requirements:

1) Doors should have fire rating as per the requirements at the location of installation;

2) Activation of the building automatic sprinkler or fire detection system, if provided, should automatically unlock the doors in the direction of egress, and the doors should remain unlocked until the automatic sprinkler system or fire-alarm system has been manually reset;

3) Loss of power to the part of the access control system that locks the doors should automatically unlock the doors in the direction of egress;

4) A manual release device should be provided in the readily accessible vicinity of the egress door with a signage 'PUSH TO EXIT' and when the same is operated, it should result in direct interruption of power to the lock, independent of the access control system electronics.

h) *Turnstiles* — Turnstiles or similar devices that restrict travel to one direction or are used to collect fares or admission charges should not be placed so as to obstruct any required means of egress unless door openings of required width are available within 3 m thereof.

Turnstiles or such similar devices should also be disengaged through automatic or manual intervention to allow egress in the direction of exit.

j) Doors in folding partition should not be treated as approved means of egress.

Table 4 Travel Distance (Based on Occupancy and Construction Type)

[*Clauses* 4.4.2.1, 4.4.2.2 (a), 4.4.2.4.2 (a) *and* 6.8.1.1]

Sl No.	Occupancy Group	Maximum Travel Distance m		
		Types 1 and 2 (Unsprinklered)	Types 1 and 2 (Sprinklered)	Types 3 and 4
(1)	(2)	(3)	(4)	(5)
i)	Residential (Group A)	30.00	60.00	22.5
ii)	Educational (Group B)	30.00	45.00	22.5
iii)	Institutional (Group C)	30.00	45.00	22.5
iv)	Assembly (Group D)	30.00	45.00	30.00
v)	Business (Group E)			
	Businesses (including admin area of Datacentre building)	30.00	60.00	30.00
	Datacentre building	N.A.	60.00	N.A.
vi)	Mercantile (Group F)	30.00	45.00	30.00

Table 4 (*Concluded*)

Sl No.	Occupancy Group	Maximum Travel Distance m		
		Types 1 and 2 (Unsprinklered)	Types 1 and 2 (Sprinklered)	Types 3 and 4
(1)	(2)	(3)	(4)	(5)
vii)	Industrial (Group G)			
	G-1, G-2	45.00	60.00	*see* Note 3
	G-3	22.50	45.00	
viii)	Storage (Group H)	30.00	90.00	
ix)	Hazardous (Group J)	22.50	30.00	

NOTES

1 The common path of travel should be not more than 50 percent of the above distances.

2 Ramps are not to be counted as an exit in case of basements below the first basement in car parking.

3 Construction of Type 3 or Type 4 is not permitted.

4 Utility service areas and equipment areas may be exempt from the measurement of travel distance from within the room.

5 For ceiling height 10 m or above at ground floor in buildings such as airports, exhibition halls, convention centres, atrium in shopping malls, entrance lobbies and the like and provided with sprinkler system, the travel distance in such areas may be increased by 100 percent of the values specified. This is not to be applied to the values given in col (4) above.

6 In such buildings having ceiling heights 17 m or more and would have sprinkler exemption, the travel distance of such areas may be allowed to be increased by 100 percent of the values specified. This is not to be applied to the values given in col (4) above. In such cases, to prevent heat build-up at ceiling level, suitable smoke/heat venting systems are recommended.

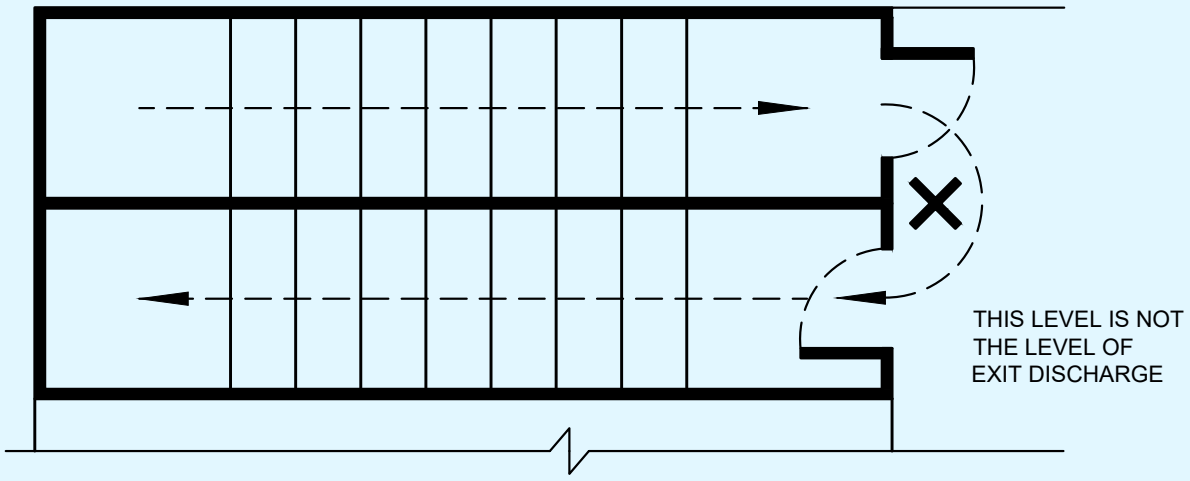


FIG. 11 UNACCEPTABLE ARRANGEMENT FOR ENCLOSING A STAIR SERVING AS A REQUIRED EXIT

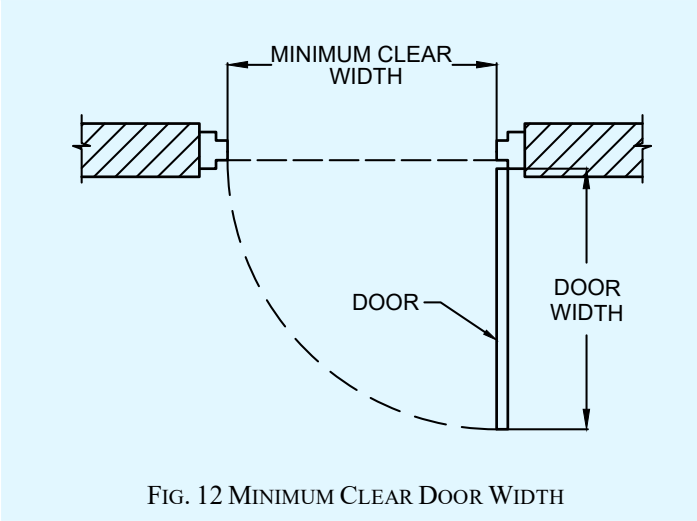


FIG. 12 MINIMUM CLEAR DOOR WIDTH

4.4.2.4.2 *Corridors and passageways of means of egress*

a) Corridors and passageways should be of width not less than the calculated aggregate width of exit doorways leading from them in the direction of travel to the exit (*see* Table 3 and Table 4); and

b) In the case of buildings where there is a central corridor, which is part of exit access, the doors of rooms (except for rooms having assembly occupancy) should open inwards to permit smooth flow of traffic in the corridor.

4.4.2.4.3 *Staircases*

4.4.2.4.3.1 *General*

The requirements of number of staircases should supplement the requirement of different occupancies in **6.1** to **6.9**.

All high rises and special buildings, as mentioned in **1.2**, should have a minimum of two staircases. The actual number of staircases should comply with the requirement of **4.4.2.1**.

NOTE — These required fire exit staircases calculated as per the laid down provisions, are recommended to be free of FAR.

All exit staircases should discharge, at the level of exit discharge, to the exit discharge, either,

a) directly, or

b) through an exit passageway, or

c) through a large lobby.

At least 50 percent of the staircases should discharge as per (a) and/or (b) above. For firefighting shafts, it is preferred to have the discharge through (a), or as an alternate through (b). Option (c) is not applicable for firefighting shafts. In case of residential buildings and educational buildings, firefighting shafts should discharge through (a) only.

Each compartment should be planned with its access to the firefighting shaft. In buildings/floors having three or more compartments, there should be at least two firefighting shafts to serve the compartments. In buildings/floors having three or more compartments, there should be at least two firefighting shafts to serve the compartments.

The minimum width of tread without nosing should be 250 mm for staircase of residential buildings. This should be minimum 300 mm for assembly, hotels, educational, institutional, business, and other buildings. The treads should be constructed and maintained in a manner to prevent slipping. The maximum height of riser should be 175 mm for staircase of one or two family dwelling residential buildings and 150 mm for other buildings. The number of risers in a flight is recommended as 12. However, considering the floor-to-floor height, there should not be more than 15 risers in a flight.

The staircases may be internal staircases or external staircases.

4.4.2.4.3.2 *Internal staircases*

The internal staircases may be constructed with an external wall, or otherwise, and should comply with the following:

a) Internal stairs should be constructed of non-combustible materials throughout, and should have fire resistant rating of minimum 120 min.

b) A staircase should not be arranged round a lift shaft.

c) Fire exits should not be used as a portion of a supply, return or exhaust air system serving adjoining areas. Any opening(s) should not be permitted in walls or in doors, separating fire exits from adjoining areas.

d) No flue chimney, electromechanical equipment, air conditioning units, gas piping or electrical panels should be allowed in the stairway.

e) Notwithstanding the detailed provision for exits in accordance with **4.2** and **4.3**, the following minimum width should be provided for staircases for respective building typology:

1) Residential building (One or two family dwellings) : 1.00 m

NOTE — For row housing with 2 storeys, the minimum width should be 0.75 m.

2) Residential building (A-I, A-II and A-III) : 1.25 m

3) Residential hotel building (A-IV and A-V) : 1.50 m

4) Assembly building : 2.00 m

NOTE — The width of stairs may be accepted to be 1.50 m in case of assembly occupancy having less than 150 persons.

5) Educational building : 1.50 m

6) Institutional building : 2.00 m

Maximum width of stairs in hospitals should be 2.00 m.

7) All other buildings : 1.50 m

NOTE — Where staircase width is above 2.00 m, it is recommended to provide a central handrail.

f) A handrail should be provided on one side of the staircase of width less than 1 500 mm, and on both sides of the staircase of width 1 500 mm and more. The projection of handrail(s) in the staircase width should not be more than 90 mm.

g) Handrails may project inside the measured width by not more than 90 mm.

h) The design of staircase should also take into account the following:

1) The minimum headroom in a passage under the landing of a staircase and under the staircase should be 2.2 m.

2) Access to fire sexit staircase should be through a fire door of a minimum 120 min fire resistance rating.

3) No living space, store or other fire risk should open directly into staircases.

4) The exit (including staircases) should be continuous from refuge floors or terrace level, as applicable, to the level of exit discharge.

5) No electrical shafts/air conditioning ducts or gas pipes, etc, should pass through or open in the staircases.

6) Lifts should not open in staircase (or in mid-landings).

7) No combustible material should be used for decoration/wall panelling in the staircase.

8) Beams/columns and other building features should not reduce the head room/width of the staircase.

9) The floor indication board, indicating the location/designated number of staircase, respective floor number and direction to exit discharge should be placed inside the staircase, on the wall nearest to the fire door. It should be of size not less than 300 mm × 200 mm (*see* Fig. 13).

10) Individual floors should be prominently indicated on the wall outside the staircase and facing it.

11) All staircase should terminate at the level of exit discharge. The access to the basement should be by a separate staircase.

12) Scissors type staircases (of type where intermingling of persons in the landing is possible or of type where both stairs use the common air space) should not be treated as part of exit.

4.4.2.4.3.3 *Curved stairs*

Curved stairs should not be treated as part means of egress. However, these may be used as part of exit access provided the depth of tread is not less than 280 mm at a point 350 mm from the narrower end of the tread and the smallest radius is not less than twice the stair width.

4.4.2.4.3.4 *External staircases*

The external staircases are the staircases provided on the external wall/facade, and should comply with the following:

a) External stairs should always be kept in sound and usable condition;

b) All external stairs should be directly connected to the ground;

c) Entrance to the external stairs should be separate and remote from the internal staircase;

d) Where an external staircase is provided, it should be ensured that the use of it at the time of fire is not prejudiced by smoke and flame from openings (for example, windows, doors) in the external face of the building. Care should be taken to ensure that no external wall or window opening opens on to or close to an external stair. If such openings exists within 3 m from an external staircase, they should be protected with fire rated doors/window assemblies with rating of at least 60 min (*see* Fig. 14);

e) The external stairs should be constructed of non-combustible materials, and any doorway leading to it should have minimum 120 min fire resistance;

f) No external staircase, should be inclined at an angle greater than 45° from the horizontal;

g) External stairs should have straight flight not less than 1 500 mm wide;

h) Handrails, to be provided on both sides, should be of a height not less than 1 000 mm and not exceeding 1 200 mm. There should be provisions of balusters with maximum gap of 150 mm; and

j) The use of spiral staircase should be limited to low occupant load and to a building not exceeding 9 m in height. A spiral staircase should be not less than 1 500 mm in diameter and should be designed to give adequate headroom.

4.4.2.4.3.5 *Ramps*

a) Ramps should comply with all the applicable requirements for staircases regarding enclosure, capacity (*see also* Table 3) and limiting dimensions, except where specified in **6.1** to **6.9** for special uses and occupancies;

b) The slope of a ramp should not exceed 1 in 12 (8 percent);

c) Ramp(s) should be surfaced with approved slip resistant materials that are securely attached. No perforations are permissible on ramp floors;

d) Any changes in travel direction in ramp should be preceded by landings of minimum 1.5 m × 1.5 m size;

e) Ramps and intermediate landings should continue with no decrease in width along the direction of egress travel;

f) Outside ramps and landings should be designed to minimize water accumulation on their surfaces;

g) Ramps should have landings located at the top, at the bottom, and at doors opening onto the ramp;

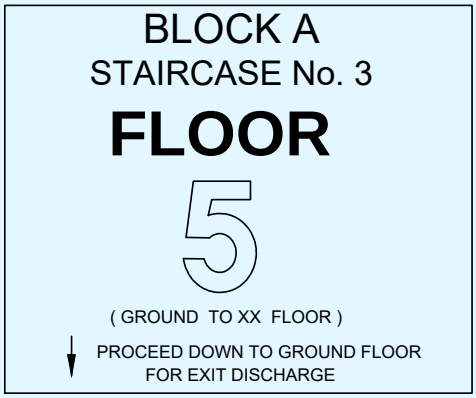
h) Every landing should be not less than 1 500 mm long in the direction of travel;

j) Where the ramp is not part of an accessible route, the ramp landings should not be required to exceed 1 250 mm in the direction of travel, provided that the ramp has a straight run; and

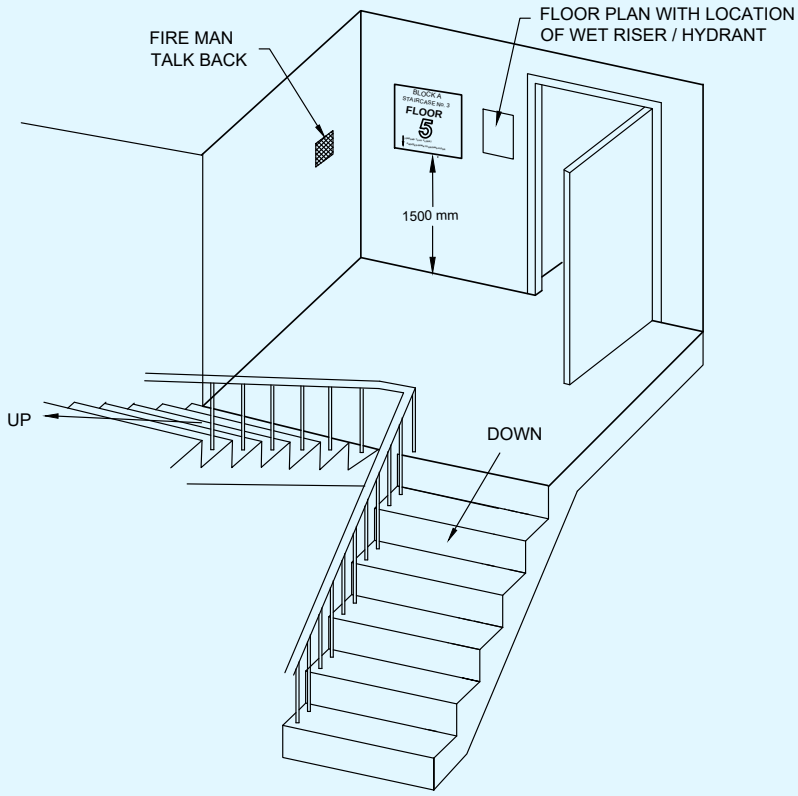
k) Handrails should be provided on all ramps on both sides (*see* **4.4.2.4.3.4**).

NOTE — Above requirements are not applicable to basement car parking ramps.

The ramps should, in addition, comply with the requirements given in good practice [F(31)].



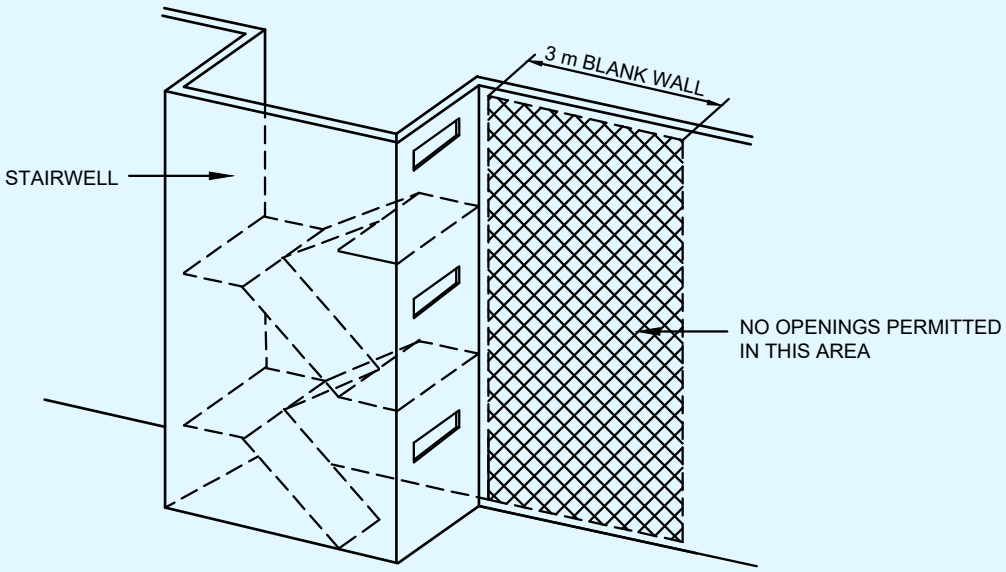
9A EXAMPLE OF A STAIRWAY MARKING SIGN (FLOOR INDICATION BOARD)



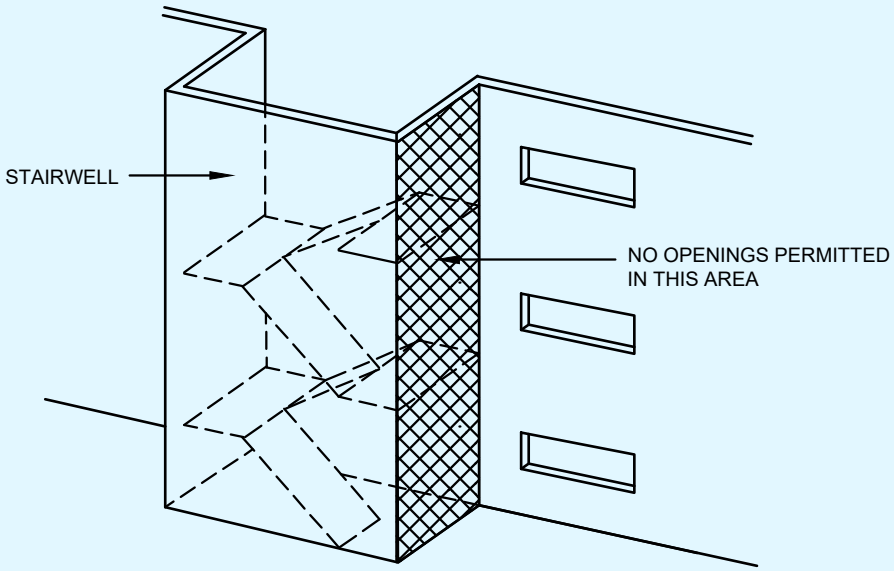
9B STAIR SIGN PLACEMENT

NOTE — BLOCK/WING/BUILDING NAME TO BE PROJECT SPECIFIC. STAIRCASE No. SHOWN AS "3" IS INTENDING TO SHOW THE NUMBER ASSIGNED TO THE STAIRCASE. ALL EXITS PREFERABLY TO BE ASSIGNED WITH NUMBER /IDENTIFICATION ENABLING OCCUPANT/FIRE MAN TO DECLARE LOCATION / POSITION.

FIG. 13 SIGN MARKING AND REQUIREMENT IN EXIT



14A LIMITATIONS ON OPENINGS NEAR STAIRWELL



14B OPENING RESTRICTIONS ON STAIRWELL WALLS

FIG. 14 OPENING RESTRICTIONS

4.4.2.5 *Smoke control of exits*

a) In building design, compartmentation plays a vital part in limiting the spread of fire and smoke. The design should ensure avoidance of spread of smoke to adjacent spaces through the various leakage openings in the compartment enclosure, such as cracks, openings around pipes ducts, airflow grills and doors. In the absence of proper sealing of all these openings, smoke and toxic gases will obstruct the free movement of occupants of the building through the exits. Pressurization of staircases is of great importance for the exclusion of smoke and toxic gases from the protected exit.

b) Pressurization is a method adopted for protecting the exits from ingress of smoke, especially in high-rise buildings. In pressurization, air is injected into the staircases, lobbies, etc, as applicable, to raise their pressure slightly above the pressure in adjacent parts of the building. As a result, ingress of smoke or toxic gases into the exits will be prevented. The pressurization of staircases and lift lobbies should be adopted as given in Table 5.

   The pressure difference for staircases should be 50 Pa.

   Pressure differences for lobbies (or corridors) should be between 25 Pa and 30 Pa. Further, the pressure differential for enclosed staircase adjacent to such lobby (or corridors) should be 50 Pa. For enclosed staircases adjacent to non-pressurized lobby (or corridors), the pressure differential should be 50 Pa.

c) Equipment and ductwork for staircase pressurization should be in accordance with one of the following:

   1) Directly connected to the stairway by ductwork enclosed in non-combustible construction.

   2) If ducts used to pressurize the system are passed through shafts and grilles are provided at each level, it should be ensured that hot gases and smoke from the building cannot ingress into the staircases under any circumstances.

d) The normal air conditioning system and the pressurization system should be designed and interfaced to meet the requirements of emergency services. When the emergency pressurization is brought into action, the following changes in the normal air conditioning system should be effected:

   1) Any re-circulation of air should be stopped and all exhaust air vented to atmosphere.

   2) Any air supply to the spaces/areas other than exits should be stopped.

   3) The exhaust system may be continued provided,

      i) the positions of the extraction grills permit a general air flow away from the means of egress;

      ii) the construction of the ductwork and fans is such that, it will not be rendered inoperable by hot gases and smoke; and

      iii) there is no danger of spread of smoke to other floors by the path of the extraction system which can be ensured by keeping the extraction fans running.

e) For pressurized stair enclosure systems, the activation of the systems should be initiated by signalling from fire alarm panel.

f) Pressurization system should be integrated and supervised with the automatic/manual fire alarm system for actuation.

g) Wherever pressurized staircase is to be connected to unpressurized area, the two areas should be segregated by 120 min fire resistant wall.

h) Fresh air intake for pressurization should be away (at least 4 m) from any of the exhaust outlets/grille.

Table 5 Pressurization of Staircases and Lift Lobbies

[*Clauses* 4.4.2.5 (b) *and* D-2]

Sl No.	Component	Height of the Building		
		Less than 15 m	15 m to 30 m	More than 30 m
(1)	(2)	(3)	(4)	(5)
i)	Internal staircase not with external wall	Pressurized except for residential buildings (apartment houses and one or two family dwellings)	Pressurized	Pressurized
ii)	Internal staircase with external wall	Pressurized except for residential buildings (Apartment houses and one or two family dwellings) or Naturally ventilated	Naturally ventilated or Pressurized	Cross-ventilated or Pressurized
iii)	Lift lobby	Not required at ground and above. However, lift lobby segregation and pressurization is required for lift commuting from ground to basement	Naturally ventilated or Pressurized[1)]	Cross-ventilated or Pressurized[1)]

NOTES

1 The natural ventilation requirement of the staircase should be achieved through opening at each landing, of an area 0.5 m^2 to 1.5 m^2 (as defined earlier) in the external wall. A cross ventilated staircase should have 2 such openings in opposite/adjacent walls or the same should be cross-ventilated through the corridor.

2 Enclosed staircase leading to more than one basement should be pressurized.

[1)] Lift lobby with fire doors (120 min) at all levels with pressurization of 25 Pa to 30 Pa is required. However, if lift lobby cannot be provided at any of the levels in air-conditioned buildings or in internal spaces where funnel/flue effect may be created, lift hoistway should be pressurized at 50 Pa. For building greater than 30 m, multiple point injection air inlets to maintain desired pressurization level should be provided. If the lift lobby, lift, and staircase are part of firefighting shaft, lift lobby necessarily has to be pressurized in such case, unless naturally ventilated.

4.5 Compartmentation

4.5.1 *General*

It is important to limit the spread of a fire in special/high rise buildings, usually through the use fire barriers. In some instances, these barriers need to be penetrated for ductwork, plumbing and electrical systems, and in such cases, use of passive fire protection measures should be done so that the integrity of these barriers is not compromised.

4.5.2 The compartmentation can be achieved with following type of construction/type of fire barrier with protected openings:

a) Type A — Masonry construction with fire rated door assembly;

b) Type B — Fire rated fabric dropdown curtain assembly;

c) Type C — Fire rated glazed partition and door assembly;

d) Type D — Fire rated gypsum board/cementitious board assembly; and

e) Type E — Masonry construction with fire rated metal sliding door.

Integrity (E) is the ability of the fire curtain assembly when exposed to fire from one side to withstand temperature up to 1 050 °C, to resist passage of flames and hot gases for a period of 120 min.

Radiation control (EW) is the ability of the fire curtain assembly when exposed to fire from one side to resist transfer of heat on the other side. When measured, it should does not exceed 15 kW/m^2 at 1 m distance.

Insulation (EI) is the ability of the fire curtain assembly when exposed to fire from one side to limit temperature rise on the other not exceeding 140 °C above the ambient.

Smoke control (Sa) is the ability of fire curtain assembly when exposed to a fire from one side resist passage of hot/cold smoke not exceeding 3 m^3/m/h at a pressure of smoke leakage rate of 25 Pa.

4.5.2.1 *Type B — Fire rated fabric dropdown curtain assembly*

The fire rated fabric should be tested and certified by any reputed third-party independent certification body for following parameters:

a) Type 1 — Integrity (E) of 120 min + Radiation (EW) of 60 min + Smoke control (Sa);

b) Type 2 — Integrity (E) of 120 min + Radiation (EW) of 120 min + Smoke control (Sa); and

c) Type 3 — Integrity + Radiation (EW) of 120 min + Insulation (EI) of 60 min + Smoke control (Sa).

4.5.2.2 *Type C — Fire rated glazed partition and door assembly*

The fire rated glazed partition and door assembly should be tested and certified by any reputed third-party independent certification body for following parameters:

a) Type 1 — Integrity (E) of 120 min + Radiation (EW) of 120 min + Insulation (EI) of 30 min + Smoke control (Sa); and

b) Type 2 — Integrity (E) of 120 min + Radiation (EW) of 120 min + Insulation (EI) of 60 min + Smoke control (Sa)

4.5.3 Floor(s) should be compartmented with area as given in Table 6. The maximum size of the compartment is suggested as follows. However, State/Local Authorities may prescribe their own requirements based on their risk assessment and other fire safety provisions.

Table 6 Compartmentation

(*Clause* 4.5.3)

Sl No.	Type of Building	Floor Area Compartmentation Area (without Sprinkler) m^2	Floor Area Compartmentation (when Sprinklered) m^2	Type of Construction/ Type of Fire Barrier with Protected Openings
(1)	(2)	(3)	(4)	(5)
i)	Enclosed basement vehicle parking in residential, educational, institutional, assembly, business, mercantile, industrial or storage occupancies	750	5 000	E - Barrier between the designated fire compart-ments/zones B - Limited to driveway not exceeding 9 m with Type-2 only.

Table 6 (*Continued*)

Sl No.	Type of Building	Floor Area Compartmentation Area (without Sprinkler) m^2	Floor Area Compartmentation (when Sprinklered) m^2	Type of Construction/ Type of Fire Barrier with Protected Openings
(1)	(2)	(3)	(4)	(5)
ii)	Basements other than car parking in residential, educational, institutional, assembly, business, mercantile, industrial and storage occupancies	750	2 000	A/D - barrier between the designated fire compartments/zones
iii)	Hospitals and nursing homes with beds/sleeping patients in institutional occupancies	750	2 000	Any combination of A, B (Type-3 only), D - barrier between the designated fire compartments/zones
iv)	Buildings used for custody and care of children, convalescents, aged people who are incapable of self-preservation	750	1 500	Any combination of A, B (Type-3 only), D - barrier between the designated fire compartments/zones
v)	Mercantile buildings, multistorey mercantile buildings consisting of shops, departmental stores, markets	750	Not essential	Any combination of A, B (Type 2 only), D - barrier between the designated fire compartments/zones
vi)	Assembly buildings with/without atriums	1 500	Not essential	Any combination of A, B (Type 2 only), D - barrier between the designated fire compartments/zones
vii)	Buildings under business occupancy	750	3 000	Any combination of A, B, C (Type 1), D - barrier between the designated fire compart-ments/zones
viii)	Datacentre buildings	*See* Note 1	2 000	Any combination of A, C (Type 2) , D - barrier between the designated fire compartments/zones
ix)	Hotel building with or without dining facilities	750	3 000	Any combination of A, C (Type 1) , D - barrier between the designated fire compartments/zones
x)	Industrial buildings less than 6.7 m in height	1 500	10 000	Any combination of A, E - barrier between the designated fire compart-ments/zones

Table 6 (*Concluded*)

Sl No.	Type of Building	Floor Area Compartmentation Area (without Sprinkler) m^2	Floor Area Compartmentation (when Sprinklered) m^2	Type of Construction/ Type of Fire Barrier with Protected Openings
(1)	(2)	(3)	(4)	(5)
xi)	Hazardous or high hazard buildings	*See* Note 1	500	A-barrier between the designated fire compart-ments/zones
xii)	Buildings with atrium with smoke management system	*See* Note 1	Not required	Subject to compliance of atrium as in Annex E
xiii)	Warehouses less than 5.0 m in height	*See* Note 1	5 000	*See* also good practice [F(142)]

NOTES

1 Compartmentation size is not specified, as the buildings have to be sprinklered.

2 Ceiling level partition may be considered (from ceiling level to 25 percent of floor height) to act as a smoke reservoir and venting thereof.

4.5.3.1 For space with large heights [such as airports, exhibition halls, convention centres, atrium in shopping-malls, warehouses (of height beyond 5 m), industrial (of height beyond 6.7 m), double height entrance lobbies and the like], these may be exempted from above requirement of compartmentation.

4.5.3.2 In addition to the above floor area compartmentation, all critical utility rooms within each compartment area construction should be 2 h fire rated. Rooms such as electrical room, server room, uninterrupted power supply (UPS) room, battery room, lift machine rooms, IT networking room, main distribution frame (MDF), intermediate distribution frame (HUB/IDF rooms), main communication room (MCR room), network switch rooms, multiplexer (MUX) rooms, telecom equipment room, janitor storage room, chemical storage room, QA and QC laboratories, etc, should be enclosed from all sides and construction should be 2 h fire rated irrespective of the size/area.

4.5.3.3 Guest rooms, guest room corridors, banquets, should be 60 m fire compartmented with 30 min fire rated doors, in addition to above area of compartmentation.

4.5.3.4 In buildings with open atrium, the effect of compartmentation on the atrium should be disregarded, provided the fire safety requirements given in Annex E on atrium are complied.

4.5.3.5 In industrial and storage occupancies, all hazardous areas irrespective of area/size should be compartmented namely, vehicle charging areas, ignitable chemical storage areas, hazardous waste storage areas, flammable scrap storage areas, unless these are located 30 m away from any adjacent occupied buildings.

4.5.3.6 All live cooking areas with any type of fuel (induction, LPG, PNG, etc) in hotels, IT parks, business buildings cafeteria, hostels, educational facility, food courts, malls, any commercial kitchens should be 120 min fire rated segregated from other areas.

4.5.3.7 Pantries without live cooking, buffet setting counters (*bain-marie* serving) (with/without re-heating facility), breakout areas with microwave stations, water and dispensing areas, collaboration areas, tea coffee maker areas should be exempted from above compartmentation requirements.

4.6 Smoke Control

4.6.1 *Smoke Exhaust and Pressurization of Areas Above Ground*

Corridors in exit access (exit access corridor) are created for meeting the requirement of use, privacy, and layout

in various occupancies. These are most often noted in hospitality, health care occupancies and sleeping accommodations.

Exit access corridors of guest rooms and indoor patient department/areas having patients lacking self-preservation and for sleeping accommodations such as service apartments, custodial, penal, and mental institutions, etc, should be provided with 60 min fire resistant wall and 30 min self-closing fire doors along with all fire stop sealing of penetrations.

Smoke exhaust system having make-up air and exhaust air system or alternatively pressurization system with supply air system for these exit access corridors should be required.

Smoke exhaust system having make-up air and exhaust air system should also be required for theatres/auditoria.

Such smoke exhaust system should also be required for large lobbies and which have exit through staircase leading to exit discharge. This would enable eased exit of people through smoke-controlled area to exit discharge.

All exit passageway (from exit-to-exit discharge) should be pressurized or naturally ventilated. The mechanical pressurization system should be automatic in action with manual controls in addition. All such exit passageway should be maintained with integrity for safe means of egress and evacuation. Doors provided in such exit passageway should be fire rated doors of 120 min rating.

Smoke exhaust system where provided, for above areas and occupancies should have a minimum of 12 air changes per hour smoke exhaust mechanism.

Pressurization system where provided, should have a minimum pressure differential of 25-30 Pa in relationship to other areas.

The smoke exhaust fans in the mechanical ventilation system should be fire rated, that is, 250 °C for 120 min.

For naturally cross-ventilated corridors or corridors with operable windows, such smoke exhaust system or pressurization system will not be required.

4.6.2 *Smoke Exhaust and Pressurization of Areas Below Ground*

a) Each basement should be separately ventilated;

b) Vents with cross-sectional area (aggregate) not less than 2.5 percent of the floor area spread evenly round the perimeter of the basement should be provided in the form of grilles, or breakable stall board lights or pavement lights or by way of shafts.

   Alternatively, a system of mechanical ventilation system may be provided. Mechanical ventilation system should be designed to permit 12 air changes per hour (ACPH) in case of fire or distress call. However, for normal operation, air changes schedule should be as given in Part D 'Building Services, Section 3 Air conditioning, Heating and Mechanical Ventilation' of this NBCS. In case of single basement, fresh-air may be considered from ramp and perimeter opening to achieve 12 ACPH ventilation requirement.

c) In multi-level basements, independent air intake and smoke exhaust shafts (masonry or reinforced concrete) for respective basement levels and compartments therein should be planned with its make-up air and exhaust air fans located on the respective level and in the respective compartment. Alternatively, in multi-level basements, common intake masonry (or reinforced cement concrete) shaft may serve respective compartments aligned at all basement levels. Similarly, common smoke exhaust/outlet masonry (or reinforced cement concrete) shafts may also be planned to serve such compartments at all basement levels. All supply air and exhaust air fans on respective levels should be installed in fire resisting room of 120 min. Exhaust fans at the respective levels should be provided with back draft damper connection to the common smoke exhaust shaft ensuring complete isolation and compartmentation of floor isolation to eliminate spread of fire and smoke to the other compartments/floors.

d) Due consideration should be taken for ensuring proper drainage of such shafts to avoid insanitation condition. Inlets and extracts may be terminated at ground level with stall board or pavement lights as before. Stall board and pavement lights should be in positions easily accessible to the fire brigade and clearly marked 'AIR INLET' or 'SMOKE OUTLET' with an indication of area served at or near the opening.

e) Smoke from any fire in the basement should not obstruct any fire exit serving the ground and upper floors of the building.

f) The smoke exhaust fans in the mechanical ventilation system should be fire rated, that is, 250 °C for 120 min.

g) The smoke ventilation of the basement car parking areas should be through provision of supply and exhaust air ducts duly installed with its supports and connected to supply air and exhaust fans. Alternatively, a system of impulse fans (jet fans) may be used for meeting the requirement of smoke ventilation complying with the following:

    1) Structural aspects of beams and other down stands/services should be taken care of in the planning and provision of the jet fans.

    2) Fans should be fire rated, that is, 250 °C for 120 min.

    3) Fans should be adequately supported to enable operations for the duration as above.

    4) Power supply panels for the fans should be located in fire safe zone to ensure continuity of power supply.

    5) Power supply cabling should meet circuit integrity requirement in accordance with accepted standard [F(13)].

The smoke extraction system should operate on actuation of flow switch actuation of sprinkler system. In addition, a local and/or remote 'manual start-stop control/switch' should be provided for operations by the fire fighters.

Visual indication of the operation status of the fans should also be provided with the remote control.

No system relating to smoke ventilation should be allowed to interface or cross the transformer area, electrical switchboard, electrical rooms or exits.

Smoke exhaust system having make-up air and exhaust air system for areas other than car parking should be required for common areas and exit access corridor in basements/underground structures and should be completely separate and independent of car parking areas and other mechanical areas.

Supply air should not be less than 5 m from any exhaust discharge openings.

For specific details on smoke management using mechanical means, *see* Part D ‘Building Services, Section 3 Air Conditioning, Heating and Mechanical Ventilation’ of this NBCS.

4.7 Gas Supply

4.7.1 *Town Gas/LPG Supply Pipes*

Where gas pipes are run in buildings, the same should be run in separate shafts exclusively for this purpose and these should be on external walls, away from the staircases. Gas distribution pipes should always be below the false ceiling. The length of these pipes should be as short as possible. In the case of kitchen cooking range area, hood should have grease filters using metallic grille to trap oil vapours escaping into the fume hood.

NOTE — For detailed information on gas pipe installations, reference may be made to Part E ‘Plumbing services, Section 4 Gas supply’ of this NBCS.

4.7.2 *Thermal Detectors*

These should be installed into fume hoods of large kitchens for hotels, hospitals, and similar areas located in high rise buildings. Arrangements should be made for automatic tripping of the exhaust fan in case of fire. If gas is used, the same should be shut off. The voltage should be 24 V or 100 V d.c. operated with external rectifier. The valve should be of the hand re-set type and should be located in an area segregated from cooking ranges. Valves should be easily accessible. The hood should have manual facility for steam or suitable hood extinguishing gas released depending on duty condition.

4.7.3 Gas cylinders and manifold should need to be housed in a detached location with no other occupancy within distances prescribed in good practice [F(14)] thereof. There should be an enclosure suitably ventilated. It is desirable to provide medium velocity spray nozzles which can be operated by quick opening valve situated away

from the enclosure.

4.7.4 In the case of gas cylinders, if manifold has to be installed on podium/close to podium, the same should be away from any air intakes/smoke exhaust openings/any windows.

4.7.5 Pressure regulating stations should be designed and installed at critical locations for excess flow shut off valves. Seismic shut off valve at the main distribution point should be installed for buildings having mixed use assembly occupancy (like malls) and institutional occupancy above 15 m.

4.7.6 Gas meters should be housed in a suitably constructed metal cupboard located in a well-ventilated space, keeping in view the fact that LPG is heavier than air and natural gas is lighter than air.

4.7.7 Wherever LPG reticulation/cylinders are used in buildings above 100 m, gas leak detectors should be provided at the usage points and monitored from fire command centre. The cables used for signalling should be circuit integrity cables.

4.7.8 The gas lines should not be installed through any enclosed staircase or electrical shafts, escape routes, refuge areas/refuge floors.

4.7.9 Kitchens working on LPG fuel should not be permitted in basements. Small kitchen using other than LPG fuel, such as induction/PNG/electricity-based, may be permitted in incidental occupancies in the basement.

4.8 Hazardous Areas, Gaseous, Oil Storage Yard, etc

Rooms containing high pressure boilers, refrigerating machinery, transformers, or other service equipment subject to possible explosion should not be located directly under or adjacent to fire exits. All such rooms should be effectively cut-off from other parts of the building and should be provided with adequate vents to the outside air.

All rooms or areas of high hazard in additions to those hereinbefore mentioned, should be segregated, or should be protected with fire resistant walls having fire rating of 120 min as fire, explosion or smoke therefrom is likely to interfere with safe egress from the building. Further,

a) each building should be provided with an approved outside gas shut-off valve conspicuously marked. The detailed requirements regarding safe use of gas should be as specified in Part E 'Plumbing services, Section 4 Gas Supply' of this NBCS; and

b) all exterior openings in a boiler room or rooms that contain central heating equipment, if located below opening in another storey or if less than 3 m from other doors or windows of the same building should be protected by a fire assembly as in **3.5.4**. Such assemblies should be fixed, automatic or self-closing.

4.9 Fire Detection and Alarm

a) The requirements of fire detection and alarm systems are covered for each occupancy in Table 7A to Table 7J and under **6.1** to **6.9** for annunciation to occupants in view of the ensuing vulnerability and to warn occupants early of the existence of fire, so as to facilitate orderly and safe egress;

b) Fire detection and alarm systems in buildings should be so planned and programmed so as to enable operations of various systems and equipment to facilitate requirements leading to life safety, compartmentation and fire protection. These systems and equipment may include electromechanical systems such as air handling units; pressurization systems; smoke management systems; creation of compartmentation through the release of fire barrier, hold-up fire doors, etc; and monitoring of fire water storage tanks and pumps, pressures in hydrant and sprinkler system, etc. These planning and requirements should be based on building occupancy and other requirements on case-to-case basis;

c) Voice evacuation systems should employ English, Hindi and vernacular language using pre-recorded messages and integrate with fire alarm panels for alerting the zone of fire and surrounding zones/floors as required for annunciation (*see also* Table 7A to Table 7J);

d) Appropriate visual warning arrangement through visual strobes/beacons may be considered in appropriate situations particularly in public buildings, at required locations to ensure visual as well as alarm for persons with hearing impairment;

e) For assembly buildings, institutional buildings and all buildings above 30 m in height where fire alarm system is provided in accordance to Table 7A to Table 7J, detectors should also be provided inside the electrical shafts, lift machine rooms, etc, besides occupancy areas;

f) Fire alarm panels should be connected in peer-to-peer network or with redundant cables, run in different shafts. Each panel should be able to work in standalone mode and master slave architecture may be used where required;

g) The fire detection system should be in accordance with accepted standards [F(15)];

h) Guidelines for selection of various types of fire detectors for different occupancies and their installation and maintenance should be in accordance with good practice [F(16)]. *See also* Handbook for 'Asset and Facility Management' for guidance;

j) In buildings where automatic fire alarm system is provided, the following should be monitored from fire alarm panel:

   1) Water level in all tanks.

   2) Hydrant and sprinkler pressures of respective zones, as provided.

   3) Pump ‘ON/OFF’ status.

   4) All isolation valves, wherever provided with supervisory switch (non-padlock valves).

   5) Other requirements to meet electro-mechanical services interface.

Table 7A Requirements for Firefighting Installations – For Residential Buildings

[*Clauses* 4.9 (a), 4.9 (c), 4.9(e), 5.1.1 (a), 5.1.1(d), 5.1.2.1, 5.1.3 (a), D-6.1, G-2(f) *and* Table 31]

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Fire Detection and Alarm System and LPG/PNG Gas Detector	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	RESIDENTIAL BUILDINGS (A)								
a)	**Lodging and Rooming Houses (A- I)**	**Up to 500 m^2 area and up to 24 m height (both conditions to be met), self-certification by a certified and State approved building professional should be treated acceptable**							
1)	24 m and above in height and, having any area Or Less than 24 m in height but of area,								
i)	floor area on any single floor 501 m^2 to 1 000 m^2 **(HL-1)** *See* Notes 1, 2, 3 and 4	R	R	NR	NR	NR	NR	R	NR
ii)	1 001 m^2 and above **(HL-2)** *See* Notes 2, 3 and 4	R	R	R	NR	NR	NR	R	R

Table 7A (*Continued*)

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Fire Detection and Alarm System and LPG/PNG Gas Detector	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
b)	**Dormitories (A-II)**	**Up to 500 m^2 area and up to 24 m height (both conditions to be met), self-certification by a certified and State approved building professional should be treated acceptable**							
1)	501 m^2 to 1 000 m^2 **(HL-1)** *See* Notes 1, 2, 3 and 4	R	R	NR	NR	NR	NR	NR	NR
2)	1 001 m^2 and above **(HL-2)** *See* Notes 2, 3 and 4	R	R	R	NR	NR	NR	R	NR
c)	**Apartment Houses (A-III)**	**Up to 500 m^2 area and up to 24 m height (both conditions to be met), self-certification by a certified and State approved building professional should be treated acceptable**							
1)	24 m and above but not exceeding 60 m in height; and, height less than 24 m, but of area:								
i)	501 m^2 to 1 000 m^2 **(HL-2)** See Notes 2, 3, 4, 7 and 9	R	R	R	NR	NR	NR	NR	NR

Table 7A (*Continued*)

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Fire Detection and Alarm System and LPG/PNG Gas Detector	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ii)	1 001 m^2 and above **(HL-3)** *See* Notes 2, 3, 4, 5, 7, 9 and 10	R	R	NR	R	R	NR	R	R
2)	Above 60 m height **(CL-4)** *See* Notes 3, 4, 5, 7, 8, 9, and 10	R	R	NR	R	R	R	R	R
d)	**Hotels (A-IV)**	**Up to 500 m^2 area and up to 24 m height (both conditions to be met), self-certification by a certified and State approved building professional should be treated acceptable**							
1)	Up to 24 m in height, but of area:								
i)	501 m^2 to 1 000 m^2 **(HL-3)** *See* Notes 2, 3, 4, 7 and 9	R	R	R	NR	NR	NR	R	NR
ii)	1 001 m^2 and above **(CL-3)** *See* Notes 3, 4, 7 and 9	R	R	NR	R	NR	R	R	R

Table 7A (*Concluded*)

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Fire Detection and Alarm System and LPG/PNG Gas Detector	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
2)	24 m and above but not exceeding 60 m in height OR 3/4 Star Hotels **(CL-4)** *See* Notes 3, 4, 5, 7, 8 and 9	R	R	NR	R	R	R	R	R
3)	Above 60 m – *See* Note 5								
e)	**Starred (Franchise – 5 Star) Hotels (A-V)**								
1)	Up to 60 m **(CL-5)** *See* Note 4	R	R	NR	R	R	R	R	R
2)	Above 60 m – *See* Note 5								

R – Required NR – Not Required

REMARK 1: Any state or area where the municipal supply caters to municipal/public yard hydrant system with hydrant outlets provided throughout the premises with adequate water supply meeting the wet riser requirement demand flow and pressure 24 × 7 uninterrupted, such states/areas/ jurisdiction can replace the wet riser system and its associated pumping with water storage with a dry riser system. Dry riser system is also recommended for areas where ambient temperature below is 4 °C and has facility of connecting the yard hydrant to the dry riser in any event of fire in the building. This system is to be maintained with quarterly checks to ensure the system integrity to handle the required flow and pressure. This is applicable for buildings height only up to 24 m where HL Protection is required as per above Table**.**

REMARK 2: Sharing of water storage tank may be permitted between the adjacent neighbouring properties including industry clusters, without any loss of hydraulic effects (which is essential to fight the fire during an emergency).

NOTES

1 If the building has kitchen, the protection level will be **HL-2**.

2 If the building has basement to be protected with sprinklers, the protection level should comply with **CL-3**.

3 If the building has electrical vehicles (EV) parks in podium or basements, it should be protected with sprinklers and complying to **CL-5**.

4 Rate of rise of heat sensor/detection system should be provided in EV (Electrical Vehicles) parks and charging areas. Smoke sensor/detectors should be provided in all basements in all areas other than internal combustion engine (ICE) vehicles parks as part of the fire alarm system. ICE vehicle parks should be provided with carbon monoxide sensors as part of fire alarm system to activate ventilation system.

5 If the building height exceeds 60 m the hydraulic calculations meeting recommended system architecture with multi-level pumping and storage with gravity redundant down comer may be considered. The pumps considered should not exceed 12 bar shutoff pressure.

6 Pump pressure and quantity should be supported by hydraulic calculations.

7 2,500 lpm at 10 bar common pumping and water storage of 2,55,000 litre should be provided for a cluster of maximum 5 buildings, with or without common basement. The buildings should not be closer than 9 m. If the buildings are closer than 9 m, or the basement is used for EV parking and or charging facilities, the protection level should comply with **CL-5**.

8 Multi-level pumping and water storage as per schematic line drawing (SLD) may be considered for cluster buildings more than 45 m in height; and water storage at every 45 m above should be provided for individual buildings.

9 If the cluster of buildings exceeds 5, another set of pumps and water storage of similar capacity should be provided. A maximum of two such sets is recommended, provided it satisfies the hydraulic requirements and functioning at the remotest point.

10 Table 7K and Table 7M suggesting the basis for water quantity required for fire-fighting, respectively for combined (sprinkler and hose) protection and hose protection be considered.

Table 7B Requirements for Firefighting Installations – For Educational Buildings

[*Clauses* 4.9 (a), 4.9 (c), 4.9(e), 5.1.1 (a), 5.1.1(d), 5.1.2.1, 5.1.3 (a), D-6.1, G-2(f) *and* Table 31]

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	EDUCATIONAL BUILDINGS (B)	**Up to 500 m^2 area and up to 24 m height (both conditions to be met), self-certification by a certified and State approved building professional should be treated acceptable**							
1)	24 m and above but not exceeding 45 m; And, height less than 24 m, but of area:								
i)	501 m^2 to 1 000 m^2 **(HL-3)** *See* Notes 1, 2, 3, 5, 7 and 9	R	R	NR	R	R	NR	R	R
ii)	1 001 m^2 and above **(CL-4)** *See* Notes 3, 5, 7, 9 and 10	R	R	NR	R	R	R	R	R
2)	45 m and above but not exceeding 60 m in height **(CL-4)** (*See* Notes 5, 6, 7, 8, 9 and 10)	R	R	NR	R	R	R	R	R
3)	Above 60 m – *See* Note 5								

R – Required NR – Not Required

REMARK 1: Any state or area where the municipal supply caters to municipal/public yard hydrant system with hydrant outlets provided throughout the premises with adequate water supply meeting the wet riser requirement demand flow and pressure 24 × 7 uninterrupted, such states/areas/ jurisdiction can replace the wet riser system and its associated pumping with water storage with a dry riser system. Dry riser system is also recommended for areas where ambient temperature below is 4 °C and has facility of connecting the yard hydrant to the dry riser in any event of fire in the building. This system is to be maintained with quarterly checks to ensure the system integrity to handle the required flow and pressure. This is applicable for buildings height only up to 24 m where HL Protection is required as per above Table**.**

REMARK 2: Sharing of water storage tank may be permitted between the adjacent neighbouring properties including industry clusters, without any loss of hydraulic effects (which is essential to fight the fire during an emergency).

NOTES

1 If there are laboratories, AV/computer rooms, auditoriums, they should be protected with sprinkler and the protection level should comply with **CL-3**.

2 If the building has basement to be protected with sprinklers, the protection level should comply with **CL-3**.

3 If the building has electrical vehicles (EV) parks in podium or basements, it should be protected with sprinklers and complying to **CL-5**.

4 Rate of rise heat sensor/detection system should be provided in Electrical Vehicles (EV) parks and charging areas. Smoke sensor/detectors should be provided in all basements in all areas other than internal combustion engine (ICE) vehicles parks as part of the fire alarm system. ICE vehicle parks should be provided with carbon monoxide sensors as part of fire alarm system to activate ventilation system.

5 If the building height exceeds 60 m the hydraulic calculations meeting recommended system architecture with multi-level pumping and storage with gravity redundant down comer may be considered. The pumps considered should not exceed 12 bar shutoff pressure.

6 Pump pressure and quantity should be supported by hydraulic calculations.

7 2,500 lpm at 10 bar common pumping and water storage of 2,55,000 litre should be provided for a cluster of maximum 5 buildings, with or without common basement. The buildings should not be closer than 9 m. If the buildings are closer than 9 m, or the basement is used for EV parking and or charging facilities, the protection level should comply with **CL-5**.

8 Multi-level Pumping and water storage as per schematic line drawing (SLD) may be considered for cluster buildings more than 45 m; and water storage at every 45 m above should be provided for individual buildings.

9 If the cluster of buildings exceeds 5, another set of pumps and water storage of similar capacity should be provided. A maximum of two such sets is recommended, provided it satisfies the hydraulic requirements and functioning at the remotest point.

10 Table 7K and Table 7M suggesting the basis for water quantity required for fire-fighting, respectively for combined (sprinkler and hose) protection and hose protection be considered.

Table 7C Requirements for Firefighting Installations – For Institutional Buildings

[*Clauses* 4.9 (a), 4.9 (c), 4.9(e), 5.1.1 (a), 5.1.1(d), 5.1.2.1, 5.1.3 (a), D-6.1, G-2(f) *and* Table 31]

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	INSTITUTIONAL BUILDINGS (C)								
a)	**Nursing homes and sanatoria**	**Up to 500 m^2 area and up to 24 m height (both conditions to be met), self-certification by a certified and state approved building professional should be treated acceptable**							
i)	(*see* Note 1) Building height above 15 m; and, for heights up to 15 m, and area 501 m^2 and above **(HL-3)** *See* Notes 1, 2, 4, 6 and 9	R	R	R	NR	NR	NR	R	NR
b)	**Hospitals (C-I)**	**Up to 500 m^2 area and up to 24 m height (both conditions to be met), self-certification by a Certified and State Approved building professional should be treated acceptable**							
1)	For heights not exceeding 45 m in height								

Table 7C (*Continued*)

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	501 m^2 to 1 000 m^2 **(CL-3)** *See* Notes 2, 4, 6, 7, 9 and 10	R	R	NR	R	R	R	R	NR
ii)	Above 1 001 m^2 **(CL-4)** *See* Notes 2, 4, 6, 7, 9 and 10	R	R	NR	R	R	R	R	R
2)	Above 45 m but not exceeding 60 m in height **(CL-5)** *See* Notes 4, 6, 7, 9 and 10	R	R	NR	R	R	R	R	R
3)	Above 60 m – *See* Note 3								
b)	**Custodial, Penal and Mental Institutions (C-II and III)**	**Up to 500 m^2 area and up to 24 m height (both conditions to be met), self-certification by a Certified and State Approved building professional should be treated acceptable**							

Table 7C (*Concluded*)

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1)	For heights not exceeding 45 m in height								
i)	501 m^2 to 1 000 m^2 **(HL-2)** *See* Notes 1, 2, 4 and 6	R	R	R	NR	NR	NR	NR	R
ii)	1 001 m^2 and above **(HL-3)** *See* Notes 1, 2, 4, 6 and 9	R	R	NR	R	R	NR	R	R
2)	Above 45 m **(HL-4)** *See* Notes 1, 2, 3, 6, 8 and 9	R	R	NR	R	R	NR	R	R

R – Required NR – Not Required

REMARK 1: Any state or area where the municipal supply caters to municipal/public yard hydrant system with hydrant outlets provided throughout the premises with adequate water supply meeting the wet riser requirement demand flow and pressure 24 × 7 uninterrupted, such states/areas/jurisdiction can replace the wet riser system and its associated pumping with water storage with a dry riser system. Dry riser system is also recommended for areas where ambient temperature below is 4 °C and has facility of connecting the yard hydrant to the dry riser in any event of fire in the building. This system is to be maintained with quarterly checks to ensure the system integrity to handle the required flow and pressure. This is applicable for buildings height only up to 24 m where HL Protection is required as per above Table**.**

REMARK 2: Sharing of water storage tank may be permitted between the adjacent neighbouring properties including industry clusters, without any loss of hydraulic effects (which is essential to fight the fire during an emergency).

NOTES

1 Basement area or storage of oxygen or any medical gases or any gas fuel, laundry or linen/waste, transformer/HT rooms within the building foot print or in basement should be protected with sprinkler and the protection level should comply with **CL-3**.

2 If the building has electrical vehicles (EV) parks in podium or basements, it should be protected with sprinklers and complying to **CL-5**.

3 If the building height exceeds 60 m the hydraulic calculations meeting recommended system architecture with multi-level pumping and storage with gravity redundant down comer may be considered. The pumps considered should not exceed 12 bar shutoff pressure.

4 Protection should comply to supplementary protection for specific hazard/critical rooms as per Table 9/ Table 10/ Table 11 as applicable.

5 Pump pressure and quantity should be supported by hydraulic calculations.

6 Rate of rise heat sensor/detection system should be provided in electrical vehicles (EV) parks and charging areas. Smoke sensor/detectors should be provided in all basements in all areas other than internal combustion engine (ICE) vehicles parks as part of the fire alarm system. ICE vehicle parks should be provided with carbon monoxide sensors as part of fire alarm system to activate ventilation system. (recommendation only for parking and podium)

7 3785/2500 lpm at 10 bar common pumping and water storage of 3,50,000/2,55,000 litre should be provided of cluster of maximum 5 building 45 m height, with or without common basement. The buildings should not be closer than 9 m. If the buildings are closer than 9 m, or the basement is used for Electric Vehicles (EV) parking and or charging facilities, the protection level should comply with **CL-5**.

8 Multi-level pumping and water storage as per schematic line drawing (SLD) may be considered for cluster buildings more than 45 m; and water storage at every 45 m above should be provided for individual buildings.

9 If the cluster of buildings exceeds 5, another set of pumps and water storage of similar capacity should be provided. A maximum of two such sets is recommended, provided it satisfies the hydraulic requirements and functioning at the remotest point.

10 If the building height exceeds 30 m it should comply hydraulic calculations meeting recommended system architecture.

11 Table 7K and Table 7M suggesting the basis for water quantity required for fire-fighting, respectively for combined (sprinkler and hose) protection and hose protection be considered.

Table 7D Requirements for Firefighting Installations – For Assembly Buildings

[*Clauses* 4.9 (a), 4.9 (c), 4.9(e), 5.1.1 (a), 5.1.1(d), 5.1.2.1, 5.1.3 (a), D-6.1, G-2(f) *and* Table 31]

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	ASSEMBLY BUILDINGS (D) *See* Note 4								
a)	**Assembly Buildings**	**Up to 500 m^2 area and up to 9 m height (both conditions to be met), self-certification by a certified and State approved building professional should be treated acceptable**							
1)	9 m and above but not exceeding 15 m in height; and, for heights less than 9 m; and area *See* Note 6								
i)	501 m^2 to 1 000 m^2 **(HL-3)** *See* Notes 1, 2, 3, 5 and 8	R	R	NR	R	NR	NR	R	NR

Table 7D (*Concluded*)

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ii)	1 001 m^2 and above **(CL-4)** *See* Notes 2, 5, 8 and 9	R	R	NR	R	R	R	R	NR
2)	Above 15 m in height **(CL-4)** *See* Notes 2, 5, 6, 7, 8 and 9	R	R	NR	R	R	R	R	NR

R – Required NR – Not Required

REMARK 1: Any state or area where the municipal supply caters to municipal/public yard hydrant system with hydrant outlets provided throughout the premises with adequate water supply meeting the wet riser requirement demand flow and pressure 24×7 uninterrupted, such states/areas/ jurisdiction can replace the wet riser system and its associated pumping with water storage with a dry riser system. Dry riser system is also recommended for areas where ambient temperature below is 4 °C and has facility of connecting the yard hydrant to the dry riser in any event of fire in the building. This system is to be maintained with quarterly checks to ensure the system integrity to handle the required flow and pressure. This is applicable for buildings height only up to 24 m where HL Protection is required as per above Table**.**

REMARK 2: Sharing of water storage tank may be permitted between the adjacent neighbouring properties including industry clusters, without any loss of hydraulic effects (which is essential to fight the fire during an emergency).

NOTES

1 If the building has basement to be protected with sprinklers, the protection level should comply with **CL-3**.

2 If the building has electrical vehicles (EV) parks in podium or basements, it should be protected with sprinklers and complying to **CL-5**.

3 Live cooking kitchens, boiler/furnace rooms, laundry or linen/waste rooms, transformer/HT rooms within the building foot print or in basement the area should be protected with sprinkler protection and should comply with **CL-4**.

4 Pump pressure and quantity should be supported by hydraulic calculations.

5 Rate of rise heat sensor/detection system should be provided in electrical vehicles (EV) parks and charging areas. Smoke sensor/detectors should be provided in all basements in all areas other than internal combustion engine (ICE) vehicles parks as part of the fire alarm system. ICE vehicle parks should be provided with carbon monoxide sensors as part of fire alarm system to activate ventilation system. (recommendation only for parking and podium).

6 2,500 lpm at 10 bar common pumping and water storage of 2,55,000 litre should be provided for a cluster of maximum 5 buildings, with or without common basement. The buildings should not be closer than 9 m. If the buildings are closer than 9 m, or the basement is used for EV parking and or charging facilities, the protection level should comply with **CL-5**.

7 Multi-level pumping and water storage as per schematic line drawing (SLD) may be considered for cluster buildings more than 45 m; and water storage at every 45 m above should be provided for individual buildings.

8 If the cluster of buildings exceeds 5, another set of pumps and water storage of similar capacity should be provided. A maximum of two such sets is recommended, provided it satisfies the hydraulic requirements and functioning at the remotest point.

9 Table 7K and Table 7M suggesting the basis for water quantity required for fire-fighting, respectively for combined (sprinkler and hose) protection and hose protection be considered.

Table 7E Requirements for Firefighting Installations – For Business Buildings

[*Clauses* 4.9 (a), 4.9 (c), 4.9(e), 5.1.1 (a), 5.1.1(d), 5.1.2.1, 5.1.3 (a), D-6.1, G-2(f) *and* Table 31]

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	BUSINESS BUILDINGS (E) *See* Notes 5								
a)	**Business Buildings (Human Occupied)**	**Up to 500 m^2 area and up to 15 m height (both conditions to be met), self-certification by a Certified and State approved building professional should be treated acceptable**							

Table 7E (*Continued*)

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1)	15 m and above but not exceeding 45 m in height; and, for heights less than 15 m and area								
i)	500 m^2 to 1 000 m^2 **(CL-2)** *See* Notes 1, 2, 3, 6, 7, 9 and 11	R	R	R	NR	NR	R	R	R
ii)	1 001 m^2 to 3 000 m^2 **(CL-3)** *See* Notes 2, 3, 6, 7, 9 and 11	R	R	NR	R	R	R	R	R
iii)	3 001 m^2 and above **(CL-4)** *See* Notes 2, 3, 6, 7, 9 and 11	R	R	NR	R	R	R	R	R

Table 7E (*Continued*)

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
2)	Above 45 m but not exceeding 60 m height **(CL-5)** *See* Notes 3, 4, 6, 7, 8, 9 and 11	R	R	NR	R	R	R	R	R
3)	For buildings over 60 m height	*See* Note 4							
b)	**Data Centres (Machine Environment)** *See* Notes 3, 12 ,13 and 15								
1)	Less than 15 m in height								
i)	Floor Area on any single floor up to 1 000 m^2	R	R	NR	R	R	R	R	R
ii)	1 001 m^2 and above	R	R	NR	R	R	R	R	R

Table 7E (*Concluded*)

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
2)	Above 15 m in height								
i)	Floor area on any single floor up to 1 000 m^2	R	R	NR	R	R	R	R	R
ii)	1 001 m^2 and above	R	R	NR	R	R	R	R	R

R – Required NR – Not Required

REMARK 1: Any state or area where the municipal supply caters to municipal/public yard hydrant system with hydrant outlets provided throughout the premises with adequate water supply meeting the wet riser requirement demand flow and pressure 24 × 7 uninterrupted, such states/areas/jurisdiction can replace the wet riser system and its associated pumping with water storage with a dry riser system. Dry riser system is also recommended for areas where ambient temperature below is 4 °C and has facility of connecting the yard hydrant to the dry riser in any event of fire in the building. This system is to be maintained with quarterly checks to ensure the system integrity to handle the required flow and pressure. This is applicable for buildings height only up to 24 m where HL protection is required as per above table.

REMARK 2: Sharing of water storage tank may be permitted between the adjacent neighbouring properties including industry clusters, without any loss of hydraulic effects (which is essential to fight the fire during an emergency).

NOTES

1 If the building has basement to be protected with sprinklers, the protection level should comply with **CL-3**.

2 If the building has Electrical Vehicles (EV) parks in podium or basements, it should be protected with sprinklers and complying to **CL-5**.

3 Protection should comply to supplementary protection for specific hazard/critical rooms as per Table 9/ Table 10/ Table 11 as applicable.

4 If the building height exceeds 60 m the hydraulic calculations meeting recommended system architecture with multi-level pumping and storage with gravity redundant down comer may be considered. The pumps considered should not exceed 12 bar shutoff pressure.

5 Pump pressure and quantity should be supported by hydraulic calculations.

6 2500 lpm at 10 bar common pumping and water storage of 2,55,000 litre should be provided for a cluster of maximum 5 buildings, with or without common basement. The buildings should not be closer than 9 m. If the buildings are closer than 9 m, or the basement is used for EV parking and or charging facilities, the protection level should comply with **CL-5**.

7 3785 lpm at 10 bar common pumping and water storage of 3,50,000 litre should be provided of cluster of maximum 5 building, with or without common basement. The buildings should not be closer than 9 m. If the buildings are closer than 9 m, or the basement is used for Electric Vehicles (EV) parking and or charging facilities, the protection level should comply with **CL-5**.

8 Multi-level pumping and water storage as per schematic line drawing (SLD) (*see* Fig. 20) may be considered for cluster buildings more than 45 m; and water storage at every 45 m above should be provided for individual buildings.

9 If the cluster of buildings exceeds 5, another set of pumps and water storage of similar capacity should be provided. A maximum of two such sets is recommended, provided it satisfies the hydraulic requirements and functioning at the remotest point.

10 The entire building it should be protected with sprinkler and the protection level should comply with **CL-5**. IT/Data Hall should be protected with suitable clean agent gas suppression only if the racks are without BBU (not exceeding 20 kWh backup battery units).

11 All internet data centres or hyper scales or colocation data centres comply with protection level **CL6**.

12 If the IT/data hall (DC) racks are with BBUs with Lithium-ion batteries not exceeding 20 kWh/rack, wet or dry sprinkler/pre-action/water mist (3rd party tested for lithium ion BBUs) should be deployed. If the BBUs exceed 20 kWh/rack, water mist should not be installed.

13 If the cluster of data centre buildings to a maximum of 3, common pumping system and storage may be with an additional diesel engine pump, with double water storage.

14 If the any of the building houses lithium-ion energy storage systems exceeding 600 kWh/floor, the building should comply to protection level **CL-6**.

15 Lithium-ion battery energy storage systems (BESS) room should be protected with wet/single interlock pre action sprinkler only, considering entire room as “assumed area of operation”. Pump and water storage should be calculated based on maximum design and hydraulic calculations whichever is higher.

16 Table 7K and Table 7M suggesting the basis for water quantity required for fire-fighting, respectively for combined (sprinkler and hose) protection and hose protection be considered.

Table 7F Requirements for Firefighting Installations – For Mercantile Buildings

[*Clauses* 4.9 (a), 4.9 (c), 4.9(e), 5.1.1 (a), 5.1.1(d), 5.1.2.1, 5.1.3 (a), D-6.1, G-2(f) *and* Table 31]

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	MERCANTILE BUILDINGS (F) *See* Note 4								
a)	**Mercantile Buildings (F)**	**Up to 500 m^2 area and up to 15 m height (both conditions to be met), self-certification by a certified and State approved building professional should be treated acceptable**							
1)	Above 15 m but not exceeding 30 m in height; and, for heights less than 15 m and area								
i)	501 m^2 to 1 000 m^2 **(HL-3)** *See* Notes 1, 2, 3, 5, 6 and 7	R	R	R	NR	NR	NR	R	NR
ii)	1 001 m^2 and above **(CL-4)** *See* Notes 2, 3, 5, 6, 7 and 8	R	R	NR	R	R	R	R	NR

Table 7F (*Concluded*)

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
2)	Above 30 m	See Note 5							
b)	**Underground Shopping Complex (CL-5)** *See* Note 3	R	R	NR	R	R	R	R	R

R – Required NR – Not Required

REMARK 1: Any state or area where the municipal supply caters to municipal/public yard hydrant system with hydrant outlets provided throughout the premises with adequate water supply meeting the wet riser requirement demand flow and pressure 24 × 7 uninterrupted, such states/areas/ jurisdiction can replace the wet riser system and its associated pumping with water storage with a dry riser system. Dry riser system is also recommended for areas where ambient temperature below is 4 °C and has facility of connecting the yard hydrant to the dry riser in any event of fire in the building. This system is to be maintained with quarterly checks to ensure the system integrity to handle the required flow and pressure. This is applicable for buildings height only up to 24 m where HL Protection is required as per above table.

REMARK 2: Sharing of water storage tank may be permitted between the adjacent neighbouring properties including industry clusters, without any loss of hydraulic effects (which is essential to fight the fire during an emergency).

NOTES

1 If the building has basement to be protected with sprinklers, the protection level should comply with **CL-3**.

2 If the building has electrical vehicles (EV) parks in podium or basements, it should be protected with sprinklers and complying to **CL-5**.

3 Protection should comply to supplementary protection for specific hazard/critical rooms as per Table 9/ Table 10/ Table 11 as applicable.

4 Pump pressure and quantity should be supported by hydraulic calculations.

5 If the building height exceeds 30 m it should comply hydraulic calculations meeting recommended system architecture.

6 If the building height exceeds 60 m multi-level pumping and storage with gravity redundant down comer. The pumps considered should not exceed 12 bar shutoff pressure.

7 Rate of rise heat sensor/detection system should be provided in electrical vehicles (EV) parks and charging areas. Smoke sensor/detectors should be provided in all basements in all areas other than internal combustion engine (ICE) vehicles parks as part of the fire alarm system. ICE vehicles parks should be provided with carbon monoxide sensors as part of fire alarm system to activate ventilation system.

8 Table 7K and Table 7M suggesting the basis for water quantity required for fire-fighting, respectively for combined (sprinkler and hose) protection and hose protection be considered.

Table 7G Requirements for Firefighting Installations – For Industrial Buildings

(*See also* Annex N on Fire Protection for Specific Industries)

[*Clauses* 4.9 (a), 4.9 (c), 4.9(e), 5.1.1 (a), 5.1.1(d), 5.1.2.1, 5.1.3 (a), D-6.1, G-2(f), Annex N *and* Table 31]

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Industrial Buildings (G) *See* Note 5								
a)	**Low Hazard (G-1)** *See* Notes 1 and 6								

Table 7G (*Continued*)

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	Built up area up to 1 000 m^2 (Including the MSMEs) **(HL-1)**	R	R	NR	NR	NR	NR	NR	NR
ii)	Built up area from 1 001 m^2 to 2 000 m^2 **(HL-2)**	R	R	R	NR	NR	NR	NR	NR
iii)	Built up area from 2 001 m^2 up to 3 000 m^2 **(HL-3)**	R	R	NR	NR	R	NR	R	NR
iv)	Above 3 001 m^2 **(HL-4)** *See* Note 1	R	R	NR	NR	R	NR	R	NR

Table 7G (*Continued*)

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
b)	**Moderate Hazard (G-2)** *See* Notes 1, 4 and 6								
i)	Built up area up to 500 m^2 **(HL-2)**	R	R	R	NR	NR	NR	NR	NR
ii)	Built up area from 501 m^2 to 2 000 m^2 **(HL-3)**	R	R	NR	R	R	NR	R	NR
iii)	Built up area from 2 001 m^2 to 3 000 m^2 **(HL-4)**	R	R	NR	R	R	NR	R	NR
iv)	Built up area above 3 001 m^2 **(CL-5)**	R	R	NR	R	R	R	R	NR

Table 7G (*Continued*)

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
c)	**High Hazard (G- 3)**								
i)	Built up area up to 250 m^2 **(CL-4)** *See* Notes 1, 2, 3 and 7	R	R	NR	R	R	R	NR	NR
ii)	Built up area from 251 m^2 to 1 000 m^2 **(CL-5)** *See* Notes 1, 2, 3, 4 and 7	R	R	NR	R	R	R	R	NR

Table 7G (*Concluded*)

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
iii)	Built up area above 1 001 m^2 **(CL-6)** *See* Notes 2, 3, 4 and 7	R	R	NR	R	R	R	R	R

R – Required NR – Not Required

REMARK 1: Any state or area where the municipal supply caters to municipal/public yard hydrant system with hydrant outlets provided throughout the premises with adequate water supply meeting the wet riser requirement demand flow and pressure 24×7 uninterrupted, such states/areas/ jurisdiction can replace the wet riser system and its associated pumping with water storage with a dry riser system. Dry riser system is also recommended for areas where ambient temperature below is 4 °C and has facility of connecting the yard hydrant to the dry riser in any event of fire in the building. This system is to be maintained with quarterly checks to ensure the system integrity to handle the required flow and pressure. This is applicable for buildings height only up to 24 m where HL Protection is required as per above Table**.**

REMARK 2: Sharing of water storage tank may be permitted between the adjacent neighbouring properties including industry clusters, without any loss of hydraulic effects (which is essential to fight the fire during an emergency).

NOTES

1 If the building has any type of combustible storage, combustible packing, fuel storage, boilers, furnaces such areas should be protected and should comply to protection level **CL-6**.

2 Alternate suppression agent should be considered as per relevant Indian Standards if water is not a suitable agent for materials protected.

3 Oxidizing materials, ignitable liquids, water resistive chemicals, explosives, aluminium dust, or any other explosive environment should be treated separately.

4 Protection should comply to supplementary protection for specific hazard/critical rooms as per Table 9/ Table 10/ Table 11 as applicable.

5 Pump pressure and quantity should be supported by hydraulic calculations.

6 If the cluster of buildings exceeds 5, another set of pumps and water storage of similar capacity should be provided. A maximum of two such sets is recommended, provided it satisfies the hydraulic requirements and functioning at the remotest point.

7 Table 7K and Table 7M suggesting the basis for water quantity required for fire-fighting, respectively for combined (sprinkler and hose) protection and hose protection be considered.

Table 7H Requirements for Firefighting Installations – For Storage Buildings

[*Clauses* 4.9 (a), 4.9 (c), 4.9(e), 5.1.1 (a), 5.1.1(d), 5.1.2.1, 5.1.3 (a), D-6.1, G-2(f) *and* Table 31]

Sl No.	**Type of Building Occupancy**	**Type of Installation**							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Storage Buildings (H) (*See* Note 1, 2 and 3)								
i)	Built-up area up to 500 m^2 **(HL-4)**	R	R	NR	R	NR	NR	R	NR
ii)	501 m^2 to 1 000 m^2 **(HL-5)**	R	R	NR	R	R	NR	R	NR

Table 7H (*Concluded*)

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
iii)	1 001 m^2 to 2 000 m^2 or building ridge height up to 7.6 m **(CL-6)**	R	R	R	NR	R	R	R	NR
iv)	Above 2 001 m^2 or Building ridge height above 7.6 m and up to 9.0 m **(CL-7)**	R	R	NR	R	R	R	R	R
v)	Building of any height with rack storage	R	R	NR	R	R	R	R	R

R – Required NR – Not Required

REMARK 1: Any state or area where the municipal supply caters to municipal/public yard hydrant system with hydrant outlets provided throughout the premises with adequate water supply meeting the wet riser requirement demand flow and pressure 24×7 uninterrupted, such states/areas/ jurisdiction can replace the wet riser system and its associated pumping with water storage with a dry riser system. Dry riser system is also recommended for areas where ambient temperature below is 4 °C and has facility of connecting the yard hydrant to the dry riser in any event of fire in the building. This system is to be maintained with quarterly checks to ensure the system integrity to handle the required flow and pressure. This is applicable for buildings height only up to 24 m where HL Protection is required as per above table.

REMARK 2: Sharing of water storage tank may be permitted between the adjacent neighbouring properties including industry clusters, without any loss of hydraulic effects (which is essential to fight the fire during an emergency).

NOTES

1 Pump pressure mentioned in above table is considering minimum requirement, it should be supported hydraulic calculations. The above Table applies to the below Storage categories only, stored on ground, not exceeding 3.7 m, (12 feet) excluding tyre storage. In addition, they should also comply with supplementary protection for all hazard/critical rooms as per Table 9/Table 10/ Table 11:

a) Packaging materials stored on ground with or without pallets

b) Raw materials storage, in solid pile, shelves, pallets

c) Finished goods storage, solid pile, shelves, pallets

d) Miscellaneous storage in and around manufacturing/assembly/packaging areas

e) Retail storage in shelves other than catwalk storage

2 For rack storages, with plastic/combustible packaging (exposed/cartoned unexpanded or exposed/ cartoned expanded), water reactive solids/liquid storages, lithium battery storages, ignitable chemical storages, or retail cat walk, any other oxidizing agent storages, relevant Indian Standards should be followed, and pumping capacities and water storage should be justified by way of hydraulic calculations.

3 If the cluster of buildings exceeds 5, another set of pumps and water storage of similar capacity should be provided. A maximum of two such sets is recommended, provided it satisfies the hydraulic requirements and functioning at the remotest point

4 Table 7K and Table 7M suggesting the basis for water quantity required for fire-fighting, respectively for combined (sprinkler and hose) protection and hose protection be considered.

Table 7J Requirements for Firefighting Installations – For Hazardous Buildings

[*Clauses* 4.9 (a), 4.9 (c), 4.9(e), 5.1.1 (a), 5.1.1(d), 5.1.2.1, 5.1.3 (a), D-6.1, G-2(f) *and* Table 31]

Sl No.	**Type of Building Occupancy**	**Type of Installation**							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Hazardous Buildings (J) (*See* Notes 1 and 2)								
1)	Up to 15 m in height								
i)	Single storey building **(CL-7)**	R	R	NR	R	R	R	R	NR

Table 7J (*Concluded*)

Sl No.	Type of Building Occupancy	Type of Installation							
		Fire Extinguisher	First Aid Hose Reel	Down Comer	Wet Riser	Yard Hydrant	Automatic Wet Sprinkler System	Automatic Detection and Alarm System	Public Address and Voice Evacuation System
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ii)	More than one floor building but not exceeding 15 m **(CL-8)**	R	R	NR	R	R	R	R	R

R – Required NR – Not Required

REMARK 1: Any state or area where the municipal supply caters to municipal/public yard hydrant system with hydrant outlets provided throughout the premises with adequate water supply meeting the wet riser requirement demand flow and pressure 24 × 7 uninterrupted, such states/areas/ jurisdiction can replace the wet riser system and its associated pumping with water storage with a dry riser system. Dry riser system is also recommended for areas where ambient temperature below is 4 °C and has facility of connecting the yard hydrant to the dry riser in any event of fire in the building. This system is to be maintained with quarterly checks to ensure the system integrity to handle the required flow and pressure. This is applicable for buildings height only up to 24 m where HL Protection is required as per above Table.

REMARK 2: Sharing of water storage tank may be permitted between the adjacent neighbouring properties including industry clusters, without any loss of hydraulic effects (which is essential to fight the fire during an emergency).

NOTES

1 These buildings should deploy specific tailor-made systems and solutions in terms of water hydrant/sprinklers, dry chemical, dry powder, water mist, gas/ wet chemical suppression, foam or/and any other as per relevant Indian Standards and international standards (wherever Indian Standards are not available) in consultation with local fire services or Authority having Jurisdiction (AHJ).

2 Pump pressure and quantity should be supported by hydraulic calculations.

3 Table 7K and Table 7M suggesting the basis for water quantity required for fire-fighting, respectively for combined (sprinkler and hose) protection and hose protection be considered.

Table 7K Base Calculations for Combined Protection System (Sprinkler System and Hose Stream)

[*Clause* 5.1.1 (a)]

Sl No.	Combined System	Hazard Classification	Sprinkler Demand		Hose Stream Flow @ 3.5 bar	Number of Hose Streams	Pump Capacity and Quantity	Duration min
(1)	(2)	(3)	(4)		(5)	(6)	(7)	(8)
i)	Level of Protection – **CL-1**	Extra Low Hazard -1	2.25	84	50	2	379 lpm × 1	30 – 60
ii)	Level of Protection – **CL-2**	Extra Low Hazard -2	4.1	140	170	2	946 lpm × 1	30 – 60
iii)	Level of Protection – **CL-3**	Low Hazard	6.1	230	285	3	1 892 lpm × 1	30 – 60
iv)	Level of Protection – **CL-4**	Moderate Hazard -1	8.1	230	285	3	2 500 lpm × 1	60 – 120
v)	Level of Protection – **CL-5**	Moderate Hazard -2	12.2	230	475	3	3 785 lpm × 1	60 – 120
vi)	Level of Protection – **CL-6**	Extra Hazard -1	16.3	230	475	3	4 731 lpm × 1	60 – 120
vii)	Level of Protection – **CL-7**	Extra Hazard -2	18.3	280	670	4	7 570 lpm × 1	60 – 120
viii)	Level of Protection – **CL-8**	High Hazard	24.5	280	1050	4	4731 lpm x 2	60 – 120
Pump capacity = Total flow with 20 percent overflow and operating at 140 percent capacity. For example, for **CL-5**, capacity will be (12.2 × 230) + (475 × 3) = 4 231 litre; with overflow margin works to 5 077.2 litre; and pump selection will be 5 077.2/140*100 = 3 627 lpm (and the nearest Indian Standard pump is 3 785 lpm).								

NOTES

1 'Pump' implies, providing an electric pump and 'Standby pump of equivalent capacity'. For loss in pressure, jockey pump is also to be provided.

2 The duration of firefighting may be decided from 30 min to 120 min based on the hazard, fire preparedness, local conditions, to name a few.

3 The required quantity of water may be calculated as per the respective Indian Standards (where available); or based on the Table 7K and Table 7M.

Table 7M Base Calculations for Hose Stream Protection System

[*Clause* 5.1.1 (a) *and* D-6.1]

Sl No.	Hose Stream Only	Hazard Classification	Hose Stream Flow	Number of Hose Streams	Pump Capacity and Quantity	Duration min
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Level of Protection – **HL-1**	Extra Light -1	50	4	379 lpm × 1	30 – 60
ii)	Level of Protection – **HL-2**	Extra Light -2	170	4	946 lpm × 1	30 – 60
iii)	Level of Protection – **HL-3**	Low Hazard	270	4	1 514 lpm × 1	30 – 60
iv)	Level of Protection – **HL-4**	Moderate -1	475	4	2 839 lpm × 1	60 – 120
v)	Level of Protection – **HL-5**	Moderate -2	670	5	4 731 lpm × 1	60 – 120
vi)	Level of Protection – **HL-6**	Extra Hazard	670	6	5 677 lpm × 1	60 – 120

Pump capacity = Total flow with 40 percent overflow and operating at 140 percent capacity. For example, for **HL-3**, capacity will be 270 × 4 = 1 080 litre; together with overflow margin works to 1 512 litre; and pump selection will be 1 512/140 × 100 = 1 514 lpm (nearest Indian Standard pump).

NOTES

1 'Pump' implies, providing an Electric pump and 'Standby pump of equivalent capacity'. For loss in pressure, jockey pump is also to be provided.

2 The duration of firefighting may be decided from 30 min to 120 min based on the hazard, fire preparedness, local conditions, to name a few.

3 The required quantity of water may be calculated as per the respective Indian Standards (where available); or based on the Table 7K and Table 7M.

4.10 Fire Officer

The essential capabilities of the Fire Officer should be to maintain fire equipment, develop and implement fire safety operational plans, train occupants on fire tools and evacuation, and coordinate with the city fire brigade to ensure constant safety compliance. It is recommended that a qualified Fire Officer should be stationed on-site for large building complexes and specific high-rise or high-risk buildings.

4.11 Fire Drills and Fire Orders

Fire notices/orders should be prepared to fulfil the requirements of firefighting and evacuation from the buildings in the event of fire and other emergency. The occupants should be made thoroughly conversant with their action in the event of emergency, by displaying fire notices at vantage points and also through regular training. Such notices should be displayed prominently in bold lettering. The State/Local Authorities may also decide on the nature and frequency of fire drills to be carried out in buildings.

5 FIRE PROTECTION

5.1 Fire Extinguishers/Fixed Firefighting Installations

5.1.1 All buildings depending upon the occupancy use and height should be protected by fire extinguishers, hose reels, wet riser, down-comer, yard hydrants, automatic sprinkler installation, deluge system, high/medium velocity water spray, foam, water mist systems, gaseous or dry powder system, manual/automatic fire alarm system, etc, in accordance with the provisions of various clauses given below, as applicable:

a) These fire extinguishing equipment and their installation should be in accordance with accepted standards [F(17)]. The extinguishers should be mounted at a convenient height to enable its quick access and efficient use by all in the event of a fire incidence. The requirements of fire extinguishers/yard hydrant systems/wet riser/down-comer installation, etc, should be as specified in Table 7A to Table 7J. *See also* Table 7K and Table 7M for guidance, on base calculation for capacity of water storage tanks and fire pumps. The requirements regarding size of mains/risers should be as given in Table 8. The typical arrangements of down-comer and wet riser installations, as also the pumping system are shown in Fig. 15, Fig. 16 and Fig. 17. The wet riser should be designed for zonal distribution ensuring that unduly high pressures are not developed in risers and hose-pipes.

b) First-aid firefighting appliances should be provided and installed in accordance with good practice [F(18)]. The firefighting equipment and accessories to be installed in buildings for use in firefighting should also be in accordance with the accepted standard [F(17)] and should be maintained periodically so as to ensure their perfect serviceability at all times.

c) Valves in fixed firefighting installations should have supervisory switch with its signalling to fire alarm panel or to have chain(s), pad lock(s), label, and tamper-proof security tag(s) with serial number to prevent tampering/unauthorized operation. These valves should be kept in their intended 'open' position.

d) In addition to wet riser or down-comer, first-aid hose reels should be installed in buildings (where required under Table 7A to Table 7J) on all the floors, in accordance with accepted standard [F(19)]. The first-aid hose reel should be connected directly to the riser/down-comer main and diameter of the hose reel should not be less than 19 mm.

e) Wet risers should be interconnected at terrace level to form a ring and cut-off should be provided for each connection to enable repair/ maintenance without affecting rest of the system.

f) Pressure at the hydraulically remote hydrant and at the highest hydrant should not be less than 3.5 bar. The pressure at the hydrants should however not exceed 7.0 bar, considering the safety of operators. It may be planned to provide orifice plates for landing valves to control pressure to desired limit especially at lower levels. This could also be achieved through other suitable means of pressure reducing devices such as pressure-controlled hydrant valves.

g) Hydrants for firefighting and hose reels should be located in the lobby in firefighting shaft. Those hydrants planned to be provided near fire exit staircase on the floor should be within 5 m from fire exit door in exit access. Such hydrant cabinet may finish with doors to meet interior finishes with requirement of glass panel to provide visibility to the installations inside and inscribed with the word: 'FIRE HOSE CABINET' of letter size 75 mm in height and 12 mm in width. Such door of the fire hose cabinet need not be fire resistant rated. The location of such cabinets should be shown on floor plan and duly displayed in the landing of the respective fire exit staircase.

5.1.2 *Static Water Storage Tanks and Pump House*

5.1.2.1 *Static water storage tanks*

A satisfactory supply of water for the purpose of firefighting should always be available in the form of underground/terrace level static storage tank with capacity specified for each building with arrangements or replenishment.

Water for the hydrant services should be stored in an easily accessible surface/underground lined reservoir or above ground tanks made of steel or concrete or masonry. The effective capacity of the reservoir above the top of the pump casing (flooded suction) for various types of occupancies should be as indicated in Table 7A to Table 7J.

Water for firefighting should be stored in two or more interconnected compartments of equal size to facilitate cleaning and maintenance of the tanks without interrupting the water availability for firefighting.

To prevent stagnation of water in the static water storage tank, the suction tank of the domestic water supply should be fed only through an overflow arrangement from the fire water storage tanks to maintain the level therein at the minimum specified capacity.

Alternatively, domestic and fire water can be stored in two interconnected compartments as mentioned above. The suction inlet(s) for the domestic water pumps should be so located at an elevation that minimum water requirements for firefighting as stated in Table 7A to Table 7J will be always available for fire pumps.

The static storage water supply required for the above-mentioned purpose should entirely be accessible to the fire engines of the local fire service. Sufficient number of manholes should be provided for inspection, repairs, insertion of suction hose, etc. As an alternative to the arrangement of manholes to allow access from the top, suitable arrangement to enable efficient access to the tank by the firemen from the adjoining fire pump room having direct access from the ground level, should be made. The underground fire water storage tank(s) should not be more than 7 m in depth from the level having fire brigade draw-out connection, while the draw-out connection should not be more than 5 m away from the tank wall.

The covering slab and its supporting wall/supporting system should be able to withstand a total vehicular load of 45 tonnes (or higher as applicable) equally divided as a four-point load when the slab forms a part of fire apparatus pathway/driveway.

The static water storage tank should be provided with a fire brigade collecting head with 4 number 63 mm diameter (2 number 63 mm diameter for pump with capacity 1 400 litre/min) instantaneous male inlets arranged in a valve box at a suitable point at street level. The same should be connected to the static tank by a suitable fixed galvanized iron pipe not less than 150 mm in diameter to discharge water into the tank when required at the rate of 2 250 litre/min if tank is in the basement or not approachable for the fire engines.

Each of the static water storage tanks should also be provided with a fire brigade draw out collecting head with 63 mm diameter instantaneous male draw out arranged in a valve box at a suitable point at street level. This draw out should be connected to galvanized iron pipe of 100 mm diameter with foot valve arrangement in the tank.

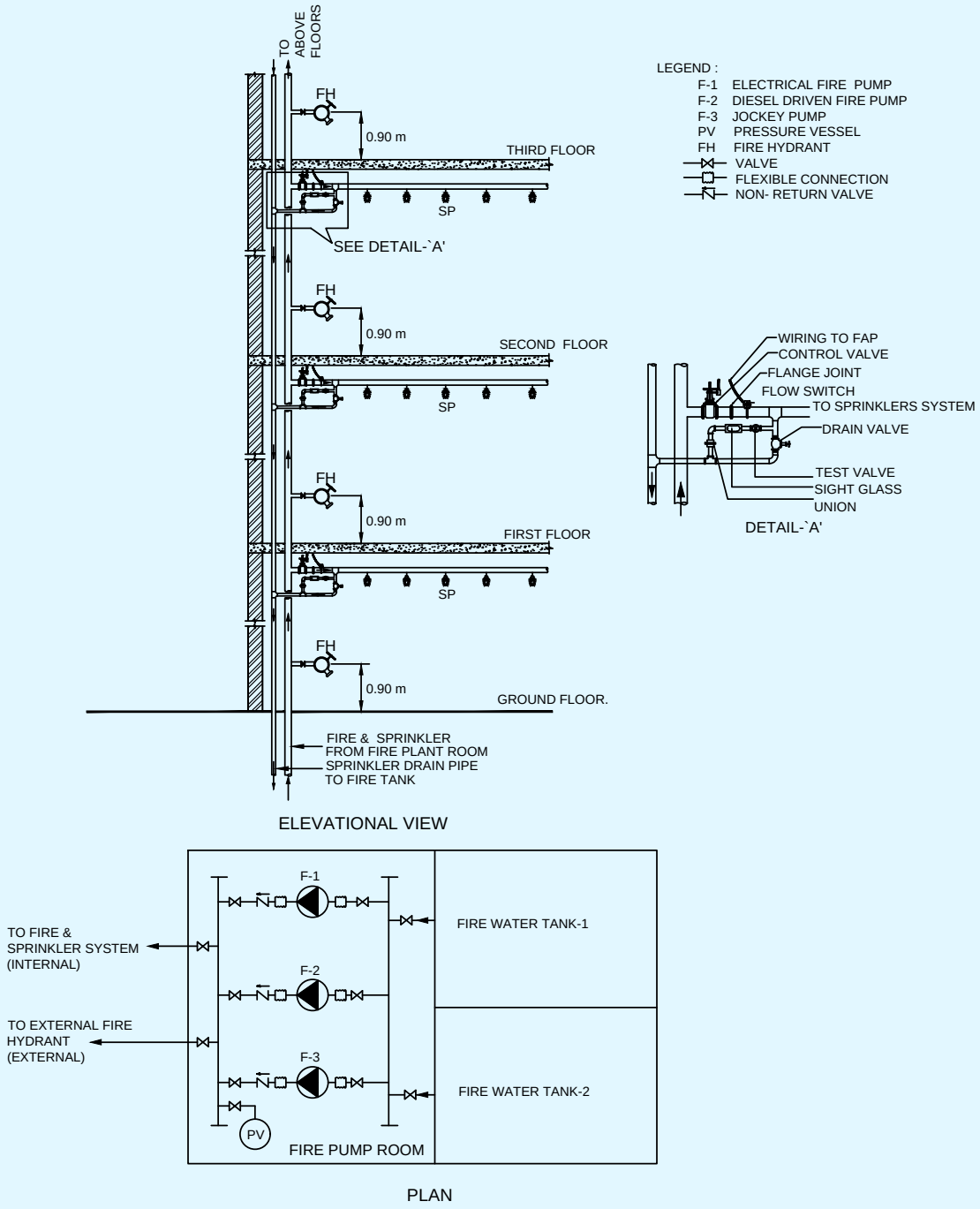


FIG. 15 TYPICAL SYSTEM OF PUMPING WITH ONE ELECTRIC, ONE DIESEL FIRE PUMP

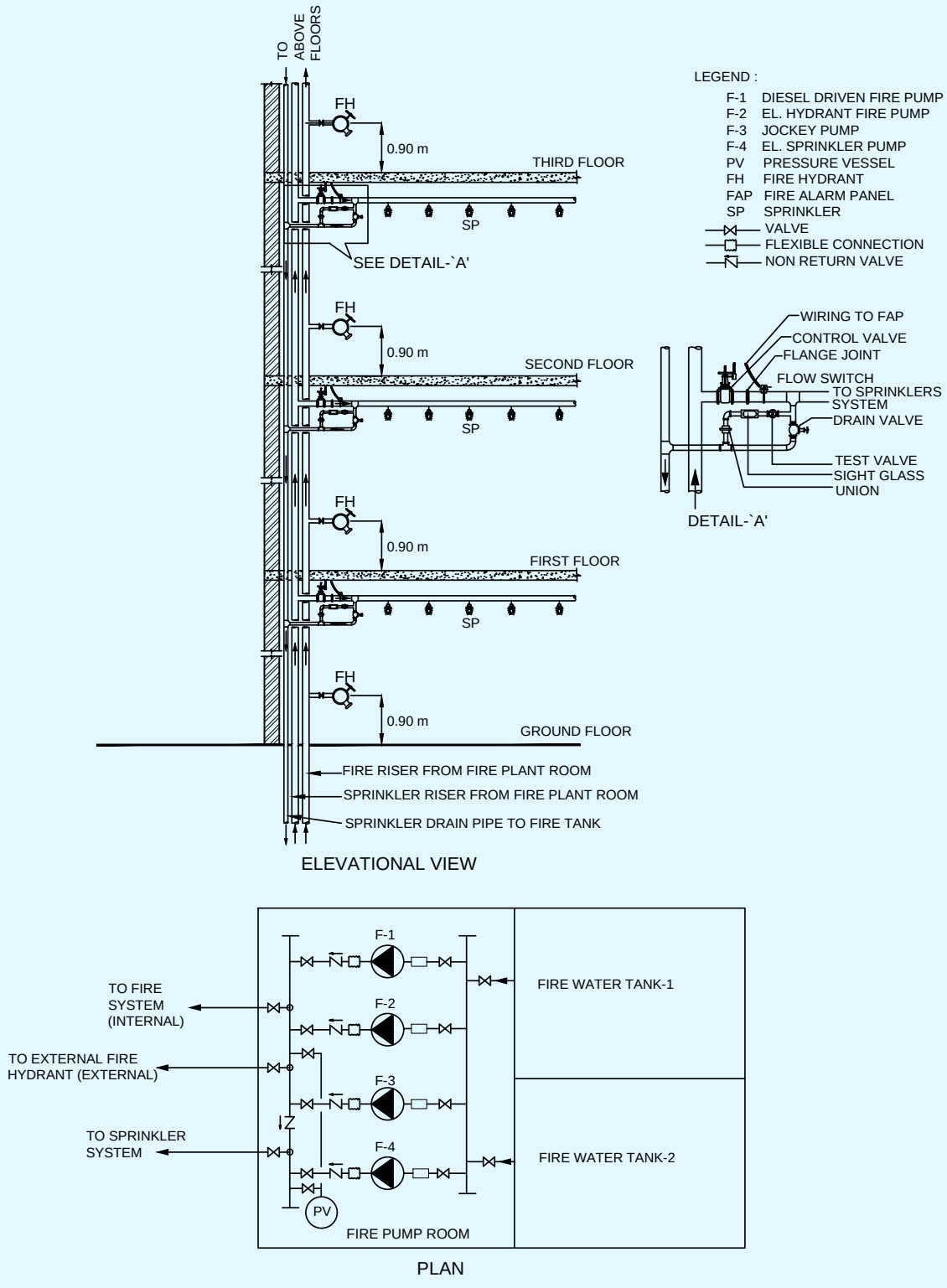


FIG. 16 TYPICAL SYSTEM OF PUMPING WITH TWO ELECTRIC, ONE DIESEL FIRE PUMP

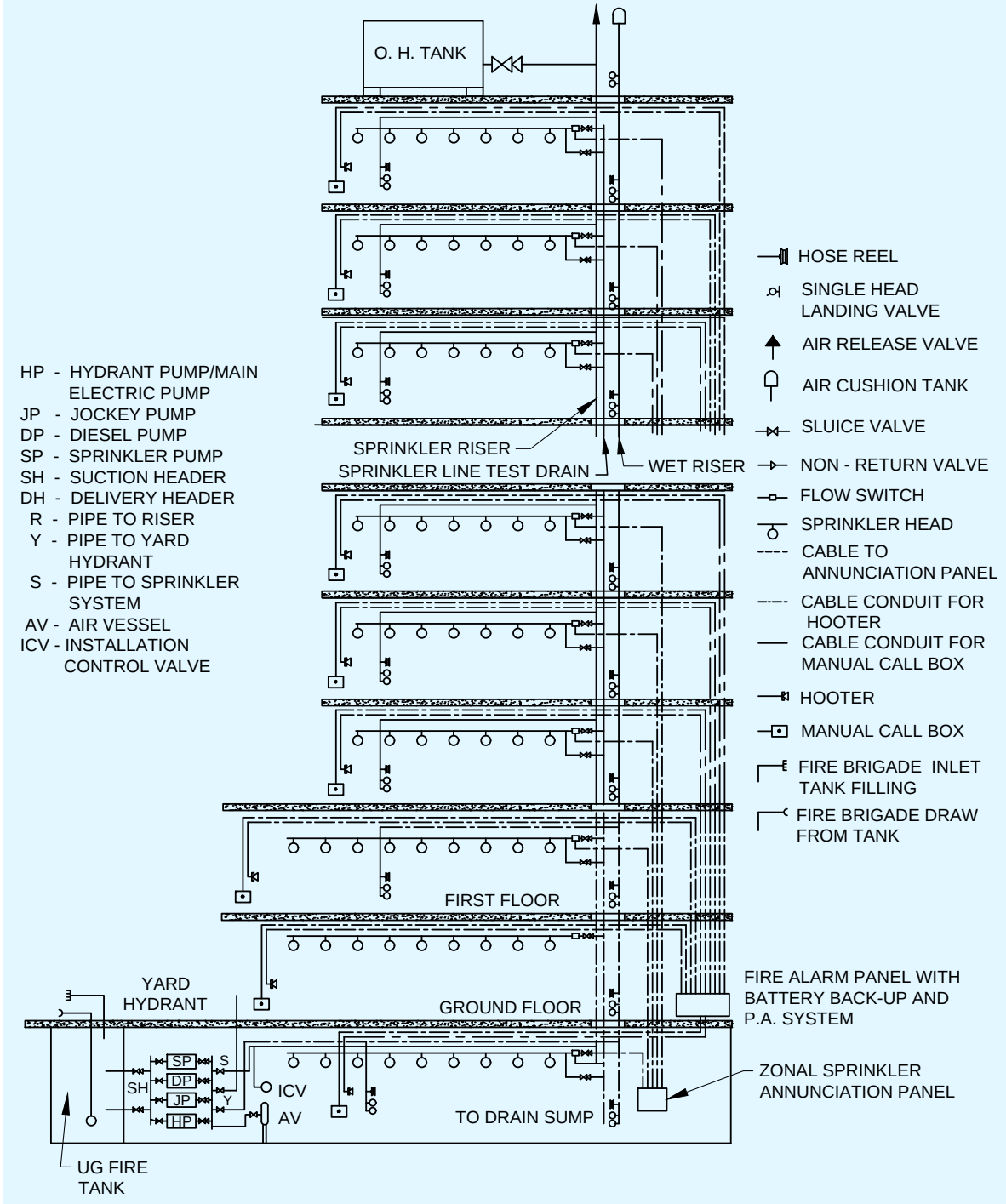


FIG. 17 TYPICAL ARRANGEMENT OF WET RISER AND TOTAL SPRINKLER SYSTEM OF BUILDING

Table 8 Size of Mains

[*Clause* 5.1.1(a)]

Sl No.	Minimum Size of the Mains mm	Type of Building		Building Height m
(1)	(2)	(3)		(4)
i)	100 mm with single outlet 63 mm landing valve	a)	Residential buildings (A)	
			1) Dormitories	–
			2) Apartments	Up to 15 m
			3) Hotels	Up to 15 m
		b)	Educational buildings (B)	Up to 15 m
		c)	Institutional buildings (C)	Up to 15 m
		d)	Assembly buildings (D)	Up to 15 m
		e)	Business buildings (E)	Up to 15 m
		f)	Mercantile buildings (F)	Up to 9 m
		g)	Industrial buildings (G)	Up to 9 m
ii)	150 mm with single outlet 63 mm landing valve	a)	Hotels	Above 15 m
		b)	Starred hotels	–
		c)	Institutional buildings (C)	Above 15 m
		d)	Business buildings (E)	Above 15 m
		e)	Industrial buildings (G)	Up to 15 m
		f)	Storage buildings (H)	Up to 15 m
		g)	Hazardous buildings (J)	Up to 15 m

5.1.2.2 *Firefighting pump house*

The requirements should be as given below:

a) Pump house should be situated so as to be directly accessible from the surrounding ground level. In the case of industrial occupancies, it is preferable to install the pump house at ground level.

b) When located below ground, the pump house is much preferred in the first basement and should not be installed lower than the second basement (in which case the pumping efficiency should be ascertained). When installed in the basement, staircase with direct accessibility (or through enclosed passageway with 120 min fire rating) from the ground, should be provided. Access to the pump room should not require to negotiate through other occupancies within the basement.

c) Pump house need to be separated by fire walls all around and doors to be protected by fire doors (120 min rating).

d) Pump house should be well ventilated and due care should be taken to avoid water stagnation.

e) No other utility equipment should be installed inside fire pump room.

f) Insertions like flexible couplings, bellows, etc, in the suction and delivery piping should be suitably planned and installed.

g) Installation of negative suction arrangement and submersible pumps should not be allowed.

h) Pump house should be sufficiently large to accommodate all pumps, and their accessories like pressure reducing valves (PRVs), installation control valves (ICVs), diesel tank and electrical panel. ICV for the towers (superstructure) is allowed to be installed in the first basement, in a duly protected room of 120 min fire resistance rating.

j) Battery of diesel engine operated fire pump should have separate charger from emergency power supply circuit.

k) Exhaust pipe of diesel engine should be insulated as per best engineering practice and taken to a safe location at ground level, considering the back pressure.

m) Fire pump is to be provided with soft starter or variable frequency drive starter.

5.1.3 *Automatic Sprinkler Installation*

The requirements should be as given below:

a) Automatic sprinklers should be installed wherever required in terms of Table 7A to Table 7J throughout the building, for uses as specified in, and in accordance with good practice [F(20)].

b) If selective sprinklering is adopted, there is a real danger of a fire starting in one of the unsprinklered area gathering momentum spreading to other areas and reaching the sprinklered areas as a fully developed fire. In such an event, the sprinklers can be rendered useless or ineffective.

c) Automatic sprinklers should be installed in false ceiling voids exceeding 800 mm in height.

d) Installation of sprinklers may be excluded in any area to be used for substation and DG set.

e) In areas having height 17 m or above such as in atria, sprinkler installations may be rendered ineffective and hence may be avoided.

f) Pressure in sprinkler system should not exceed 12 bar or else high pressure sprinkler to be installed for above 12 bar operations.

g) The maximum floor area on any one floor to be protected by sprinklers supplied by any one sprinkler system riser from an installation control valve should be based on system protection area limitations considering maximum floor area on any one floor to be 4 500 m^2 for all occupancies except industrial and hazardous occupancies, where Authorities should be consulted for advice based on type and nature of risk.

h) Sprinkler installation control valves, should be installed inside the fire pump room.

j) For industrial buildings, such installation control valves may be installed outside the building and Authorities should be consulted in situations where it is not possible to locate them inside the buildings. It is advisable to provide electrically operated siren for each valve outside the buildings in addition to water gongs in such case.

k) The sprinkler flow switches provided should be monitored by fire alarm panel.

m) It is essential to make provisions for avoiding water from sprinkler/hydrant operation entering lifts and electrical rooms.

n) Ramps at all levels should be protected with sprinklers.

p) The water based sprinkler systems are not suited for specific buildings for example, areas manufacturing electronic equipment, in which case alternate type of protection should only be provided.

q) Colour of the sprinkler piping may be matched to suit the interiors; however, in such case, the piping should be provided with red colour band of about 100 mm wide, every 3 m along the length of the pipe. In no case, the sprinkler heads should be painted.

r) Based on interior design or interior requirements where it is necessary to provide pendent sprinkler with no false ceiling, to achieve the sprinkler response/activation, it is required to provide about 250 mm diameter circular plate around the sprinkler.

5.1.4 *Automatic High Velocity and Medium Velocity Water Spray Systems*

Automatic high velocity water spray or emulsifying system should be provided for protection of outdoor and/or indoor oil-cooled transformers as applicable in accordance with good practice [F(21)] where applicable (*see* Annex D). Also, medium velocity water spray system should be provided for tankage (where applicable), conveyors, cable galleries and other occupancies listed in good practice [F(21)].

5.1.5 *Fixed Foam Installation*

Fixed foam generating system should be provided for protection of oil storage area for boilers with its ancillary storage of furnace oils in basement. Fixed foam installations can be low, medium, or high expansion types, which can be provided based on the type of fire hazards identified in the facility. High expansion foams are used for cable tunnels and other confined areas. Design and installation of foam systems should be governed by good practice [F(22)].

5.1.6 *Gas Based Suppression System*

Gas based fire extinguishing installation should be provided in accordance with good practice on premises where water or foam cannot be used for fire extinguishing because of the special nature of the contents of the buildings/areas to be protected where either the building(s) have very limited manpower or unmanned. The protection design for fixed carbon dioxide fire extinguishing system should conform to good practice [F(23)] in all respects. For some special fire risk/essential applications, carbon dioxide may not be suitable and alternate provisions should be made as per relevant standards (*see* **5.1.9**).

NOTE — Hypoxic air technology should not be used in occupiable areas (considering the tenability aspects), and specific caution should be exercised in consultation with the Authority, regarding its applicability.

5.1.7 Firefighting equipment should be suitably located and clearly marked by luminous signs.

5.1.8 *Automatic Water Mist Systems*

These systems involve the use of fine water sprays for the efficient extinguishment of fires. These systems may be provided to protect areas in buildings for the uses as specified in good practice [F(24)].

5.1.9 *Extinguishing Systems with Clean Agents*

Alternative systems for halon gas protection systems should be provided where necessary as prescribed in this Part. These should be in accordance with the accepted standards [F(25)].

5.2 Fire Detection and Alarm System

See also **4.9**.

5.2.1 *Automatic Detection System*

5.2.1.1 *Pneumatic linear high-sensitivity heat detection*

Pneumatic linear high-sensitivity heat detection is a gas-pressure-based linear detector. The tube material (copper/steel/Teflon) is selected based on the environmental and operational needs, copper for fast response and standard indoor use, steel for rugged corrosive areas, and Teflon for chemically aggressive or electrically sensitive spaces.

5.2.1.2 *Flame/gas/spark detection*

A flame detector works by sensing the electromagnetic radiation and, through algorithms and filters, discriminates it from false sources (sunlight, hot machinery). The following are the characteristic radiation emitted by the flames/gas/spark:

a) Ultraviolet (UV) 180 nm to 260 nm, from most hydrocarbon and hydrogen flames;

b) Infrared (IR) 2 μm to 6 μm, from hot CO_2/H_2O in the flame; and

c) Some systems also use visible light (VIS).

5.2.1.3 *Video detection*

Video-based fire detection (VFD) is an advanced fire detection technology that uses CCTV cameras combined with image-processing software to automatically detect visible signs of fire, such as smoke, flames, or heat distortions, and alert emergency systems for early fire response. The system is capable of simultaneous fire detection and visual verification. The system can use infrared (IR) or thermal imaging cameras for low-light or dusty conditions.

5.2.1.4 *Gas detection*

To detect accumulation of combustible gases or vapours (for example, methane, propane, jet fuel vapours) or toxic gases (for example, carbon monoxide, hydrogen sulphide, ammonia) before they ignite or endanger personnel**.** Common sensor types used are: catalytic, infrared (IR), electrochemical, or semiconductor.

5.2.1.5 *Spark detection*

To detect ignition sources (sparks, hot particles, embers) transported by air or material flow before they enter dust collectors, filters, or silos and ignite an explosion.

This detection uses infrared photo-sensors tuned to glowing particle radiation (approx. 0.8 μm to 1.1 μm). The same is installed in dark ducts or pneumatic conveying lines. The system should detect sparks within milliseconds (≤ 10 ms). The system should be integrated with automatic extinguishing systems (for example, water spray or deluge system) in industrial processes.

5.2.1.6 *Fuel leak detection*

Fuel leak detection (FLD) is a safety and monitoring system designed to identify and alert operators to the accidental release of fuel or flammable liquids from storage tanks, pipelines, or equipment. The system helps prevent fires, explosions, environmental contamination, and operational hazards by detecting leaks early.

5.2.1.7 *High ceiling beam detector*

The beam detector works like an electronic eye and keeps watching a clear light path; when smoke blocks the beam, it raises the alarm. A high-ceiling beam detection system is a projected or reflected IR smoke detection technology designed for large, tall spaces where spot detectors are ineffective. The system works works by sensing reduction in light intensity caused by smoke particles in the beam path and provides early warning for fast-developing fires in high-volume spaces.

5.2.1.8 *Linear heat sensing cable*

A linear heat sensing cable (digital/analogue) is a wire-type, continuous heat detector that triggers an alarm when it gets hot at any point, making it ideal for protecting long or irregular spaces where many spot-type heat detectors would otherwise be needed.

5.2.1.9 *Probe type heat detector*

A probe type heat detector is essentially a temperature-sensing probe that extends into the area to detect fire or abnormal heat early, especially in confined, harsh, or high-risk industrial environments. The probe is usually metallic (steel, copper) for good thermal conduction. Its length allows it to reach inside equipment, ducts, or confined spaces where smoke detectors may not work effectively.

5.2.1.10 *Aspiration high-sensitivity smoke detection*

Aspiration high-sensitivity smoke detection is a pipe-based, actively sampled smoke detection system that can detect smoke at very low concentrations, giving earliest possible warning of fire, especially in high-value, high-ceiling, or challenging environments. It continuously samples air from the protected area through a network of pipes and detects smoke at very low concentrations, providing early warning of fire before visible smoke accumulates.

5.2.2 *Automatic Fire Suppression Systems*

5.2.2.1 *Water spray system*

A water spray system is a fixed fire protection system that delivers water through a network of piping and specially designed spray nozzles to cool surfaces, control, or extinguish a fire. It is similar to a sprinkler system but is designed to protect specific equipment or areas, rather than an entire room, by spraying water in a predetermined pattern and density.

5.2.2.2 *Wet/Dry pre-action*

A pre-action system is a special hybrid system used in areas where accidental water discharge would cause serious damage, such as data centres, archives, museums, cleanrooms. A wet sprinkler system is the simplest and most common type of sprinkler system. The pipes are always filled with water under pressure up to each sprinkler head**.** A dry sprinkler system is used in areas subject to freezing temperatures (for example, unheated warehouses, loading docks). The pipes are filled with pressurized air or nitrogen, and not water.

5.2.2.3 *Modular panel/rack suppression system*

A modular panel/rack suppression system with heat-sensitive tubing is a self-contained automatic fire protection system that uses a pressurized agent cylinder and flexible heat-sensitive tubing. The tube detects heat, ruptures at the fire spot, and releases the agent directly, providing fast, localized suppression for sensitive enclosures.

5.2.2.4 *Nitrogen injection*

The system is used for oil filled transformer system in which an overheating triggering the nitrogen gas displaces air/oxygen above the oil surface, preventing further combustion. The increased pressure helps to seal the transformer tank and suppress vapour formation, thereby preventing transformer fires and minimizing damage.

5.2.2.5 *Water mist system*

A water mist system is a specialized fire suppression system that uses very fine water droplets (mist) – typically less than 1 000 µ in diameter – to control, suppress, or extinguish fires. A water mist firefighting system suppresses fire by discharging a fine spray of water droplets that cools the fire, displaces oxygen, and reduces radiant heat, offering effective protection with minimal water use.

5.2.2.6 *Foam sprinkler system*

A foam sprinkler system automatically discharges a water-foam mixture through sprinkler heads to cool, smother, and suppress flammable liquid fires, providing effective fire protection for high-risk liquid storage and handling areas. It operates like a conventional sprinkler system; sprinkler heads open when heat rises above a preset temperature. It is primarily designed to suppress flammable liquid (Class B) fires, such as oil, fuel, or chemical storage, by cooling the fire and forming a foam blanket that smothers vapours.

5.2.2.7 *Wet chemical kitchen suppression system*

A wet chemical kitchen suppression system is a specialized fire suppression system designed to extinguish fires in commercial cooking areas, especially those involving cooking oils and grease (Class K fires). It uses a liquid wet chemical agent that reacts with hot grease to form a soapy foam layer (saponification), which cools and smothers the fire.

5.2.2.8 *Dry powder flooding system*

A dry powder flooding system is a fixed fire suppression system that floods a hazard area with dry chemical powder, quickly extinguishing flammable liquid, combustible metal, or electrical fires by interrupting the combustion reaction and isolating fuel from oxygen.

The dry chemical powder (for example, sodium bicarbonate, potassium bicarbonate, or special metal powders) is stored in pressurized vessels or storage tanks. Upon activation, the powder is discharged through a network of piping and nozzles into the protected space.

5.2.2.9 *Clean agent total flooding*

A clean agent total flooding system is a fixed fire suppression system that protects an enclosed space by discharging a gaseous extinguishing agent (clean agent) to rapidly suppress fire without leaving any residue. The term "total flooding" indicates that the agent fills the entire protected volume to extinguish the fire. The agent absorbs heat and/or interrupts the chemical reaction of the fire.

5.2.2.10 *Carbondioxide flooding*

A carbon dioxide flooding firefighting system is a fixed system that rapidly floods an enclosed area with carbon dioxide, extinguishing fire by removing oxygen and cooling while leaving no residue, but it requires evacuation of personnel due to asphyxiation risk. It is fast-acting and effective for flammable liquid and electrical fires.

5.2.2.11 *Aerosol-based fire suppression system*

An aerosol-based fire suppression system is a fixed or modular fire protection system that extinguishes fires by releasing a fine particulate aerosol a mixture of solid microscopic particles suspended in inert gas which interrupts the chemical reactions of combustion. When triggered, it rapidly vapourizes and condenses into ultra-fine particles (1 microns to 10 microns) suspended in gas. It is highly effective for enclosed spaces.

5.3 The fixed firefighting installations and systems should be maintained in accordance with good practice [F(26)]. *See also* the 'Handbook on Asset and Facility Management'.

5.4 Fire Detection and Suppression Systems Based on the Specific Type and Intensity of Industrial Hazards

Table 9 serves as a guiding tool for designers, fire safety engineers, and facility managers in selecting appropriate fire detection and suppression systems based on the specific type and intensity for G to J occupancy hazards. Table 9 supports a risk-based approach, recognizing that fire protection requirements vary with operational processes, materials handled, and business continuity considerations. It moves away from a one-size-fits-all model and promotes hazard-specific fire safety planning to ensure enhanced protection, system reliability, and life safety in special industrial occupancies.

5.5 Supplementary Protection for Specific Areas/Hazards

Table 10 provides a guide for the structured classification of automatic detection systems, and Table 11 provides for automatic fire suppression systems, based on the specific type and intensity for G to J occupancy hazards. The tables serve as a reference for designers, fire safety engineers, and regulatory authorities to determine the appropriate supplementary protection measures based on the specific fire risks present in a building or facility.

The automatic detection systems covered in the table include high-sensitivity pneumatic linear (or tubing) heat detection, aspiration high-sensitivity smoke detection, gas/flame/visual detection, fuel leak detection, and linear heat detection (LHS). The automatic fire suppression systems include water mist, clean agent gas suppression, wet/dry pre-action sprinkler systems, water spray protection, carbon dioxide flooding, etc.

Each system is marked as either 'S' (Suitable) or 'NS' (Not Suitable) depending on its effectiveness for a given hazard scenario. The selection of a special protection system should be based on a comprehensive fire risk assessment, considering factors such as fuel type, occupancy, fire growth rate, and critical infrastructure protection. These tables provides essential guidance for ensuring compliance with fire safety regulations and enhancing fire protection strategies in buildings.

Table 9 Fire Detection and Suppression Systems

(Based on the Specific Type and Intensity of A to F Occupancies)

(*Clauses* 3.5.5.4 *and* 5.4)

Sl No.	Type of Risk/ Hazard	Types of Special Protection System											
		Automatic Detection System					Automatic Fire Suppression Systems						
		Pneumatic Linear (Copper/ Steel/ Teflon Tubing) High Sensitivity Heat Detection	Aspiration High Sensitivity Smoke Detection	Gas/ Flame/ Video Detection	Fuel Leak Detection	Linear Heat Sensing Cable (LHS)	Water Mist Low/High Pressure	Clean Agent Gas Suppression	Water Pre-Action Sprinkler	Modular Panel/ Rack Suppression with Heat Sensitive Tubing	Water Spray Protection	Wet Chemical Kitchen Suppre-ssion	Aerosol Based Fire Suppre-ssion
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
i)	UPS room without batteries	NS	S	S	NS	NS	S	S	S	NS	NS	NS	NS
ii)	UPS room with batteries (except Lithium ion)	NS	S	S	NS	NS	S	S	S	NS	NS	NS	NS
iii)	Battery room with Lithium ion	S	S	S	NS	NS	NS	NS	S	NS	S	NS	NS
iv)	Server room/data halls	NS	S	NS	NS	NS	S	S	S	NS	NS	NS	NS
v)	Kitchen with any type of fuel, (live cooking)	NS	NS	S	NS	S	S	NS	NS	NS	NS	NS	NS
vi)	Network/ Electrical rooms	NS	S	NS	NS	NS	S	S	S	NS	NS	NS	NS

Table 9 (*Continued*)

Sl No.	Type of Risk/ Hazard	Types of Special Protection System											
		Automatic Detection System					Automatic Fire Suppression Systems						
		Pneumatic Linear (Copper/ Steel/ Teflon Tubing) High Sensitivity Heat Detection	Aspiration High Sensitivity Smoke Detection	Gas/ Flame/ Video Detection	Fuel Leak Detection	Linear Heat Sensing Cable (LHS)	Water Mist Low/High Pressure	Clean Agent Gas Suppression	Water Pre-Action Sprinkler	Modular Panel/ Rack Suppression with Heat Sensitive Tubing	Water Spray Protection	Wet Chemical Kitchen Suppre-ssion	Aerosol Based Fire Suppre-ssion
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
vii)	Electrical/ MCC panels	NS	S	NS	NS	NS	NS	S	NS	S	NS	NS	S
viii)	Cable cellar and trenches and trays over 1.5 m wide	S	NS	NS	NS	S	S	NS	NS	NS	S	NS	S
ix)	Dry transformer indoor	S	NS	S	NS	NS	NS	NS	NS	NS	NS	NS	NS
x)	Oil transformer outdoor more than 2.0 MVA or 2 000 litre oil	S	NS	S	NS	NS	NS	NS	NS	NS	S	NS	NS
xi)	DG rooms	S	NS	S	S	S	S	NS	NS	NS	S	NS	S
xii)	Cold/freezer rooms	S	S	NS	NS	NS	NS	NS	S	NS	NS	NS	NS

Table 9 (*Concluded*)

Types of Special Protection System													
Sl No.	**Type of Risk/ Hazard**	**Automatic Detection System**					**Automatic Fire Suppression Systems**						
		Pneumatic Linear (Copper/ Steel/ Teflon Tubing) High Sensitivity Heat Detection	Aspiration High Sensitivity Smoke Detection	Gas/ Flame/ Video Detection	Fuel Leak Detection	Linear Heat Sensing Cable (LHS)	Water Mist Low/High Pressure	Clean Agent Gas Suppression	Water Pre-Action Sprinkler	Modular Panel/ Rack Suppression with Heat Sensitive Tubing	Water Spray Protection	Wet Chemical Kitchen Suppre-ssion	Aerosol Based Fire Suppre-ssion
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
xiii)	MRI/ scanning rooms	NS	S	NS	NS	NS	S	NS	NS	NS	NS	NS	NS
xiv)	Operation theatres	NS	S	NS	NS	NS	S	NS	S	NS	NS	NS	NS
xv)	Tunnel protection	S	NS	S	NS	S	S	NS	NS	NS	S	NS	NS

NS = Not Suitable

S = Suitable

NOTES

1 Wet sprinklers are acceptable for all areas where pre-action sprinklers or closed water mist is suitable.

2 DG rooms should be protected with total flooding open nozzles where water mist is being deployed.

3 Spray system should be supplemented with suitable foam, if ignitable liquids or water miscible liquids are involved.

4 Water mist system should be selected based on 3rd party independent test carried out for the specific application, flow rate, density, etc. The products in terms of functionality and the performance should be based on actual test results and certifications, and should NOT be prescriptive.

5 Water mist solution selected, total flooding with sprinklers, total flooding with open nozzles, wet system, pre-action system should comply based on actual test results, and certifications.

Table 10 Special Protection Systems — Automatic Detection Systems for G to J Occupancies

(*Clause* 5.5)

Sl No.	Type of Risk/Hazard	Pneumatic Linear (Copper/Steel/Teflon Tubing) High Sensitivity Heat Detection	Flame/Gas/ Spark Detection	High Ceiling Beam Detection System	Linear Heat Sensing Cable	Probe Type Heat Detector	Aspiration High Sensitivity Smoke Detection
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Generator room	S	S	NS	S	S	NS
ii)	Water reactive chemical store	S	S	NS	S	S	NS
iii)	Chemical store	S	S	NS	S	S	NS
iv)	Paint booth	S	S	NS	S	S	NS
v)	Paint/varnish storage	S	S	NS	S	S	NS
vi)	Warehouse	NS	S	S	NS	NS	S
vii)	Above ground fuel oil storage	S	S	NS	S	NS	NS
viii)	Oil transformers	S	S	NS	NS	NS	NS
ix)	Diesel/HSD tanks	S	S	NS	S	NS	NS
x)	LPG bullets/Benzene, Xylene, Toulene tanks	NS	NS	NS	NS	NS	NS
xi)	Airport hanger	S	S	S	S	S	S
xii)	Hydrogenation rooms	NS	S	NS	S	S	S
xiii)	Sulphur storage	S	S	NS	S	S	NS
xiv)	Tanker loading/unloading bay	NS	S	NS	NS	NS	NS
xv)	Kitchen	S	S	NS	S	S	NS
xvi)	Conveyors	S	S	NS	S	NS	NS

Table 10 (*Concluded*)

Sl No.	Type of Risk/Hazard	Pneumatic Linear (Copper/Steel/Teflon Tubing) High Sensitivity Heat Detection	Flame/Gas/ Spark Detection	High Ceiling Beam Detection System	Linear Heat Sensing Cable	Probe Type Heat Detector	Aspiration High Sensitivity Smoke Detection
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
xvii)	QA/QC labs	S	S	NS	S	S	NS
xviii)	Open large atriums	NS	NS	NS	NS	NS	S
xix)	Floating roof tanks	S	S	NS	S	NS	NS
xx)	Oil fire boiler room, oil quenching tank	S	S	NS	S	S	NS
xxi)	Cooling tower	NS	NS	NS	S	NS	NS
xxii)	MCC room	S	NS	NS	S	S	S
xxiii)	Cable cellar/trenches	S	NS	NS	S	S	NS
xxiv)	Electrical panels	S	NS	NS	S	NS	NS

NOTE

NS = Not Suitable

S = Suitable

Table 11 Special Protection Systems — Automatic Fire Suppression Systems for G to J Occupancies

(*Clause* 5.5)

Sl No.	Type Of Risk/Hazard	Water Spray System	Wet/Dry Pre-action	Nitrogen Injection	Water Mist	Foam Sprinkler System	Dry Powder Flooding System	Clean Agent Total Flooding	Carbon-Dioxide Flooding
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	Generator room	S	NS	NS	S	NS	NS	NS	NS
ii)	Water reactive chemical store	NS	NS	NS	NS	NS	S	NS	S
iii)	Chemical store	S	NS	NS	S	S	NS	NS	NS
iv)	Paint booth	S	NS	NS	S	NS	NS	NS	NS
v)	Paint/varnish storage	S	NS	NS	S	S	S	NS	NS
vi)	Warehouse	NS	NS	NS	NS	NS	NS	NS	NS
vii)	Above ground fuel oil storage	S	NS	NS	NS	S	NS	NS	NS
viii)	Oil transformers	S	NS	S	S	NS	NS	NS	NS
ix)	Diesel / HSD tanks	S	NS	NS	NS	S	NS	NS	NS
x)	LPG bullets/Benzene, Xylene, Toulene tanks	S	NS	NS	NS	NS	NS	NS	NS
xi)	Airport hanger	NS	NS	NS	NS	S	NS	NS	NS
xii)	Hydrogenation rooms	S	NS	NS	S	NS	NS	NS	NS
xiii)	Sulphur storage	NS	NS	NS	S	NS	NS	NS	NS
xiv)	Tanker loading/unloading bay	S	NS	NS	NS	NS	NS	NS	NS
xv)	Kitchen	NS	NS	NS	S	NS	NS	NS	NS
xvi)	Conveyors	S	NS	NS	S	NS	NS	NS	NS
xvii)	QA/QC labs	NS	S	NS	S	S	S	S	NS
xviii)	Open large atriums	NS	NS	NS	S	NS	NS	NS	NS
xix)	Floating roof tanks	S	NS	NS	NS	S	NS	NS	NS

Table 11 (*Concluded*)

Sl No.	Type Of Risk/Hazard	Water Spray System	Wet/Dry Pre-action	Nitrogen Injection	Water Mist	Foam Sprinkler System	Dry Powder Flooding System	Clean Agent Total Flooding	Carbon-Dioxide Flooding
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
xx)	Oil fire boiler room, oil quenching tank	S	NS	NS	S	S	NS	NS	NS
xxi)	Cooling tower	S	NS	NS	NS	NS	NS	NS	NS
xxii)	MCC room	NS	S	NS	S	NS	NS	S	S
xxiii)	Cable cellar/trenches	S	NS	NS	S	NS	NS	NS	S
xxiv)	Electrical panels	NS	NS	NS	NS	NS	NS	S	S

NS = Not Suitable

S = Suitable

NOTES

1 Spray system should be supplemented with suitable foam, if ignitable liquids or water miscible liquids are involved.

2 Chemical material safety data sheet (MSDS) as per manufacture should be referred to select the right suppression agent.

3 Water mist system should be selected based on third party independent test carried out for the specific application, flow rate, density, etc. The products in terms of functionality and the performance should be based on actual test results and certifications, and should not be prescriptive.

4 Water mist solution selected, total flooding with sprinklers, total flooding with open nozzles, wet system, pre-action system should comply based on actual test results, and certifications.

5 Oxygen-reduction systems, which is not listed but area proactive fire prevention solutions by maintaining the oxygen percentage below the threshold needed for ignition and sustained combustion but suitable for human occupancy. These systems should be carefully evaluated and used for normally unoccupied areas with proper monitoring of oxygen levels. Fully enclosed very sensitive and critical high valve equipment rooms, rooms in heritage buildings for storing archives or ancient manuscripts, areas where no other fire protection system are effective and feasible are a few areas where it can be implemented. The implementer should ensure all 3rd party product/system accreditations certifications for specific applications and approval from local statutory bodies and AHJs in place before use.

6 SPECIFIC OCCUPANCY WISE REQUIREMENTS

Apart from the general requirements on fire prevention given in 3, the life safety requirements given in 4, and the fire protection requirements given in 5, the following specific requirements should also be complied with for each type of occupancy.

For specific requirements for high rise buildings, the provisions as given in Annex D should apply.

Atriums in building occupancies should comply with the provisions as given in Annex E.

For specific requirements for data centres, the provisions as given in Annex F should apply.

For fire protection requirements of commercial kitchen, cooking facilities with or without restaurants, the provisions of good practice [F(30)] should be referred.

6.1 Residential Buildings (Group A)

6.1.1 *Life Safety*

6.1.1.1 *Subdivision A*-I

a) All locking devices, which would impede or prohibit exit, such as chain type bolts, limited opening sliding type locks and burglar locks, which are not disengaged easily by quick- releasing catches, should be prohibited.

b) All bathroom door locks or fasteners should be designed to permit the opening of the locked or closed door from the outside in an emergency without the use of a special key.

c) No lodging or rooming house should have its sole means of egress pass through any non-residential occupancy in the same building.

d) Rooming and lodging houses having floor area of 500 m^2 on any one or more floors should have access to minimum two separate means of exits, at least one of which should be so arranged as to have direct exit discharge.

6.1.1.2 *Subdivision A*-II

a) Requirements of 6.1.1.1 should be applicable.

b) All sleeping rooms having occupancy of more than 10 persons should have two separate and distinct exit access in different directions.

6.1.1.3 *Subdivision A*-III

In case of high-rise apartments, of the minimum exits as specified in 4.4.2.4.3.1, the naturally ventilated/cross-ventilated exit staircases may not require the provision of fire door. However, fire door should be provided for all other staircases and pressurized staircases.

6.1.1.4 *Subdivision A*-IV

a) Panic bars should be provided in the fire exits. Panic bars should be located at a height between 865 mm and 1 220 mm from the floor level.

b) All guest rooms and suites should be protected by extended throw or quick response type sprinklers only. Also, these areas should be provided with audio-based detectors, having a sound level of at least 75 dB.

c) Horizontal-sliding doors should not be used for door openings across corridors.

6.1.1.5 *Additional Precautions*

a) Flammable liquids for household purposes should be kept in tightly stoppered or sealed containers. For the limits of quantities of flammable liquids to be allowed in various occupancies, reference may be made to appropriate regulations.

b) No stove or combustion heater should be located directly under or immediately at the foot of stairs or otherwise so located as to block escape in case of malfunctioning of the stove or heater.

c) All kitchen exhaust fans, where provided, should be fixed to an outside wall or to a duct of non-combustible material, which leads directly to the outside. The ducts should not pass through areas having combustible materials. However, in case of centralized ducting, the duct should be provided with adequate protection to limit the spread of fire.

d) Stores, engineering workshops, areas of high hazard, etc used for storage of substantial amount of flammable liquids should be of 120 min fire resistance rated wall. Such areas should be provided with fire doors, to be kept closed and should be posted with a sign on each side of the door prominently in block letters stating — 'FIRE DOOR — KEEP CLOSED'.

6.2 Educational Buildings (Group B)

6.2.1 *Fire Prevention*

a) Buildings intended for educational occupancy should not be used for storage of any hazardous material.

b) Gymnasiums, indoor stadiums, and similar occupancies are permitted to have floors/running tracks of wood, cinder, synthetic or the like.

6.2.2 *Life Safety*

a) Every room with a capacity of over 45 persons in area should have at least two doorways. Exit doors should be operated by panic bars except that doors leading from classrooms directly to the outside may be equipped with the same type of lock as is used on classroom doors leading to corridor, with no provision whatsoever for locking against egress from the classroom.

b) A building, which will have only the first floor and is accessible to not more than 20 pupils at any time, may be used for school purposes with the following exceptions:

   1) Exterior walls or parts of walls which are less than 900 mm from adjacent property lines should have no openings therein.

   2) Classrooms may have only one exit not less than 900 mm wide.

c) Rooms or areas for use by the preschool, kindergarten, Class/Grade 1 students should be located on ground floor/level of exit discharge. Rooms or areas occupied by Class/Grade II students should be located not above one floor higher than ground floor/level of exit discharge.

d) Of the minimum exits as specified in 4.4.2.4.3.1, the naturally ventilated exit staircases, may not require provision of fire door. However, fire door should be provided for all other staircases and pressurized staircases.

6.2.3 *Special Precautions*

a) Storage of volatile flammable liquids should be prohibited and the handling of such liquids should be restricted to science laboratories only; and

b) All exterior openings in a boiler room or rooms containing central heating equipment, if located below an opening in another storey or if less than 3 m from other doors or windows of the same building, should be protected by a fire assembly as in 3.5.4. Such assemblies should be of fixed, automatic, or self-closing type.

6.3 Institutional Buildings (Group C)

6.3.1 *Fire Prevention*

No combustible material of any kind should be stored or used in any building or section thereof used for institutional occupancy, except as necessary to normal occupancy and use of the building.

6.3.2 *Life Safety*

a) The common path of travel should be up to 30 m. The maximum dead end of corridor distance should not exceed 6 m;

b) Principle of progressive horizontal evacuation is of paramount consideration for hospital patients particularly those lacking self-preservation. This calls for moving occupants from a fire affected area to

an adjoining area at the same level through a fire resistant wall, to protect them from the immediate dangers of fire and smoke (*see* Fig. 18);

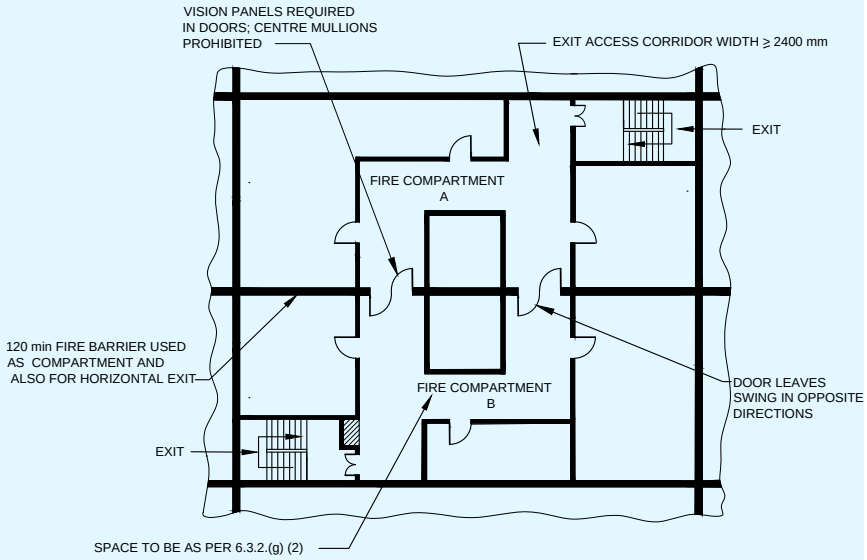


FIG. 18 PART PLAN INDICATING CONCEPT OF HORIZONTAL EXIT IN HOSPITAL

c) Progressive horizontal evacuation operates on the basis of evacuation from compartment to compartment and on use of adjacent compartments as temporary means of refuge. All compartments should be divided with self-closing (door closers) fire doors with electromagnetic hold open. A coordinator should be provided to sequence the closing of double leaf in case of emergency;

d) Doors in fire resistant walls should be so installed that these may normally be kept in open position, but will close automatically. Corridor door openings should be not less than 2.0 m in width of double swing double leaf type door. A coordinator should be provided as above, for closing of double leaf in case of emergency;

e) Exits and other features for penal and mental institutions, and custodial institutions should be the same as specified for hospitals [*see* **6.3.2** (g)], in so far as applicable. Reliable means should be provided to permit the prompt release of inmates from any locked section in case of fire or other emergency;

f) All buildings or sections of buildings in penal and mental institution used for manufacturing, storage or office purposes should have exits in accordance with the provisions of this Part for those occupancies;

g) For hospitals (Subdivision C-I), the following should also be complied with:

1) Compartmentation should meet the requirement as per **4.5.2**.

2) Each compartment (*see* **4.5.3**) should be able to accommodate, in addition to its own, the patients from adjoining compartment also considering 3.5 m^2 per person. If patients are not bed-ridden, a factor of 0.6 m^2 per person is recommended. This is towards achieving horizontal evacuation.

3) All critical patients incapable of self-preservation and those having physical impairment should preferably be housed within 45 m height. For hospitals exceeding 45 m in height, where such occupants are located above this level, the following non-exhaustive additional provisions should be complied with in consultation with local fire authorities:

i) The general life safety and protection aspects and fire protection features, as in heights up to 45 m should be provided to the entire height, including progressive horizontal evacuation.

ii) Further, the alternate floors (particularly those housing all such patients) should have refuge terraces (basically a covered area with place of safety directly exposed to atmosphere at least one side) of sufficient area (as prescribed by the local authorities) with provisions for medical gases to support patients on ventilators temporarily during evacuation during the staging/evacuation period, to ensure uninterrupted care. The refuge terraces should have:

a) direct access to the fire-fighting shaft/fire tower,

b) access through fire rated door having a minimum 2 h fire resistant rating,

c) automatic sprinkler system, public announcement system, fire detection and alarm system, dedicated and separate shaft for medical gas pipelines, utility services and for electrical services,

d) dedicated emergency power supply back up (UPS and DG), particularly for all life-saving equipment, and

e) washroom facility within it or directly accessible.

iii) A dedicated firefighting team should be available round the clock, and having relevant qualification, competence and necessary experience, as may be required by the competent authority.

4) Basement should not be used to store flammables or for pathological or other laboratories particularly those involving usage of inflammable chemicals. Medical health care services involving radiation facilities may be housed in the basements as per medical planning along with radiation therapy allied services like bunkers, SIM CT, brachytherapy, nuclear medicine, hot lab, patient hold and waiting area, consultant room, mould room, TPS room, subject to compliance of all requirements for fire safety.

5) Operation theatres, delivery rooms, intensive care units, recovery rooms, etc, that containing patients lacking self-preservation in case of emergencies should be fire/smoke separated (120 min minimum rating) from all the adjoining areas.

6) Aisles, corridors, ramps, etc, through which patients are moved, should have a minimum width of 2.4 m throughout. Aisles, corridors, and ramps in other areas not intended for the housing, treatment, or use of inpatients should be not less than 1.5 m in width.

7) All exits from hospital or infirmary sections should be not less than 2.0 m in width.

8) Minimum width of door of single or double occupancy patient room should be 1.25 m, while for the wards for 3 to 5 patient beds should be 1.50 m, to enable movement of patients. The minimum width of door for wards for more than 5 patient beds and for areas necessarily requiring patient evacuation on bed (such as ICU, recovery units, delivery rooms, etc), should have door width of 2.0 m. The width of 2.0 m may be reduced to minimum of 1.5 m where two such doors are provided in such areas.

9) Any sleeping accommodation or suite exceeding 100 m^2 in area should have at least two doorways leading to the exit access corridors.

10) Exit access corridors from a compartment to another compartment should be divided at the compartment intersection by a fire door of 120 min fire rating in the fire compartment wall.

11) Rooms designated for laboratory and the like should not exceed 100 m^2 in area, and if additional space is required, fire separation of 120 min should be provided.

12) A stretcher lift in a lift bank should also act as fireman's lift meeting the requirements of Part D 'Building Services, Section 5 Installation of Lifts, Escalators, Moving Walks and Power Driven Parking Systems, Subsection 5A Lifts' of this NBCS.

h) *Progressive evacuation strategy — See* Fig. 19, in which, as an example, the exit calculations at two locations should be based on requirements of total occupancy for area (A, B and C) divided by 2 considering progressive evacuation strategy.

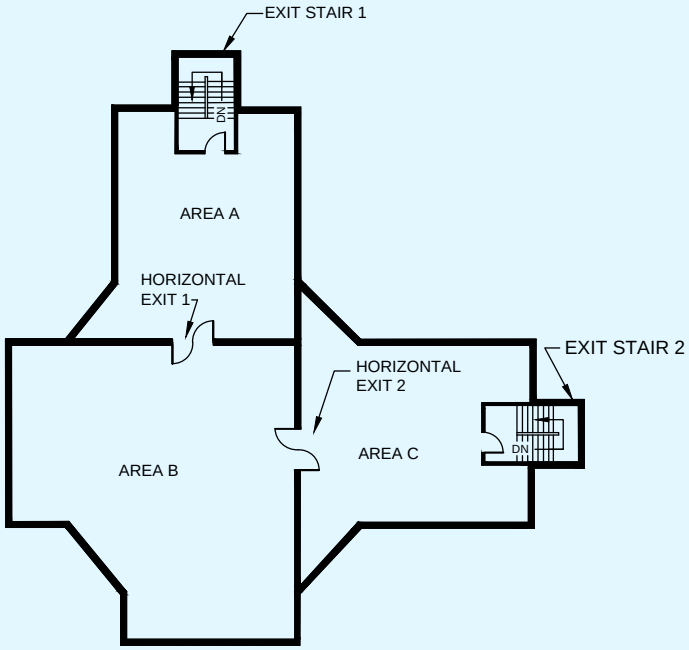


FIG. 19 MINIMUM OF TWO EXITS ACCESSIBLE FROM ALL PARTS OF FLOOR

6.3.3 *Exception and Deviation*

It is recognized that in institutions or part of buildings housing various types of psychiatric patients, or used as mental institutions and penal institutions, it is necessary to maintain locked doors and barred windows; and to such extent the necessary provision in other sections of this Part requiring the keeping of exits unlocked may be waived. It is also recognized that certain type of psychiatric patients are not capable of seeking safety without adequate guidance. In buildings where this situation prevails, reliable means for the rapid release of occupants should be provided, such as remote control of locks, or by keying all locks to keys commonly used by attendants.

6.4 Assembly Buildings (Group D)

6.4.1 *Fire Prevention*

6.4.1.1 The following should be applicable*:*

a) Decorations of places of assembly should be of non-flammable materials. Fabrics and papers used for such purpose should be treated with an effective flame-retardant material. Stage settings made of combustible materials should likewise be treated with fire retardant materials of Class 1 flame spread; and

b) Gymnasiums, indoor stadiums, and similar occupancies are permitted to have floors/running tracks of wood, cinder, synthetic or the like.

6.4.1.2 *Additional fire prevention requirements for mixed use assembly buildings* (*including malls*)

Buildings provided with multiple services/facilities like shopping, cinema theatres, multiplexes, restaurants/food court as part of mixed use assembly/mercantile occupancy should preferably limit the height of the assembly/ mercantile occupancy portion of the buildings to 30 m. Above this height the buildings may be used for business or residential occupancies with 240 min separation. Independent exits should be provided for such occupancy above 30 m and should not interface with exits of assembly/mercantile occupancy.

6.4.2 *Life Safety*

6.4.2.1 The following should be applicable:

a) Exit door width for assembly buildings should not be less than 2.0 m.

b) At least four separate exits as remote from each other as practicable are required from every place of assembly in buildings primarily meant for theatrical or operatic performances and which has a stage, proscenium curtain, fixed or portable scenery or scenery loft, lights, mechanical appliances or other theatrical accessories and equipment for example, theatres, motion picture houses, auditoria, concert halls, television and radio studios admitting an audience and which are provided with fixed seats for over 1 000 persons.

c) At least two separate exits as remote from each other as practicable are required in buildings primarily meant for or theatrical or operatic performances and which has a stage, proscenium curtain, fixed or portable scenery or scenery loft, lights, mechanical appliances or other theatrical accessories and equipment for example, theatres, motion picture houses, auditoria, concert halls, television and radio studios admitting an audience and which are provided with fixed seats. Those building having a capacity from 600 and up to 1 000 persons, at least three exits should be provided with each exit not less than of 2.0 m width.

d) Clear aisles not less than 1.2 m in width should be formed at right angles to the line of seating in such number and manner that no seat should be more than seven seats away from an aisle. Rows of seats opening on to an aisle at one end only should have not more than seven seats. Under the conditions, where all these aisles do not directly meet the exit doors, cross-aisles should be provided parallel to the line of seating so as to provide direct access to the exit, provided that not less than one cross aisle for every 10 rows should be required. The width of cross-aisles should be minimum of 1 m. Steps should not be placed in aisles to overcome differences in levels unless the gradient exceeds 1 in 10.

e) The fascia of boxes, balconies and galleries should have substantial railings not less than 1 000 mm high above the floor. The railings at the end of aisles extending to the fascia should be not less than 1 100 mm high for the width of the aisle or 1.2 m high at the foot of steps.

f) Cross-aisles, except where the backs of seats on the front of the aisle project 600 mm or more above the floor of the aisle, should be provided with railings not less than 900 mm high.

g) Turnstiles or other devices to restrict the movement of persons should not be installed in any place of assembly in such a manner as to interfere in any way with the required exit facilities.

h) In theatres and similar places of public assembly where persons are admitted to the building at a time when seats are not available for them and are allowed to wait in a lobby or similar space until seats are available, such use of lobby or similar space should not encroach upon the required clear width of exits. Such waiting should be restricted to areas separated from the required exit ways by substantial permanent partitions or fixed rigid railing not less than 1 050 mm high. Exit should be provided for such waiting spaces on the basis of maximum capacity of two largest screen of multiplex (considering the staggered movie timings). Such exits should be in addition to the exits specified for the main auditorium area and should conform in construction and arrangement to the general rules of exits given above.

j) Display or exhibit should not be so installed or operated as to interfere in any way with access to any required exit, or with any required exit sign.

k) All displays or exhibits of combustible material or construction and all booths and temporary construction in connection therewith should be so limited in combustibility or protected as to avoid any undue hazard of fire which might endanger occupants before they have opportunity to use the available exits, as determined by the authority.

m) Places of assembly in buildings of other occupancy may use exits common to the place of assembly and the other occupancy, provided the assembly area and the other occupancy are considered separately, and each has exits sufficient to meet the requirements of this Part.

n) Exits should be sufficient for simultaneous occupancy of both the places of assembly and other parts of the building.

p) For detailed information regarding cinema buildings, reference may be made to good practice [F(27)].

q) Seats in places of public assembly, accommodating more than 300 persons, should be securely fastened

to the floor, except as permitted in (r) below. All seats in balconies and galleries should be securely fastened to the floor, except that in nailed-in enclosures, boxes with level floors and having not more than 14 seats, the seats need not be fastened.

r) Chairs not secured to the floor may be permitted in restaurants, night clubs and other occupancies where the fastening of seats to the floor may not be practicable, provided that in the area used for seating, excluding dance floor, stage, etc, there should be not more than one seat for each 1.4 m^2 of floor area and adequate aisles to reach exits should be maintained at all times. The arrangements should be as follows in general:

1) Rows of seats between aisles should have not more than 14 seats.

2) Rows of seats opening on to an aisle at one end only should have not more than 7 seats.

3) Seats without dividing arms should have their capacity determined by allowing 450 mm per person.

s) The spacing of rows of seats from back to back should be neither less than 850 mm nor less than 700 mm plus the sum of the thickness of the back and inclination of the back. There should be a space of not less than 350 mm between the back of one seat and the front of the seat immediately behind it as measured between plumb lines.

t) *Lighting* — No open flame lighting devices should be used in any place of assembly, except in the following cases:

1) Where necessary for ceremonial purposes, the enforcing Authority may consider permiting open flame lighting under such restrictions as are necessary to avoid danger of ignition of combustible materials or injury to occupants.

2) Candles may be used on restaurant tables if securely supported on non-combustible bases and so located as to avoid danger of ignition of combustible materials.

3) Open flame devices may be used on stages where they are a necessary part of theatrical performance, provided adequate precautions, satisfactory to the Authority are taken to prevent ignition of combustible materials.

6.4.2.2 *Life safety provisions for mall-like* (*Assembly*, *Mercantile*, *Cinema hall*, *Restaurant*) *occupancy*

The following additional requirements should be applicable:

a) Assembly occupancies of theatres, cinema halls and multiplexes should be so located in the mall building that their exits will be separate and lead the occupant directly to exit discharge.

b) The common path of travel should be 30 m. The maximum dead end of corridor distance should not exceed 6 m.

c) The minimum width of an exit passageway should be 2.0 m.

d) Where wheeled carts or buggies are used by customers, adequate provision should be made for the transit and parking of such carts to minimize the possibility that they might obstruct means of egress. Any other storage or hindrances causing obstruction in exits should be avoided.

e) Car parking facilities should comply with Annex G. Car parking areas at upper levels adjacent to shops, food courts or multiplex should be separated by 120 min fire rated construction and building elements;

f) 50 percent lifts in common areas in the mal-like occupancies should be with features and requirement of fireman's lift.

g) The manual call points should be break glass and not pull stations.

h) Photoluminescent markings should be done along the width and length of treads in all enclosed exits staircases. Exit directional arrow on the wall (in the direction of egress) should be 175 mm × 50 mm in size.

j) Refuge area to be provided on the floor at or immediately above 18 m should be not less than 10 percent of gross area of floor. Next refuge area to be at/on the floor immediately above 24 m. The refuge area should be 10 percent of the respective floor, which may be divided into two or more separate refuge areas at each of the respective floors, with each being not less than 100 m^2. Refuge area should also meet all the requirements of life safety as per **4**.

k) When refuge spaces are resorted to, every floor should be provided with space for 20 percent of the respective occupants of that floor.

6.4.3 *Fire Protection*

a) Every stage equipped with fly galleries, grid irons and rigging for movable theatre type scenery, should have a system of automatic sprinklers over and under such stage areas or spaces and auxiliary spaces, such as dressing rooms, store rooms and workshops, and the proscenium opening should be provided with a fire resisting curtain, capable of withstanding a lateral pressure of 4 kN/m^2 over the entire area. The curtain should have an emergency closing device capable of causing the curtain to close without the use of power and when so closed, it should be reasonably tight against the passage of smoke.

b) The stage roof of every theatre using movable scenery or having a motion picture screen of highly combustible construction should have a ventilator or ventilators in or above it, openable from the stage floor by hand and also opening by fusible links or some other approved automatic heat/smoke actuated device, to give a free opening equal to at least one-eighth the area of the floor of the stage.

c) The proscenium wall of every theatre using movable scenery of decorations should have, exclusive of the proscenium opening, not more than two openings entering the stage, each not to exceed 2 m^2 and fitted with self-closing fire resistant doors.

d) Every place of assembly in which projection of motion pictures by light is made should have the projection apparatus enclosed in a fire resisting fixed booth in accordance with good practice [F(27)], except that such booth should not be required where no nitrocellulose motion picture film is used.

6.4.4 *Fire Protection and Firefighting System for Metro Stations and Metro Trainways Occupancy*

Fire and life safety requirements for metro stations and metro trainways should be in accordance with Annex H and Annex J, respectively. In case of any ambiguity with respect to provisions in Part F or any other Part of this NBCS, the respective provisions given in Annex H and Annex J should be applicable.

6.5 Business Buildings (Group E)

6.5.1 *Life Safety*

Not less than two exits should be provided for every floor, including basements occupied for office purposes or uses incidental thereto.

6.5.2 *Fire Protection*

a) For business buildings (namely laboratories, outpatient clinics, research establishments, libraries, and test houses) the requirement should be provision of automatic fire detection alarm system, while for fire protection, CO_2 and/or foam-based installation to be planned based on the requirements; and

b) For business buildings (namely electronic data processing centres, computer installations, information technology parks and call centres, telephone exchanges, broadcasting stations, T.V. stations, and air traffic control towers) the requirement should be provision of automatic fire detection alarm system, while for fire protection, any or combination of clean agents, mist technologies, etc, may be planned for appropriate/special situations/locations. Electrical panels may be provided with CO_2/inert gas flooding system based on the requirement and reliability of power for the functional requirement and performance.

6.6 Mercantile Buildings (Group F)

6.6.1 *Life Safety*

6.6.1.1 Open air mercantile operations, such as open air markets, petrol filling stations, roadside stands for the sale of a farm produce and other outdoor mercantile operations should be so arranged and conducted as to maintain free and unobstructed ways of travel at all times to permit prompt escape from any point of danger in case of fire or other emergency, but having no dead-ends in which persons might be trapped due to display stands, adjoining buildings, fences, vehicles or other obstructions.

6.6.1.2 If such mercantile operations are conducted in roofed-over areas, these should be treated as mercantile buildings, provided canopies over individual small stands to protect merchandise from the weather should not be

construed to constitute buildings for the purpose of this Part.

6.6.2 *Exception and Deviation*

Any mercantile occupancy, where goods of a highly hazardous nature are predominant, should be considered under Group J occupancy for the purpose of this Part.

6.7 Industrial Buildings (Group G)

6.7.1 *Fire Prevention*

6.7.1.1 *Fire separating walls, fire separating floors and fire partitions*

Fire separating walls should be provided between two buildings or between two blocks inside a building, having different fire hazards in accordance with the provisions of this Part. The areas having storage, manufacturing, hazardous activities such as paint store, oil storage, spray booths, etc, should be separated from non-hazardous areas like administrative office, staff canteen, etc by fire rated walls/doors of 120 min fire resistance rating. The fire resistance rating of high hazardous areas like petrochemical, explosives should be 240 min.

The fire separating wall where provided should comply with the following requirements:

a) The separating wall should be carried through the roof. This portion of the wall extending above the roof, known as 'screen wall' should be of such a height (in no case less than 600 mm) that the horizontal distance at the level of the top of the screen wall between the roofs of the buildings/compartments being segregated is at least 6 m.

b) The screen wall should be of not less than 230 mm in thickness if it is an extension of a masonry wall, and not less than 150 mm in thickness if it is an extension of a reinforced concrete wall.

c) The separating wall need not be extended as a screen wall if the roof of one or both of the buildings/blocks being segregated is of reinforced concrete construction (RCC).

d) In the case of buildings of unequal height, windows, or other openings in the wall of the higher building overlooking the roof of the lower building and within 6 m, thereof, should be protected by fire resistant glass assembly or by approved type fire doors unless the roof of the lower building is of reinforced concrete.

e) In case the eaves of the higher building fall within 6 m of the roof of the lower building such eaves should be cut-off and the screen wall raised as a parapet, 600 mm high over the roof of the higher building, unless the roof of the lower building is of RCC construction.

f) Fire separating walls should also be extended outwards on both sides by at least 450 mm.

g) Doors and window openings in external walls within 3 m of the fire separating walls should be protected by fire doors having a rating of at least 60 min and window openings may be protected by fire resistant glass assembly having same fire rating.

h) In the case of buildings/compartments having north-light roofs when a separating wall runs parallel to the axis of the north-light opening, the screen wall should be carried through and 600 mm above the ridge of the north light. If, however, the separating wall is at right angles to the axis of the north-light opening, the saw tooth gaps should be bricked up and the screen wall extended 600 mm above the ridge of the north light as well as beyond the extreme north-light opening.

j) Similarly, the thickness of the floor slabs in case of buildings having upper levels should be designed to provide fire rating as mentioned above.

k) Storage areas should be separated from the remainder of the building/block by fire walls. Moderate and high hazard areas in industries should have two fire doors each having 180 min fire resistance rating.

6.7.2 *Life Safety*

6.7.2.1 In buildings used for aircraft assembly or other occupancy requiring undivided floor areas so large that the distances from points within the area to the nearest outside walls where exit doors could be provided are in excess of 45 m, requirements for distance to exits may be satisfied by providing stairs leading to exit tunnels or to overhead passageways. In cases where such arrangements are not practicable, the Authority may, by special

ruling, permit other exit arrangements for single storeyed buildings with distances in excess of the maximum distances specified in 4, if completely automatic sprinkler protection is provided and if the heights of ceiling curtain boards and roof ventilation are such as to minimize the possibility that employees will be overtaken by the spread of fire or smoke within 1.8 m of the floor level before they have time to reach exits, provided, however, that in no case may the distance of travel to reach the nearest exit exceed 65 m where smoke venting is required as a condition for permitting distances of travel to exits in excess of the maximum otherwise allowed.

6.7.2.2 The following applies to special purpose industrial occupancies:

a) Exits need be provided only for the persons actually employed; spaces not subject to human occupancy because of the presence of machinery or equipment may be excluded from consideration.

b) Where unprotected vertical openings are necessary to manufacturing operations, these may be permitted beyond the limits specified for industrial occupancy, provided every floor level has direct access to one or more enclosed stairways or other exits protected against obstruction by any fire in the open areas connected by the unprotected vertical openings or smoke therefrom.

6.7.2.3 The following applies to high hazard industrial occupancies:

a) From every point in every floor area, there should be at least two exits accessible in different directions; where floor areas are divided into rooms, there should be at least two ways of escape from every room, however small rooms, except toilet rooms, so located that the points of access thereto are out of or suitably shielded from areas of high hazard.

b) In addition to types of exits for upper floors specified for Group G occupancies, slide escapes may be used as required exits for both new and existing buildings.

NOTE — All high hazard industrial occupancies should have automatic sprinkler protection or such other protection as may be appropriate to the particular hazard, including explosion venting for any area subject to explosion hazard, designed to minimize danger to occupants in case of fire or other emergency before they have time to utilize exits to escape.

6.7.3 *Additional Precautions*

a) In any room in which volatile flammable substances are used or stored, no device generating a glow or flame capable of igniting flammable vapour should be installed or used, such a room should be provided with a suitably designed exhaust ventilation system (*see* Annex K).

b) For detailed information on fire safety of certain individual (specific) industrial occupancies, reference may be made to good practice [F(28)].

c) Fire protection considerations for venting industrial occupancies should be as in Annex K.

6.8 Storage Buildings (Group H)

6.8.1 *Life Safety*

6.8.1.1 Every area used for the storage of hazardous commodities should have an exit within 30.0 m (*see* Table 4) of any point in the area where persons may be present or 35 m where automatic sprinkler protection is provided.

6.8.1.2 Every storage area or space exceeding 1 400 m^2 gross area, or where more than 10 persons may be normally present should have at least two exit access doors leading to the corridors in exit access, which can be readily opened. This should not be subject to locking so long as any persons are inside and should not depend on power operation. Exits in such cases should be as remote from each other as practicable.

For warehouses, natural draft smoke venting should utilize roof vents or vents in walls at or near the ceiling level; such vents should be normally open, or, if closed, should be designed for automatic opening in case of fire, by release of smoke sensitive devices.

6.8.1.3 The following special provisions should apply to aircraft hangers:

a) Exits from aircraft hangers (storage or servicing areas) should be provided at intervals of not more than 45 m on all exterior walls of aircraft hangers. There should be a minimum of two exits serving each aircraft storage or servicing areas. Horizontal exits through interior fire walls should be provided at intervals of not more than 30 m. 'Dwarf' or 'Smash' doors accommodating aircraft may be used to comply with these requirements. All doors designated as exits should be kept unlocked in the direction

of exit travel while the area is occupied; and

b) Exits from mezzanine floors in aircraft storage or servicing areas should be so arranged that the maximum travel to reach the nearest exits from any point on the mezzanine should not exceed 22.5 m. Such exits should lead directly to a properly enclosed stairwell discharging directly to the exterior or to a suitably cut-off area or to outside fire escape stairs.

6.8.1.4 The following special provisions should apply to grain elevators:

a) There should be at least one stair tower from basement to first floor and from the first floor to the top floor of workhouse which is enclosed in a dust tight non-combustible shaft.

b) Non-combustible doors of self-closing type should be provided at each floor landing.

c) An exterior fire escape of the stair or basket ladder type should be provided from the roof of the workshop to ground level or the roof of an adjoining annexe with access from all floors above the first.

d) An exterior fire escape of either the stair or basket ladder type should be provided from the roof of each storage annexe to ground level.

6.8.1.5 For provisions relating to car parking facilities, *see* Annex G.

6.8.2 *Additional Precautions*

Requirements specified in **6.7.3 (a)** should apply to Group H occupancies also.

6.9 Hazardous Uses (Group J)

6.9.1 *Life Safety*

Requirements specified in **6.7.2.3** should apply to Group J occupancies also.

6.9.2 *Additional Precautions*

The following requirements should apply to all Group J occupancies, as applicable:

a) Hazardous buildings should have vapour/flame/ember/spark detectors and explosion suppression systems depending on the type of fire hazard involved;

b) Each building where gas is employed for any purpose should be provided with an approved outside gas shut-off valve conspicuously marked. The detailed requirements regarding safe use of gas should be as specified in Part E 'Plumbing Services, Section 4 Gas Supply' of this NBCS;

c) Each boiler room or room containing a heating plant should be separated from the rest of the building by a separating wall;

d) In any room in which volatile flammable substances are used or stored, no device generating a spark, or glow flame capable of igniting flammable vapour should be installed or permitted unless it is enclosed in a flameproof enclosure;

e) The use, handling, storage and sale of gasoline, fuel oil and other flammable liquids should not be permitted in Group J occupancies unless such use, handling, storage, and sale is in accordance with appropriate legislation in force;

f) All openings in exterior walls except wall vents should be protected by a fire stop assembly as in **4** and they should be fixed, automatic or self-closing. Wall vents having an area of not less than 100 cm^2 each should be placed in the exterior walls near the floor line, not more than 1 800 mm apart horizontally. Each building should be provided with a power driven fan exhaust system of ventilation which should be arranged and operated so as to produce a complete change of air in each room every 3 min;

g) Each machine in dry-cleaning establishments which uses flammable liquid should have an adequate steam line or any other suitable extinguishing agent directly connected to it, so arranged as to have the agent automatically released to the inside of each machine should an explosion occur in the machine; and

h) Equipment or machinery which generates or emits combustible or explosive dust or fibres should be provided with an adequate dust collecting and exhaust system.

ANNEX A

(*Clause* 3.1.8)

CALORIFIC VALUES OF COMMON MATERIALS

A-1 The calorific values of some common materials are given in Table 12 for guidance.

Table 12 Calorific Values of Common Materials

(*Clause* A-1)

Sl No.	Material	Calorific Value (10^3 kJ/kg)[1)]	Wood Equivalent (kg/kg)
(1)	(2)	(3)	(4)
i)	**Solid Fuels**		
	a) Anthracite	28.6	1.66
	b) Bituminous coal	30.8	1.75
	c) Charcoal	28.4	1.61
	d) Coke (average)	27.5	1.56
	e) Peat	20.9	1.19
	f) Sub-bituminous coal	22.0	1.25
	g) Woods (hard or softwood)	17.6	1.00
ii)	**Hydrocarbons**		
	a) Benzene	39.6	2.25
	b) Butane	47.1	2.68
	c) Ethane	49.1	2.79
	d) Ethylene	47.7	2.71
	e) Fuel oil	41.6	2.36
	f) Gas oil	42.9	2.44
	g) Hexane	44.9	2.55
	h) Methane (natural gas)	52.8	3.00
	j) Octane	45.3	2.58
	k) Paraffin	39.6 to 44.0	2.3 to 2.5
	m) Pentane	46.0	2.61
	n) Propane	47.3	2.69
	p) Propylene	46.2	2.63
iii)	**Alcohols**		
	a) Ethyl alcohol	28.4	1.61
	b) Methyl alcohol	21.1	1.20

Table 12 (*Continued*)

Sl No.	Material	Calorific Value (10^3 kJ/kg)[1)]	Wood Equivalent (kg/kg)
	c) Propyl alcohol	31.9	1.81
iv)	**Polymers**		
	a) Casein	23.1	1.31
	b) Cellulose	16.5	0.94
	c) Cellulose acetate	17.8	1.01
	d) Polyethylene	48.4	2.75
	e) Polypropylene	48.4	2.75
	f) Polystyrene	41.8	2.38
	g) Polyvinylchloride	20.9	1.19
	h) Polymethyl methacrylate	24.6	1.40
	j) Polyurethane	35.2	2.00
	k) Polyamide (nylon)	22.0	1.25
	m) Polyester	22.0	1.25
v)	**Common Solids**		
	a) Asphalt	38.3	2.13
	b) Bitumen	33.4	1.90
	c) Carbon	32.1	1.83
	d) Cotton (dry)	15.8	0.90
	e) Flax	14.3	0.81
	f) Furs and skins	18.7	1.06
	g) Hair (animal)	20.9	1.19
	h) Leather	17.6	1.00
	j) Ozokerite (wax)	43.5	2.46
	k) Paper (average)	15.4	0.88
	m) Paraffin wax	40.9	2.33
	n) Pitch	33.0	1.88
	p) Rubber	37.4	2.13
	q) Straw	13.2	0.75
	r) Tallows	37.6	2.14
	s) Tan bark	20.9	1.19

Table 12 (*Concluded*)

Sl No.	Material	Calorific Value (10^3 kJ/kg)[1)]	Wood Equivalent (kg/kg)
	t) Tar (bituminous)	35.2	2.00
	u) Wool (raw)	21.6	1.23
	w) Wool (scoured)	19.6	1.11
vi)	**Foodstuffs**		
	a) Barley	14.1	0.80
	b) Bran	11.0	0.63
	c) Bread	9.9	0.56
	d) Butter	29.5	1.68
	e) Cheese (Cheddar)	18.1	1.03
	f) Corn meal	14.1	0.80
	g) Flour	14.1	0.80
	h) Margarine	29.5	1.68
	j) Oatmeal	15.8	0.90
	k) Rice	13.9	0.79
	m) Soya bean flour	16.1	0.91
	n) Sugar	15.4	0.88
	p) Whole wheat	14.3	0.81
vii)	**Miscellaneous**		
	a) Acetone	29.7	1.69
	b) Acetaldehyde	25.1	1.43
	c) Formaldehyde	17.6	1.00
	d) Hydrogen	134.2	7.63
	e) Magnesium	24.0	1.36

[1)] 1 kJ is approximately equal to 1 Btu, so the figures in the tables are also equivalent to Btu/kg.

ANNEX B

(*Clause* 3.1.8)

BROAD CLASSIFICATION OF INDUSTRIAL OCCUPANCIES INTO DIFFERENT DEGREE OF FIRE HAZARD

G1 – Low Hazard	G2 – Moderate Hazard	G3 -High Hazard
Abrasive Manufacturing Premises	Aluminium Factories	**SUB-CATEGORY (A)**
Aerated Water Factories	Atta and Cereal Grinding units	Aircraft Hangers units
Agarbatti Manufacturing	Auto Components (excluding plastics and foam components) manufacturing	Aluminium/Magnesium Powder Plants
Areca nut slicing and/or Betel nut Factories	Bakeries and Biscuit Factories	Auto Components (including Plastics and Foam Components)
Analytical and/or Quality Control Laboratories	Beedi Factories	Auto Mobiles and other Motor Vehicles powered by Lithium or Lithium-Ion Batteries manufacturing
Athletic Equipment manufacturing	Bobbin Factories	Battery Charging/Battery Service Stations
Asbestos Steam Packing and Lagging Manufacturing	Bookbinders, Envelopes and Paper bag Manufacturing	Battery Manufacturing
Auto mobiles and other motor vehicles	Cable manufacturing	Bituminized Paper and/or Hessian Cloth/Tar Felt Manufacturing
Breweries	Camphor Boiling facilities	Chemical Store (water reactive)
Brick Works	Candle Works	Cotton Waste Factories
Canning Factories	Carbon Paper/Typewriter Ribbon Manufacturing	Celluloid Goods Manufacturing
Cardamom Factories	Cardboard Box Manufacturing	Chemical Manufacturing using raw materials having flash points below 23 °C
Cement Factories and/or Asbestos or Concrete Products Manufacturing	Carpenters, Wood wool and Furniture Manufacturing	Cigarette Filter Manufacturing
Ceramic Factories and Crockery and Stoneware Pipe Manufacturing	Carpet and Durries Factories	Diesel Generator Room
Clay Works	Cashewnut Factories	Fire-works Manufacturing
Clock and Watch Manufacturing	Chemical Manufacturing using raw materials having flash points above 23 ºC	Foam Plastics Manufacturing and/or Converting Plants
Coffee Curing Roasting and grinding Premises	Chemical Store (non-water reactive)	Godowns and Warehouses (storing combustible/flammable goods)
Condensed Milk Factories, Milk Pasteurizing Plant and Dairies	Cinema Films and T.V. Production Studios	Grass, Hay, Fodder and Bhoosa (chaff) Pressing Factories
Confectionery Manufacturing	Cigar and Cigarette Factories	Hydrogenation rooms (involving Flammable Hydrogen)
Cooling Towers	Coal and/or Coke and/or Charcoal Ball and Briquettes Manufacturing	Industrial Gas Manufacturing (other than Inert/Halogenated Hydrocarbon Gases)
Electric Generating Houses (Hydroelectric)	Coir Factories	

G1 – Low Hazard	G2 – Moderate Hazard	G3 -High Hazard
Incandescent and Fluorescent and TV Picture Tube Manufacturing	Coir Carpets, Rugs, Tobacco, Hides and Skin Presses	Jute mills and jute presses
Electro-plating Works	Cold storage premises	Linoleum Factories
Engineering Workshops	Cold Freezer Room	Lithium Ion Battery Manufacturing Plants
Fruits and Vegetables Dehydrating and Drying Factories	Collieries	LPG Bottling Plants (Mini)
Fruit Products and Condiment Factories	Conveyors	Man-made Fibres (Acrylic fibres/yarn manufacturing)
Garages	Cork products manufacturing	Match Factories
Glass and Glass Fibre Manufacturing	Cotton Seed Cleaning or De-linting Factories	Metal or Tin Printers (where more than 50 percent of floor area is occupied as Engineering Workshop; this may be taken as Ordinary Hazard Risk)
Godowns and Warehouses storing non-combustible goods only	Distilleries	Oil Mills
Green houses	Dry Cleaning, Dyeing and Laundries	Oil Extraction Plants
Gold Thread/Gilding Factories	Duplicating/Stencil Paper Manufacturing	Oil Fire Boiler Room/ Oil Quenching Tank
Gum and/or Glue and Gelatine Manufacturing	Electric substations/Distribution stations	Oil Terminals/Depots handling flammable liquids having flash point of 23 °C and below
Ice, Ice Candy, and Ice-cream Manufacturing	Electric Generating stations (other than Underground power houses)	Oil Transformer Room
Ink (excluding Printing Ink) Factories	Electric Lamps Manufacturing	Paints and Varnish Factories
Mica Products Manufacturing	Electrical Appliances Manufacturing	Paint Booths
Multiple block apartment buildings	Electrical/Motor Control Centre (MCC) Panel Rooms	Paint/Varnish Storage
Open Large Atriums	Electronic Products Manufacturing	Paper and Cardboard Mills having raw material yards
Pottery Works	Enamelware Factories	Piers, Wharfs and Jetties – Handling Extra Hazardous Materials
Poultry Farms	Filter and Wax paper Manufacturing	Printing Ink Manufacturing.
QA/QC Laboratories	Flour Mills	Rosin Lamp black and Turpentine Factories
Salt Crushing Factories and Refineries	Food Processing establishments	Saw Mills
Stables	Garment Makers	Spray painting facilities
Sugar Candy Manufacturing	Ghee Factories (other than vegetable)	Server room
Tanneries/Leather Goods Manufacturers	Godowns and Warehouses (other than those under light and high hazard A categories)	Surgical Cotton Manufacturing
Umbrella Assembling Factories		Tanker Loading/Unloading Bay
Vermicelli Factories		Tarpaulin and Canvas Proofing Factories

G1 – Low Hazard	G2 – Moderate Hazard	G3 -High Hazard
Water Treatment/Filtration Plants and Water Pump Houses Zinc/Copper Factories	Grain and/or Seeds Disintegrating and/or Crushing Factories Grease Manufacturing Hosiery, Lace, Embroidery and Thread Factories Incandescent Gas Mantle Manufacturing Indoor Dry Transformer Room Industrial Gas Manufacturing (Inert/halogenated hydrocarbon gases) Kitchen with any type of fuel (Live cooking) MRI/scanning room Man-made Yarn/Fibre Manufacturing (other than acrylic fibres/yarn Manufacturing) Manure and Fertilizer Works (Blending, Mixing, and granulating) Mattress and Pillow Making Mineral Oil Blending and Processing Multiple block business buildings Multiple block star hotel buildings Musical Instruments Manufacturing Network/electrical room Oil and Leather Cloth Factories Oil Terminals/Depots other than those categorized under High hazard A Open storage of flammable liquids in drums, cans, etc Operation Theatre Rooms Optical Goods facilities Oxygen Plants Paper and Cardboard Mills without Raw Material Yards	Turpentine and Rosin Distilleries Tyre Retreading and Resoling Factories Tunnel Protection UPS Room with batteries Battery Room with Lithium-ion batteries **SUB-CATEGORY (B)** Ammonia and Urea Synthesis Plants Benzene/ Xylene/ Toluene Tanks CNG Compressing and Bottling Plants Coal based methane plants LPG bullets Explosive Factories Oil Storage (above ground) Outdoor Oil Transformer Room NOTE — In case of complexes having separate plants having varying degrees of hazard, authority having jurisdiction should be consulted to decide on level of protection to be provided.

G1 – Low Hazard	G2 – Moderate Hazard	G3 -High Hazard
	Pharmaceuticals Piers, Wharves, Jetties and Dockyards other than those categorized under High hazard A Plastic Goods Manufacturing Plywood/Wood Veneering Factories Printing Press Premises Pulverising and Crushing Mills Rice Mills Rope Works Rubber Goods Manufacturing Rubber Tyres and Tubes Manufacturing Semiconductors Manufacturing Sulphur Storage Sugar Factories and Refineries Shellac Factories Silk Filatures Soaps and Glycerine Factories Solar Cells and Modules manufacturing Sponge Iron Steel Plants (Gas Based) Starch Factories Tea Factories Textile Mills Tobacco (Chewing) and Pan-Masala Making facilities Tobacco Grinding and Crushing Tobacco Redrying Factories UPS Room without batteries Woollen Mills	

NOTES

1 Any occupancy that is not covered in this Annex should be classified in the most appropriate class which resembles the proposed occupancy.

2 For classification of industries based on 'chemical hazard', pollution, etc, the respective state/central guidelines/documents/rules may be referred.

ANNEX C

(*Clauses* 3.4.2, 3.4.3 *and* F-2.1)

AVAILABLE DATA REGARDING FIRE RESISTANCE RATING OF VARIOUS BUILDING COMPONENTS

C-1 The following tables (*see* Table 13 to Table 29) may be used, in the absence of any validated/certified rating regarding the materials used in the structural and/or non-structural element/component.

Table 13 Masonry Walls: Solid (Required to Resist Fire from One Side at a Time)

(*Clause* C-1)

Sl No.	Nature of Construction and Materials	Minimum Thickness (mm), Excluding any Finish, for a Fire Resistance (*min*) of									
		Load Bearing					Non-Load Bearing				
		60	90	120	180	240	60	90	120	180	240
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
i)	Reinforced cement concrete[1)]	120 (25)[2)]	140 (25)[2)]	160 (25)[2)]	200 (25)[2)]	240 (25)[2)]	–	–	–	–	–
ii)	Unreinforced cement concrete	150	175	–	–	–	–	–	–	–	–
iii)	No-fines concrete with: a) 13 mm cement/ sand or gypsum/ sand	–	–	–	–	–	150	150	150	150	150
	b) 13 mm light weight aggregate gypsum plaster	–	–	–	–	–	150	150	150	150	150
iv)	Bricks of clay: a) Without finish	90	100	100	170	170	75	90	100	170	170
	b) With 13 mm light weight aggregate gypsum plaster	90	90	90	100	100	75	90	90	90	100
v)	Bricks of sand lime: a) Without finish	90	100	100	190	190	75	90	100	170	170
	b) With 13 mm light weight aggregate gypsum plaster	90	90	90	100	100	75	90	90	90	100
vi)	Blocks of concrete: a) Without finish	90	100	100	–	–	75	90	100	140	150

Table 13 (*Concluded*)

Sl No.	Nature of Construction and Materials	Minimum Thickness (mm), Excluding any Finish, for a Fire Resistance (*min*) of									
		Load Bearing					Non-Load Bearing				
		60	90	120	180	240	60	90	120	180	240
	b) With 13 mm light weight aggregate gypsum plaster	90	90	90	100	100	75	75	75	90	100
	c) With 13 mm cement/sand or gypsum/sand	–	–	–	–	–	75	90	90	100	140
vii)	Blocks of light weight concrete: a) Without finish	90	100	100	140	150	75	75	75	125	140
	b) With 13 mm light weight aggregate gypsum plaster	90	90	90	100	100	50	63	75	75	75
	c) With 13 mm cement/sand or gypsum/sand	–	–	–	–	–	75	75	75	90	100
viii)	Blocks of aerated concrete: a) Without finish	90	100	100	140	180	50	63	63	75	100
	b) With 13 mm light weight aggregate gypsum plaster	90	90	100	100	150	–	–	–	–	–

[1] Walls containing at least 1 percent of vertical reinforcement.

[2] Minimum thickness of actual cover to reinforcement.

Table 14 Masonry Walls: Hollow (Required to Resist Fire from One Side at a Time)

(*Clause* C-1)

Sl No.	Nature of Construction and Materials	Minimum Thickness (mm), Excluding any Finish, for a Fire Resistance (*min*) of										
		Load Bearing						Non-load Bearing				
		60	90	120	180	240	30	60	90	120	180	240
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1)	Bricks of clay: a) Without finish	170	170	170	200	200	75	75	90	100	170	170

Table 14 (*Concluded*)

Sl No.	Nature of Construction and Materials	Minimum Thickness (mm), Excluding any Finish, for a Fire Resistance (*min*) of										
		Load Bearing						Non-load Bearing				
		60	90	120	180	240	30	60	90	120	180	240
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	b) With 13 mm lightweight aggregate gypsum plaster	170	170	170	200	200	75	75	90	100	170	170
ii)	Blocks of concrete:											
	a) Without finish	–	–	–	–	–	90	125	125	140	140	150
	b) With 13 mm cement/sand or gypsum/ sand	–	–	–	–	–	90	125	125	140	140	140
	c) With 13 mm lightweight aggregate gypsum plaste	190	200	200	–	–	75	90	90	100	125	125
iii)	Blocks of lightweight concrete:											
	a) Without finish	100	100	100	–	–	75	90	90	100	140	150
	b) With 13 mm cement/sand or gypsum/sand	–	–	–	–	–	75	75	75	100	140	140
	c) With 13 mm lightweight aggregate gypsum plaster	–	–	–	–	–	63	63	63	75	90	100

Table 15 Framed Construction, Load Bearing (Required to Resist Fire from One Side at a Time)

(*Clause* C-1)

Sl No.	Nature of Construction and Materials/Timber Studs at Centres not Exceeding 600 mm, Faced on Each Side with	Minimum Thickness (mm) of Protection for a Fire Resistance of 60 min
(1)	(2)	(3)
i)	Plasterboard layers with joints staggered, joints in outer layer taped and filled — Total thickness for each face	25
ii)	One layer of 12.7 mm plasterboard with a finish of lightweight aggregate gypsum plaster	13
iii)	Metal lath and plaster, thickness of plaster:	
	a) Sanded gypsum plaster (metal lathing grade)	22
	b) Lightweight aggregate gypsum plaster	13

Table 16 Framed Construction, Non-Load Bearing (Required to Resist Fire from One Side at a Time)

(*Clause* C-1)

Sl No.	Nature of Construction and Materials/Steel or Timber Frame at Centres not Exceeding 600 mm, Facings on Both Sides of	Stud Construction	Minimum Thickness (mm) of Protection for a Fire Resistance (min)			
			30	60	90	120
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Dry lining with materials fixed direct to studs, without plaster finish					
	a) One layer of plasterboard with taped and filled joints	Timber or steel	12.7	–	–	–
	b) Two layers of plasterboard with joints staggered, joints in outer layer taped and filled – Total thickness for each face	Timber or steel	19	25	–	–
	c) One layer of asbestos insulating board with transverse joints backed by fillers of asbestos insulating board not less than 9 mm thick, or by timber	Timber or steel	9	12	–	–
	d) One layer of wood wool slabs	Timber	25	–	–	–
	e) One layer of chipboard or of plywood	Timber or steel	18	–	–	–
ii)	Lining with materials fixed direct to suds, with plaster finish					
	a) Plasterboard of thickness:					
	1) With not less than 5 mm gypsum plaster finish	Timber or steel	9.5	–	–	–
	2) With not less than 13 mm gypsum plaster finish	Timber or steel	–	12.7	–	–
iii)	Wet finish					
	a) Metal lath and plaster, thickness of plaster:					
	1) Sanded gypsum plaster	Timber or steel	13	–	–	–
	2) Lightweight aggregate gypsum plaster	Timber	–	13	19	25
		Steel	–	13	–	–

Table 17 Framed External Walls Load Bearing (Required to Resist Fire from One Side at a Time)

(*Clause* C-1)

Sl No.	Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Fire Resistance of 60 min
(1)	(2)	(3)
i)	Timber studs at centres not exceeding 600 mm with internal linings of: Plasterboard layers with joints in outer layer taped and filled, total thickness of plasterboard	31

Table 18 Framed External Walls Non-Load Bearing [Required to Resist Fire from Inside the Building (A)]

(*Clause* C-1)

Sl No.	Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Fire Resistance (min) of					
		30	60	90	120	180	240
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Steel frame with an external cladding of non-combustible sheets (excluding sheet steel), with a steel supporting framework and internal lining of:						
	a) Metal lath and plaster, thickness of plaster:						
	1) Sanded gypsum plaster (metal lathing grade)	13	13	–	–	–	–
	2) Lightweight aggregate gypsum plaster	10	13	15	15	15	19
	b) Two layers of plasterboard with joints staggered joints in outer layer taped and filled — Total thickness	21	32	–	–	–	–
	c) Plasterboard of thickness:						
	1) With not less than 5 mm gypsum plaster finish	12.7	–	–	–	–	–
	2) With not less than 13 mm gypsum plaster finish	9.5	–	–	–	–	–
	3) With not less than 10 mm lightweight aggregate gypsum plaster	9.5	–	–	–	–	–
	d) One layer of asbestos insulating board with transverse joints backed by fillers of asbestos insulating	9	9	12	12	12	12

Table 18 (*Concluded*)

Sl No.	Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Fire Resistance (min) of					
		30	60	90	120	180	240
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	board not less than 9 mm thick, or by timber						
	e) One layer of wood/wool slabs without finish	–	50	–	–	–	–
	f) One layer of compressed straw building slabs :						
	1) Without finish	50	–	–	–	–	–
	2) With not less than 5 mm gypsum plaster finish	–	50	–	–	–	–
	g) Aerated concrete blocks	50	50	63	63	75	100
	h) Bricks of clay:						
	1) Without finish	75	75	90	90	100	100
	2) With not less than 13 mm lightweight aggregate gypsum plaster	–	–	75	75	90	90

Table 19 Framed External Walls Non-Load Bearing [(Required to Resist Fire from Inside the Building (B)]

(*Clause* C-1)

Sl No.	Nature of Construction and Materials	Minimum Thickness (mm) of Protection to Provide Sufficient Insulation to Achieve a Modified Fire Resistance of Up to 240 min
(1)	(2)	(3)
i)	Steel frame with an external cladding of sheet steel fully lapped, steel bolted and fixed to steel sheeting rails, with timber or steel supporting framework and internal lining of:	
	a) Metal lath and plaster, thickness of plaster:	
	1) Sanded gypsum plaster (metal lathing grade)	13
	2) Lightweight aggregate gypsum plaster	10

Table 19 (*Concluded*)

Sl No.	Nature of Construction and Materials	Minimum Thickness (mm) of Protection to Provide Sufficient Insulation to Achieve a Modified Fire Resistance of Up to 240 min
(1)	(2)	(3)
	b) One layer of plasterboard with joints taped and filled	12.7
	c) Plasterboard of thickness with not less than 5 mm gypsum plaster finish	9.5
	d) One layer of asbestos insulating board with transverse joints backed by fillers of asbestos insulating board not less than 9 mm thick, or by timber	9
	e) One layer of wood/wool slabs	25
	f) One layer of compressed straw building slabs	50
	g) One layer of chipboard or of plywood	18
	h) Aerated concrete blocks	50
	j) Bricks of clay	75
	k) Any internal decorative lining with a cavity fill independently supported and retained in position of mineral fibre insulating material (excluding glass) at a density of 48 kg/m3	50

Table 20 Framed Walls Non-Load Bearing [Required to Resist Fire from Inside the Building (C)]

(*Clause* C-1)

Sl No.	Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Fire Resistance of 90 min
(1)	(2)	(3)
i)	Timber frame with external cladding of weather boarding or external plywood, 9.5 mm with an internal lining of :	
	a) Plasterboard not less than 9.5 mm thick, finished with:	
	1) Gypsum plaster	13
	2) Lightweight aggregate gypsum plaster	10
	b) Plasterboard not less than 12.7 mm thick, finished with:	
	1) Gypsum plaster	10

Table 20 (*Concluded*)

Sl No.	Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Fire Resistance of 90 min
(1)	(2)	(3)
	2) Lightweight aggregate gypsum plaster	10
	c) One layer of asbestos insulating board with transverse joints backed by fillers of asbestos insulating board not less than 9 mm thick, or by timber	9 12

Table 21 Reinforced Concrete Columns

(*Clause* C-1)

Sl No.	Nature of Construction and Materials		Minimum Dimensions (mm) Excluding any Finish, for a Fire Resistance (min) of					
			30	60	90	120	180	240
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)
i)	Fully exposed	a) Width	150	200	250	300	400	450
		b) Cover	40	40	40	40	40	40
ii)	50 percent exposed	a) Width	125	160	200	200	300	350
		b) Cover	40	40	40	40	40	40
iii)	One face exposed	a) Thickness	100	120	140	160	200	240
		b) Cover	40	40	40	40	40	40

Table 22 Concrete Beams

(*Clause* C-1)

Sl No.	Nature of Construction and Materials		Minimum Dimensions (mm) Excluding any Finish, for a Fire Resistance (min) of					
			30	60	90	120	180	240
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)
i)	Reinforced concrete (simply supported)	a) Width	200	200	200	200	240	280
		b) Cover	20	20	20	40	60[1)]	70[1)]
ii)	Reinforced concrete (continuous)	a) Width	200	200	200	200	240	280
		b) Cover	20	20	20	30	40	50[1)]
iii)	Prestressed concrete (simply supported	a) Width	100	120	150	200	240	280
		b) Cover	25	40	55[1)]	70[1)]	80[1)]	90[1)]

Table 22 (*Concluded*)

Sl No.	Nature of Construction and Materials		Minimum Dimensions (mm) Excluding any Finish, for a Fire Resistance (min) of					
			30	60	90	120	180	240
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)
iv)	Prestressed concrete (continuous)	a) Width	80	100	120	150	200	240
		b) Cover	20	30	40	55[1)]	70[1)]	80[1)]

[1)] Require attention to the additional measures necessary to reduce the risk of spalling.

Table 23 Concrete Floors

(*Clause* C-1)

Sl No.	Nature of Construction and Materials		Minimum Dimensions (mm) Excluding any Finish, for a Fire Resistance (min) of					
			30	60	90	120	180	240
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)
i)	Reinforced concrete (simply supported)	a) Thickness	75	95	110	125	150	170
		b) Cover	20	20	25	35	45[1)]	55[1)]
ii)	Reinforced concrete (continuous)	a) Thickness	75	95	110	125	150	170
		b) Cover	20	20	20	25	35	45[1)]

[1)] Require attention to the additional measures necessary to reduce the risk of spalling.

Table 24 Concrete Floors: Ribbed Open Soffit

(*Clause* C-1)

Sl No.	Nature of Construction and Materials		Minimum Dimensions (mm) Excluding any Finish, for a Fire Resistance (min) of					
			30	60	90	120	180	240
(1)	(2)		(3)	(4)	(5)	(6)	(7)	(8)
i)	Reinforced concrete (simply supported)	a) Thickness of floor	75	95	110	125	150	170
		b) Rib width	125	125	125	125	150	175
		c) Cover	20	20	35	45[1)]	55[1)]	65[1)]
ii)	Reinforced concrete (continuous)	a) Thickness	75	95	110	125	150	170
		b) Width	125	125	125	125	150	175
		c) Cover	20	20	20	35	45[1)]	55[1)]

[1)] Require attention to the additional measures necessary to reduce the risk of spalling.

Table 25 Encased Steel Columns, 203 mm × 203 mm

(*Clause* 3.4.3 *and* C-1)

Sl No.	Nature of Construction and Materials	Minimum Dimensions (mm) Excluding any Finish, for a Fire Resistance (min) of				
		60	90	120	180	240
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Hollow protection (without an air cavity over the flanges):					
	a) Metal lathing with trowelled lightweight aggregate gypsum plaster[1)]	13	15	20	32	–
	b) Plasterboard with 1.6 mm wire binding at 100 mm pitch, finished with lightweight aggregate gypsum plaster not less than the thickness specified:					
	1) 9.5 mm plaster board	10	15	–	–	–
	2) 19 mm plaster board	10	13	20	–	–
	c) Asbestos insulating boards, thickness of board:					
	1) Single thickness of board, with 6 mm cover fillets at transverse joints	–	19	25	–	–
	2) Two layers of total thickness	–	–	–	38	50
	d) Solid bricks of clay, composition, or sand lime, reinforced in every horizontal joint, ulastered	50	50	50	75	100
	e) Aerated concrete blocks	60	60	60	–	–
	f) Solid blocks of lightweight concrete Hollow protection (with an air cavity over the flanges)	50	50	50	60	75
ii)	Asbestos insulating board screwed to 25 mm asbestos battens	12	19	–	–	–
iii)	Solid protections					
	a) Concrete, not leaner than 1 : 2 : 4 mix (unplastered):					
	1) Concrete not assumed to be load bearing, reinforced [2)]	25	25	25	50	75
	2) Concrete assumed to be load bearing	50	50	50	75	75
	b) Lightweight concrete, not leaner than 1 : 2 : 4 mix (unplastered): concrete not assumed to be load bearing, reinforced[2)]	25	25	25	40	60

[1)] So fixed or designed, as to allow full penetration for mechanical bond.

[2)] Reinforcement should consist of steel binding wire not less than 2.3 mm in thickness, or a steel mesh weighing not less than 0.5 kg/m^2. In concrete protection, the spacing of that reinforcement should not exceed 200 mm in any direction.

Table 26 Encased Steel Beams, 406 mm × 176 mm

(Protection Applied on Three Sides)

(*Clause* 3.4.3 *and* C-1)

Sl No.	Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Fire Resistance (min) of					
		30	60	90	120	180	240
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Hollow protection (without an air cavity beneath the lower flange):						
	a) Metal lathing with trowelled lightweight aggregate gypsum plaster[1)]	13	13	15	20	25	–
	b) Plasterboard with 1.6 mm wire binding[2)] at 100 mm pitch, finished with lightweight aggregate gypsum plaster not less than the thickness specified:						
	1) 9.5 mm plaster board	10	10	15	–	–	–
	2) 19 mm plaster board	10	10	13	20	–	–
	c) Asbestos insulating boards, thickness of board :						
	1) Single thickness of board, with 6 mm cover	–	–	19	25	–	–
	2) Two layers of total thickness	–	–	–	–	38	50
ii)	Hollow protection (with an air cavity below the lower flange):						
	a) Asbestos insulating board screwed to 25 mm asbestos battens	9	12	–	–	–	–
iii)	Solid protection :						
	a) Concrete, not leaner than 1 : 2 : 4 mix (unplastered):	25	25	25	25	50	75
	1) Concrete not assumed to be load bearing, reinforced[3)]	50	50	50	50	75	75
	2) Concrete assumed to be load bearing						
	b) Lightweight concrete[4)], not leaner than 1 : 2 : 4 (mix) unplastered	25	25	25	25	40	60

[1)] So fixed or designed, as to allow full penetration for mechanical bond.

[2)] Where wire binding cannot be used, expert advice should be sought regarding alternative methods of support to enable the lower edges of the plasterboard to be fixed together and to the lower flange, and for the top edge of the plasterboard to be held in position.

[3)] Reinforcement should consist of steel binding wire not less than 2.3 mm in thickness or a steel mesh weighing not less than 0.5 kg/m^2. In concrete protection, the spacing of that reinforcement should not exceed 200 mm in any direction.

[4)] Concrete not assumed to be load bearing, reinforced.

Table 27 Timber Floors — Tongued and Grooved Boarding, or Sheets of Tongued and Grooved Plywood or Wood Chipboard, of not Less than 21 mm Finished Thickness

(*Clause* C-1)

Sl No.	Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Fire Resistance (min) of		
		30	60	120
(1)	(2)	(3)	(4)	(5)
i)	37 mm (minimum) timber joists with a ceiling of:			
	a) Timber lathing and plaster, plaster of thickness	15	–	–
	b) Metal lathing and plaster, thickness of plaster:			
	1) Sanded gypsum plaster (metal lathing grade)	15	–	–
	2) Lightweight aggregate gypsum plaster	13	13	25
	c) One layer of plasterboard with taped and filled joints	12.7	–	–
	d) Two layers of plasterboard with joints staggered, joints in outer layer taped and filled total thickness	19	31	–
	e) One layer of plasterboard not less than 9.5 mm thick, finished with:			
	1) Gypsum plaster	5	–	–
	2) Sanded gypsum plaster	13	–	–
	3) Lightweight aggregate gypsum plaster	13	–	–
	f) One layer of plasterboard not less than 12.7 mm thick, finished with:			
	1) Gypsum plaster	5	–	–
	2) Lightweight aggregate gypsum plaster	10	–	–
	g) One layer of asbestos insulating board with any transverse joints backed by fillets of asbestos insulating board not less than 9 mm thick, or by timber	9	12	–

Table 28 Timber Floors — Tongued and Grooved Boarding, or Sheets of Tongued and Grooved Plywood or Wood Chipboard, of not Less than 15 mm Finished Thickness

(*Clause* C-1)

Sl No.	Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Fire Resistance (min) of		
		30	60	120
(1)	(2)	(3)	(4)	(5)
i)	37 mm (minimum) timber joists with a ceiling of:			
	a) Timber lathing and plaster, plaster of thickness	15	–	–

Table 28 (*Concluded*)

Sl No.	Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Fire Resistance (min) of		
		30	60	120
(1)	(2)	(3)	(4)	(5)
	b) Metal lathing and plaster, thickness of plaster for:			
	1) Sanded gypsum plaster (metal lathing grade)	15	–	–
	2) Lightweight aggregate gypsum plaster	13	13	25
	c) One layer of plasterboard with taped and filled joints	12.7	–	–
	d) Two layers of plasterboard with joints staggered, joints in outer layer taped and filled total thickness	22	31	–
	e) One layer of plasterboard not less than 9.5 mm thick, finish with:			
	1) Gypsum plaster	5	–	–
	2) Sanded gypsum plaster	15	–	–
	3) Lightweight aggregate gypsum plaster	13	–	–
	f) One layer of plasterboard not less than 12.7 mm thick, finished with:			
	1) Gypsum plaster	5	–	–
	2) Lightweight aggregate gypsum plaster	10	–	–
	g) One layer of asbestos insulating board, with any transverse joints backed by fillets of asbestos insulating board not less than 9 mm thick, or by timber	9	12 [1)]	–

[1)] Finished on top with 25 mm minimum thick glass fibre or mineral wool laid between joints.

Table 29 Timber Floors — Any Structurally Suitable Flooring of Timber or Lignocelluloses Boards

(*Clause* C-1)

Sl No.	Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Fire Resistance (min) of	
		30	60
(1)	(2)	(3)	(4)
i)	37 mm (minimum) timber joists with a ceiling of:		
	a) Timber lathing and plaster, plaster of thickness	15	–

Table 29 (*Concluded*)

Sl No.	Nature of Construction and Materials	Minimum Thickness (mm) of Protection for a Fire Resistance (min) of	
		30	60
(1)	(2)	(3)	(4)
	b) Metal lathing and plaster, thickness of plaster for :		
	1) Sanded gypsum plaster (metal lathing grade)	15	–
	2) Lightweight aggregate gypsum plaster	13	19
	c) One layer of plasterboard with joints taped and filled and backed by timber	12.7	–
	d) Two layers of plasterboard with joints staggered, joints in outer layer taped and filled total thickness	25	–
	e) Two layers of plasterboard, each not less than 9.5 mm thick, joints between boards staggered and outer layer finished with gypsum plaster	5	–
	f) One layer of plasterboard not less than 9.5 mm thick, finish with :		
	1) Sanded gypsum plaster	13	–
	2) Lightweight aggregate gypsum plaster	15	–
	g) One layer of plasterboard not less than 12.7 mm thick, finished with :		
	1) Sanded gypsum plaster	15	–
	2) Lightweight aggregate gypsum plaster	13	–
	h) One layer of asbestos insulating board with any transverse joints backed by fillets of asbestos insulating board not less than 9 mm thick, or by timber	12	–

ANNEX D

(*Clauses* 5.1.4 *and* 6)

ADDITIONAL REQUIREMENTS FOR HIGH RISE BUILDINGS

D-1 GENERAL

High rise buildings should receive special attention with respect to fire and life safety particularly with regard to planning, design, execution, maintenance and training so that the intended provisions of this NBCS are well implemented. These get further accentuated as the buildings go taller; some of the key aspects are as follows:

a) Staging and evacuation requirements of occupants;

b) Stack effect posing challenges towards pressurization and smoke exhaust;

c) Zoning of firefighting system to meet functional requirements of hydraulic pressure and flow; and

d) Challenges experienced by fire personnel in reaching the place of fire and towards evacuation.

Aspects to mitigate these challenges require innovative approach, interaction with local fire authorities and meaningful strategic planning towards maintenance and fire drills.

D-2 EGRESS AND EVACUATION STRATEGY

One firefighting shaft should be planned for each residential building/tower, in an educational building/block, and for each compartment of institutional, assembly, business and mercantile occupancy types. In buildings/floors having three or more compartments, there should be at least two firefighting shafts to serve the compartments.

For other occupancy types, requirement of firefighting shaft should be ascertained in consultation with the local fire authority. The firefighting shaft should necessarily have connectivity directly to exit discharge or through exit passageway (having 120 min fire resistance walls) to exit discharge.

Staircase and fire lift lobby of a firefighting shaft should be smoke controlled as per **4.4.2.5** and Table 5.

It is recommended that the pressurization requirement for staircase in firefighting shaft and for other fire exit staircases in buildings greater than 60 m in height be evaluated to limit the force required to operate the door assembly (in the direction of door opening) to not more than 133 N to set the door leaf in motion. The aspect of pressurization, door area/width and door closure should be planned in consideration to the above.

D-3 FIRE SAFETY REQUIREMENTS FOR LIFTS

The provisions as given in **7.1** to **7.2.4** under fire safety requirements of lifts in high rise buildings in Part D 'Building Services, Section 5 Installation of Lifts, Escalators, Moving Walks and Power-Driven Parking Systems, Subsection 5A Lifts' of this NBCS should be applicable.

D-4 HORIZONTAL EXITS AND REFUGE AREA

D-4.1 Horizontal Exit

A horizontal exit should be through a fire door of 120 min rating in a fire resistant wall. Horizontal exit require separation with the adjoining compartment through 120 min fire barrier. The adjoining compartment of the horizontal exit should allow unlocked and ease of egress and exits for the occupants using defend in place strategy.

Requirements of horizontal exits are as under:

a) Width of horizontal exit doorway should be suitable to meet the occupant load factor for egress;

b) Doors in horizontal exits should be openable at all times from both sides; and

c) All doors should swing in the direction of exit travel. For horizontal exits, if a double leaf door is used, the right hand door leaf should swing in the direction of exit travel.

D-4.2 Refuge Space/Area

a) Refuge spaces and refuge areas are provided for occupants staging requirements and also enabling assisted evacuation. The aspect of staging and refuge requirements should be planned in the building for people with disabilities and ailments, including specific assistance required for certain section of occupants based on their age and other challenges for self-evacuation.

b) Refuge spaces should be achieved by adequate planning and consideration of space provided in the lift lobby of firefighting shaft, enabling the staging for such occupants and further assisted evacuation through fireman lift in the firefighting shaft. This should enable these occupants to be assisted evacuated by the lift and further to be brought to exit discharge through the well-planned evacuation strategy through exit passageway on the ground or level of exit discharge. Provision for such staging of the occupants should be minimum 12 m^2 or 5 percent of calculated occupants of the floor (served by that firefighting shaft) with a refuge area space of 0.45 m^2 per person in the firefighting shaft lift lobby, whichever is higher.

c) Alternate to refuge spaces, refuge areas should be provided in buildings of height more than 24 m. Refuge area provided should be planned to accommodate the occupants of two consecutive floors (this should consider occupants of the floor where refuge is provided and occupants of floor above) by considering area of 0.3 m^2 per person for the calculated number of occupants and should include additionally to accommodate one wheelchair space of an area of 0.9 m^2 for every 200 occupants and portion thereof, based on the occupant load served by the area of refuge or a minimum of 15 m^2, whichever is higher, should be provided as under:

1) The refuge area should be provided on the periphery of the floor and open to air at least on one side protected with suitable railings.

2) Refuge area(s) should be provided at/or immediately above 24 m and thereafter at every 15 m or so.

   The above refuge area requirement for mall-like (mix of assembly, mercantile, cinema screen and restaurant) occupancy requirement should however be in accordance with **6.4.2.2**.

3) A prominent sign bearing the words 'REFUGE AREA' should be installed at the entry of the refuge area, having height of letters of minimum 75 mm, and also containing information about the location of refuge areas on the floors above and below this floor. The same signage should also be conspicuously located within the refuge area.

4) Each refuge area should be ventilated and provided with first aid box, fire extinguishers, public address speaker, fire man talk back, and adequate emergency lighting as well as drinking water facility.

5) Refuge areas should be approachable from the space they serve by an accessible means of egress.

6) Refuge areas should connect to firefighting shaft (comprising fireman's lift, lobby and staircase) without having the occupants requiring to return to the building spaces through which travel to the area of refuge occurred.

7) The refuge area should always be kept clear. No storage of combustible products and materials, electrical and mechanical equipment, etc should be allowed in such areas.

8) Refuge area should be provided with adequate drainage facility to maintain efficient storm water disposal.

9) Entire refuge area should be provided with sprinklers.

10) Where there is a difference in level between connected areas for horizontal exits, ramps of slope not steeper than 1 in 12 should be provided (and steps should be avoided).

NOTE — Refuge area provided in excess of the requirements should be counted towards FAR.

High rise apartment buildings with apartments having balcony, need not be provided with refuge area; however, apartment buildings without balcony should provide refuge spaces or refuge areas as given above. When refuge areas are preferred over refuge spaces in apartment buildings of height above 60 m (and having balconies), the same should be provided around 60 m level and thereafter at levels around every 30 m. The refuge area should be an area equivalent to 0.3 m^2 per person for accommodating occupants of two consecutive floors, where occupant load should be derived on basis of 12.5 m^2 of gross floor area and additionally 0.9 m^2 for accommodating wheelchair requirement or should be 15 m^2, whichever is higher.

D-5 ELECTRICAL SERVICES

The specific requirements for electrical installations in multi-storeyed buildings given in Part D 'Building Services, Section 2 Electrical and Allied Installations' of this NBCS and Section 7 of National Electrical Code of India 2023 should be followed.

Wherever transformers are planned at higher floors, the HT cables should be routed through a separate shaft having its own fire resistance rating of 120 min. Wherever HT generators are planned centrally at ground or first basement level, redundant transformers and HT cables should be planned for buildings above 60 m in height.

D-6 FIRE PROTECTION

D-6.1 For residential occupancies above 120 m in height and other occupancies above 60 m in height, the sprinklers should be fed from the main and an alternate/standby riser with suitable isolation valves. The entire sprinkler system should be designed in accordance with good practice [F(20)].

D-6.2 Where the height of the building exceeds 150 m to 175 m, fire water static storage and pumps should be required to be provided at 160 m to 180 m and thereafter at intermediate floors at higher levels enabling efficient and functional firefighting installations. The static fire water storage tanks located at such levels should have capacity at minimum half of the storage of underground static water storage tank as in. Such tanks should be supplemented with water supplies through one working and one standby pump of capacity 2 850 litre/min with two risers at alternate locations feeding to such fire water static storage tanks. The fire pump's requirement and capacity should also be derived for occupancy type as per Table 7A and Table 7J substituting the diesel pump with electrical pump. The fire pump room at such level should have dedicated connectivity through passageway (with 120 min integrity) from the firefighting shaft. Such fire pump room should have 120 min fire resisting wall and provided with adequate ventilation with talk-back connectivity to the main fire pump room and Fire Command Centre.

D-6.3 As an alternative to bottom-fed and standpipe and sprinkler that rely on pumps, in high rise buildings, water can be fed by gravity based tanks located at such levels along the height of the building designed to cater to the stories located 55 m to 60 m below. *See* Fig. 20 and Fig. 21 for guidance/details regarding sizing of pipes and achieving the desired pressure and capacity/volume {as suggested in [F(29)]} to cater respectively to the hydrants and the sprinklers. It is recommended to have the top-most tank having dual risers each connecting to different tank. A cross connection with isolation valve at the top and bottom of the dual risers is recommended.

Repeater tanks provided at higher stories can also be designed to fill the tank below, should the need arise. The top-most tank should have additional capacity (50 percent) to cater to the tank below. Overflow pipes can feed the tank below and designed accordingly. This system is particularly preferred in the case of single tower high rise building. *See* Fig. 20 and Fig. 21 for details.

D-6.4 For high rise buildings, seismic bracings should be considered for firefighting installations depending on seismic vulnerability of the region and the type of occupancy.

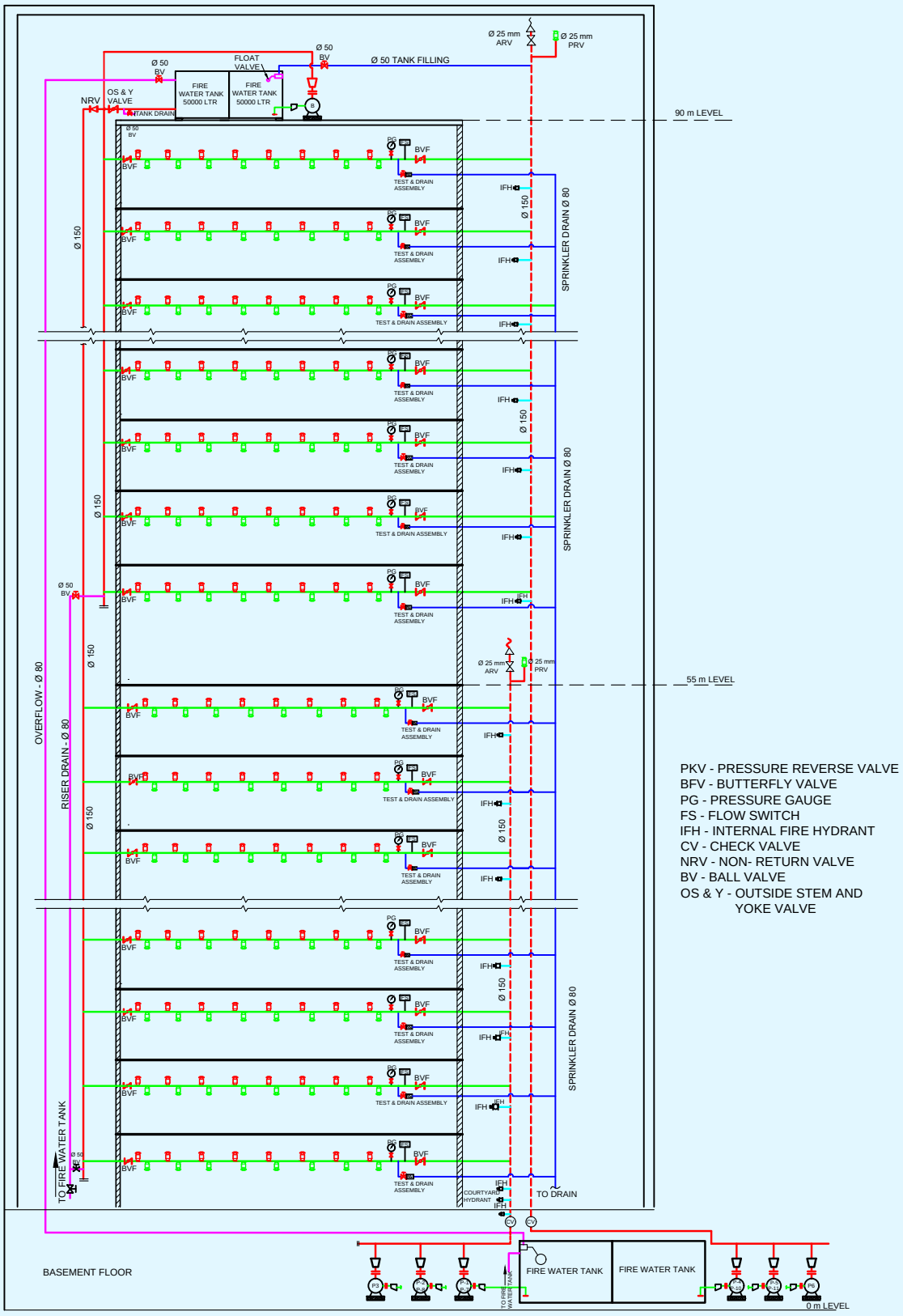


FIG. 20 SCHEMATIC OF GRAVITY BASED FEED FOR 55 M TO 90 M (CONTINUED)

EQUIPMENT DATA:

PUMP	P-1	P-2	P-3
DESIGNATION	COMMON STANDBY PUMB	COMMON MAIN PUMP	COMMON JOCEKY PUMP
CAPACITY	2 850 lpm	2 850 lpm	180 lpm
HEAD	10 bar	10 bar	10 bar
MODE OF OPERATION	AUTO START and MANUAL START/STOP	AUTO START and MANUAL START/STOP	AUTO START/STOP
DS	DIESEL STAND BY		
SE	STAND BY ELECTRICAL PUMP		
ME	MAIN ELECTRICAL PUMP		
JE	JOCKEY ELECTRICAL		
B	BOOSTER PUMP		

PUMP	P-4	P-5	P-6
DESIGNATION	COMMON STANDBY PUMB	COMMON MAIN PUMP	COMMON JOCEKY PUMP
CAPACITY	2 850 lpm	2 850 lpm	180 lpm
HEAD	15 bar	15 bar	15 bar
MODE OF OPERATION	AUTO START and MANUAL START/STOP	AUTO START and MANUAL START/STOP	AUTO START/STOP
DS	DIESEL STAND BY		
SE	STAND BY ELECTRICAL PUMP		
ME	MAIN ELECTRICAL PUMP		
JE	JOCKEY ELECTRICAL		
B	BOOSTER PUMP		

PUMP	B
DESIGNATION	BOOSTER PUMP
CAPACITY	900 LPM
HEAD	4.5 BAR

FIG. 20 DETAILS OF EQUIPMENT FOR FIGURE 55 M TO 90 M ABOVE

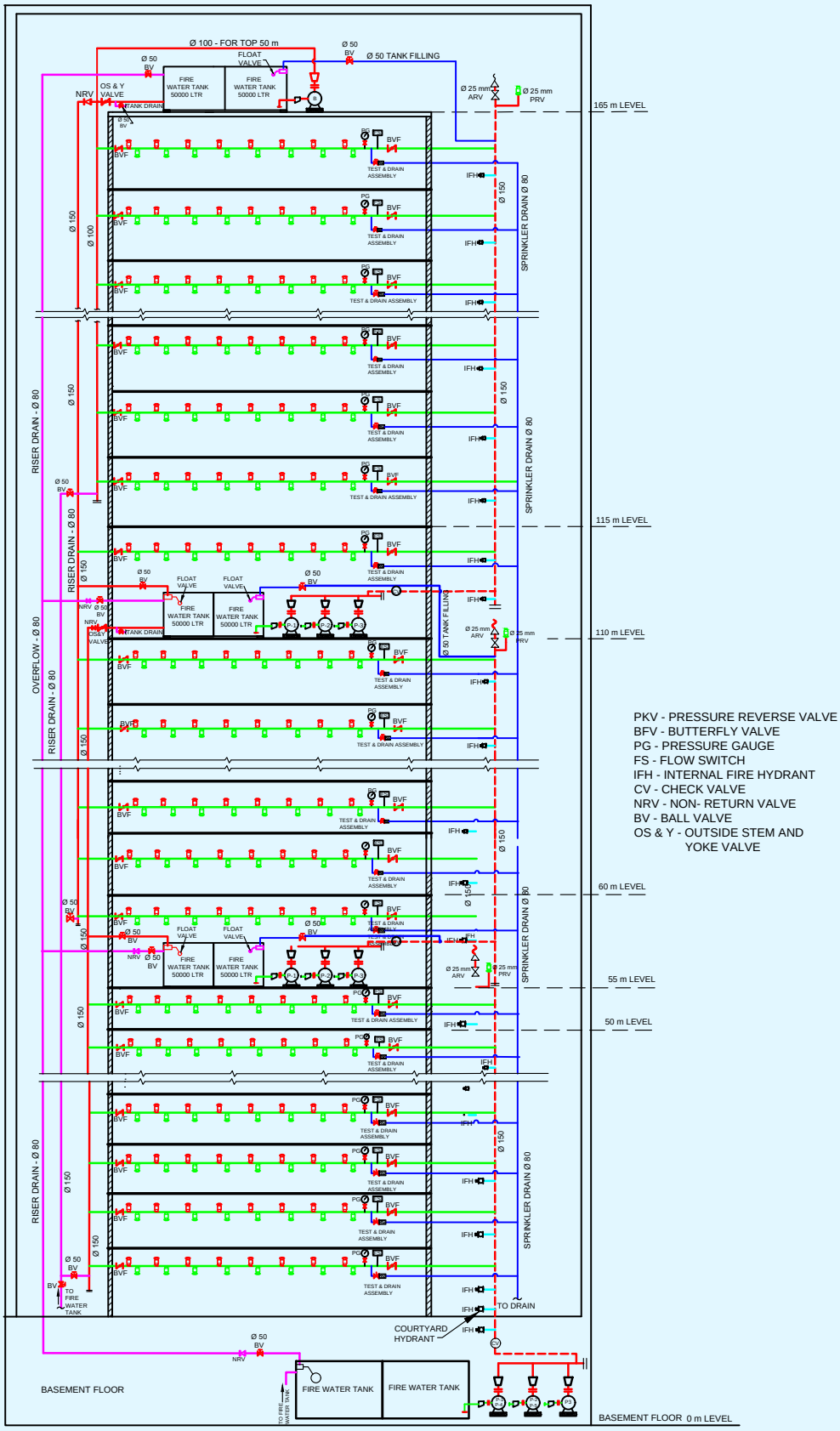


FIG. 21 SCHEMATIC OF GRAVITY BASED FEED FOR 90 M AND ABOVE HIGH RISES (CONTINUED)

EQUIPMENT DATA:

PUMP	P-1	P-2	P-3
DESIGNATION	COMMON STANDBY PUMB	COMMON MAIN PUMP	COMMON JOCEKY PUMP
CAPACITY	2 850 lpm	2 850 lpm	180 lpm
DUTY HEAD	10 bar	10 bar	10 bar
SHUT OF HEAD	12 bar	12 bar	12 bar
MODE OF OPERATION	AUTO START and MANUAL START/STOP	AUTO START and MANUAL START/STOP	AUTO START/STOP

PUMP	B
DESIGNATION	BOOSTER PUMP
CAPACITY	900 LPM
HEAD	4.5 BAR

FIG. 21 SCHEMATIC OF GRAVITY BASED FEED FOR 90 M AND ABOVE HIGH RISES

D-7 FIRE AND LIFE SAFETY AUDIT

D-7.1 The following should be applicable:

a) Fire and life safety audit should be carried out for all high rise buildings;

b) Such audits should preferably be conducted by a third party auditor having requisite experience in fire and life safety inspections;

c) Frequency of such audits should be once in two years.

DI-7.2 Good practices towards fire and life safety audit should be as given below:

a) Objective is to ensure that a building's fire prevention, fire protection and life safety measures are evaluated against established Indian Standards;

b) Methodology includes: Audit planning, on-site audit execution, documentation and reporting;

c) Audit objectives to cover: compliance verification, risk identification, performance evaluation, corrective recommendations, documentation and process review;

d) Fundamental principles should be: objectivity, consistency, risk-based approach, comprehensive coverage, continuous improvement, transparency and documentation, and stakeholder involvement;

e) In the audit methodology and process the following should be adhered: planning and preparation (Pre-audit data collection, Risk assessment and prioritization techniques, Audit team composition and qualifications), Audit execution (On-site inspection procedure, documentation review and interview, checklist and performance indicators), and Audit reporting (structure and content of the report, documentation of non-compliances and recommendations, methods for risk communication);

f) Audit criteria for fire safety should be well established; covering respectively for fire prevention namely:

1) Building design and construction features

i) Structural fire resistance

ii) Fire compartmentation and separation

iii) Material selection and non-combustibility

iv) Means of egress and access routes

v) Integration of fire safety systems

vi) Compliance with regulatory requirements

vii) Documentation and verification

2) Maintenance of fire prevention systems and housekeeping practices

i) Regular maintenance and servicing

ii) Housekeeping practices

iii) Documentation and verification

iv) Training and accountability;

g) Audit criteria for fire safety should be well established; covering respectively for fire protection systems namely:

1) Assessment of fire detection and alarm systems

i) Design and installation compliance

ii) Function performance and testing

iii) Maintenance and calibration

iv) Integration with emergency systems

v) Documentation and compliance verification

2) Inspection of fire suppression systems

i) Design and installation compliance

ii) Operational testing and performance

iii) Maintenance and inspection records

iv) Integration with fire safety systems

v) Physical condition and accessibility

vi) Compliance with regulatory and manufacturer specifications

3) Evaluation of emergency lighting signage

i) Design and installation compliance

ii) Visibility and illumination levels

iii) Operational performance

iv) Maintenance and inspection

v) Integration with overall safety systems

vi) Documentation and compliance verification

4) Evaluation of life safety components

i) Assessment of exit routes, corridors and stairways

- Design and layout
- Unobstructed passage
- Dimensions and capacity
- Signage and emergency lighting
- Physical condition and maintenance

- Special provisions
- Documentation and verification

ii) Verification of occupant load, exit capacities and travel distances

- Occupant load verification
- Assessment of exit capacities
- Measurement of travel distances
- Integration and documentation
- Assessment of portable and wheeled fire extinguisher;

h) Audit criteria for life safety should be well established to cover:

1) Structural and environment safety

i) Evaluation of structural fire resistance and compartmentation

ii) Assessment of emergency communication systems and evacuation aids

2) Accessibility and special needs

i) Consideration for persons with disabilities

ii) Audit of assisted evacuation procedures;

j) Performance indicators and compliance assessment – To address:

1) Scoring and rating methodologies for audit findings

2) Risk evaluation and prioritization of deficiencies

3) Criteria for Compliance/Partial Compliance/Non-Compliance;

k) Corrective actions and follow-up are essential so as to provide opportunity to the building owner/resident to address the shortfall so as to make the premises safe; and

m) Reporting and record keeping – To have standard formats/templates to record observations, measurements including photographs stored in compatible formats, all with a view to enable suitable reviewing for consistency.

D-8 HELIPAD

For high rise buildings above 200 m in height, provision for helipad is recommended for specific requirements like landing of fire equipment, and support facilities or other emergencies.

Suitable fire protection is required for the helipad areas to enable their safe usage at all times. The firefighting facilities for rooftop helipad includes fire detection, fixed or portable firefighting foam system (oscillating foam monitor, deck integrated foam nozzles or portable foam units), fire hydrants and trained response team.

Low expansion aqueous film forming foam (AFFF) can be applied to the helideck from either fixed nozzles or an oscillating nozzle, particularly on the landing pad, at the rate of 10 lpm per square foot for a duration of 10 min.

Without the requirement for any additional water, buildings having helipad should use the water available for wet riser, sprinkler system, etc for foam based fire protection. This can be achieved by a suitable tee connection in the standpipe by attaching a 100 mm or 150 mm deluge valve (to control the flow of water) and extending a 100 mm or 150 mm water line from that valve, to the foam producing equipment located near (outside) the helipad area.

ANNEX E

(*Clauses* 4.5.3.4, 6 *and Table* 6)

ATRIUM

E-1 ATRIUM REQUIREMENTS

a) In order for an atrium to be permitted in buildings, the following should be complied with:

   1) Atrium should be permitted in buildings of Type 1 and Type 2 construction only.

   2) The use of combustible furnishings and decorations on the floor of the atrium should be limited and sparsely distributed.

b) Smoke detectors (preferably beam type or aspirating type) should be provided on the underside of each floor protruding into the atrium, at the atrium roof and adjacent to each return air intake from the atrium. Within atrium space, beam type or aspirating type smoke detectors should be used to ensure detection of smoke, considering factors such as stratification of smoke.

c) Where the ceiling of the atrium is more than 17 m above the floor, water based protection (automatic sprinklers) at the ceiling of atrium is not required. In such case, travel distance allowance should be as applicable for sprinkler spaces.

d) Hydrants should be available at the floor of the atrium and also at the adjoining upper spaces/floors of the atrium. Sprinklers are required to be installed for coverage of glass areas of retail, tenant and other areas adjoining the exit access corridor and atrium. Sprinklers should be at a distance of 450 mm to 600 mm enabling cooling of such glass and limiting the extent of fire and smoke to the atrium (*see* Fig. 22). This provision does not allow similar sprinkler installation arrangement to offset fire compartmentation requirements, in which case fire barrier is required as per relevant provisions of this Part.

e) Atrium in business occupancy should be planned with 6 air changes per hour (ACPH) while atrium in hotels and assembly occupancy should be planned with 8 ACPH smoke extraction system.

f) Such air changes should be planned in atrium for a height of 15 m from the top.

g) Smoke exhaust fans should be capable of operating effectively at 250 °C for 120 min.

h) Makeup air supply points should be located beneath the smoke layer and on the lower levels connected by the atrium.

j) Makeup air should be provided by fans, openings to outside to allow infiltration, or the combination thereof.

k) It is recommended that makeup air be designed at 85 percent to 95 percent of the exhaust flow rate, not including the leakage through these small paths.

m) The makeup air should not cause door-opening force to exceed allowable limits.

n) The makeup air velocity should not exceed 1.02 m/s is where the makeup air could come into contact with the plume unless a higher makeup air velocity is supported by engineering analysis;

p) Atrium smoke management system fans should be provided with emergency power.

q) If so, required by the Authority, an engineering analysis should be performed which demonstrates that the smoke system for the atrium is designed to keep the smoke layer interface 1 800 mm above the highest occupied floor level of exit access, open to the atrium, for a period equal to 1.5 times the calculated egress time or 20 min, whichever is greater.

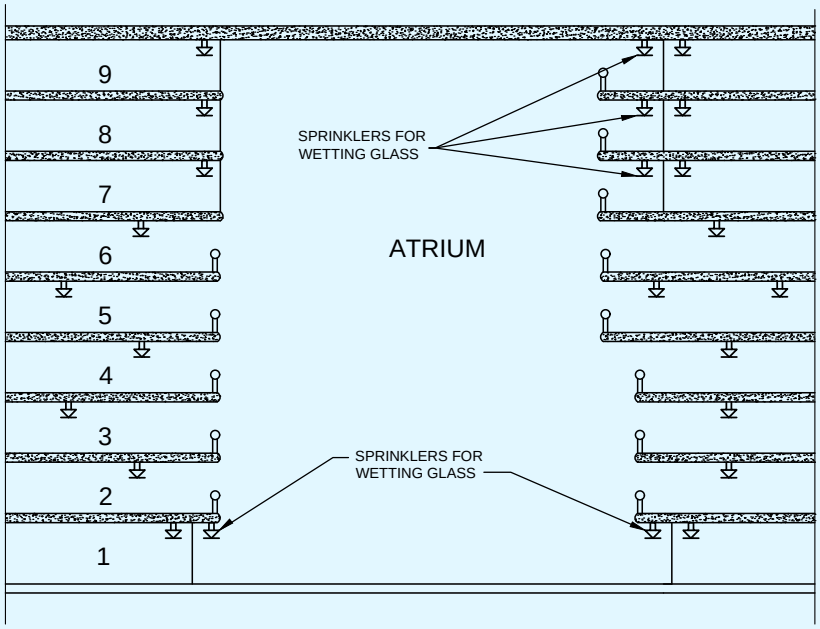


FIG. 22 SPRINKLER PROTECTION OF GLASS FOR FLOOR OPEN TO ATRIUM

ANNEX F

(*Clause* 6)

REQUIREMENTS FOR DATA CENTRES

F-1 GENERAL

Data centres are classified under Group E Business occupancy and in particular as E-II sub-occupancy considering its primary use, scale, and presence of process equipment. A comprehensive fire risk assessment should be conducted at the planning stage and periodically during operation. Assessments must include ignition sources, fire load, electrical risks, HVAC systems, etc. For guidance on the facilities and infrastructure of datacentres, refer to the following good practices.

IS/ISO/IEC 22237-1 : 2021	Information technology – Data centre facilities and infrastructures: Part 1 General concepts
IS/ISO/IEC 22237-3 : 2021	Information technology – Data centre facilities and infrastructures: Part 3 Power distribution
IS/ISO/IEC 22237-4 : 2021	Information technology – Data centre facilities and infrastructures: Part 4 Environmental control

F-2 BUILDING DESIGN AND CONSTRUCTION

F-2.1 The fire resistance rating for the structural and non-structural elements should be based on guidelines as per approved and accepted standards. The fire rating should be validated and certified with a view to meeting the requirements of Table 1. In the absence of any validated/certified rating, guidance may be obtained from the information available in Annex C.

F-2.2 An anti-static floor system is highly recommended to prevent electrostatic discharge and support cable management. The data centre must be completely isolated from dust, water, vibration, and humidity. All external openings should be sealed, and no water sources or pipelines should be routed through or above the data centre,

UPS room, or communications room to eliminate risks of leakage or moisture intrusion. However, any location of chillers at higher heights be opted considering the operational efficiency and the same should be adequately considered in the structural design; Authorities may consider exempting the increased building height in such a case. Considering the sensitivity and fire hazards, such floors should have no other occupancy or else this should be considered in the calculation of floor area ratio and height.

F-2.3 Server rooms, battery banks, fuel storage, and other high-risk areas should be physically separated using fire-rated assemblies. Cable trays and ducts openings for cable trays and ducts should be sealed with materials having fire resistance rating of the compartment.

F-2.4 The number of basements should be kept as minimum and it should not be more than 2. The basement(s) should be within the building line and their total area should not exceed the area of ground floor.

F-2.5 The parking requirement should be arrived at considering the requirement for administrative building (at 1 ECS per 100 m^2). The parking requirement for the data centre/utility building should be based on the actual required number and area (of trucks) for which additional considerations of loading and unloading spaces for services, including rack placement/replacement as advised by the OEMs, DG set, utilities, etc should be made. In addition, consideration for the fire truck and its movement should be ensured in consultation with the local Fire Authority.

F-2.6 Lifts, when planned, consider respectively for administrative building as passenger lift as per Part D/ Section 5A of this NBCS should, and for the datacentre building as special goods lifts and special service lifts, for which OEMs should be consulted considering the size, speed and weight of payload; and any required special requirement.

F-2.7 Heights of stories should be arrived at based on the size of racks opted and the associated services (like cooling/ducting) and the same is effectively addressed in the structural design. The total height of the datacentre building should be arrived based on the FAR and only Type 1 construction. Ground-coverage should ideally not exceed 60 percent considering the peculiar requirements and the essential nature of these buildings which are required in the society in the current times, and the associated moment of heavy vehicles to install/maintain/repair the racks/occupant.

NOTE — Authorities to consider also the possible change of occupancy from data centre to other permitted business as well; and the ground-coverage.

F-3 FIRE DETECTION SYSTEMS

F-3.1 Use of aspirating smoke detection system in server areas is recommended for very early detection.

F-3.2 The system should incorporate heat sensitivity and high-sensitivity smoke detectors (HSSD) to enable early fire detection and prompt activation of suppression mechanisms.

F-3.3 For other requirements on fire detection and alarm system **4.9** be referred.

F-4 FIRE SUPPRESSION SYSTEMS

F-4.1 The fire suppression system in data centres should be designed to ensure both operational continuity and protection of sensitive equipment. The preferred suppression technologies and clean agent extinguishers (such as heptafluoro propane, fluorinated ketone based system or equivalent) should be available throughout data hall areas. These systems should be effective in suppressing fires without leaving any residue, making them safe for electronic and electrical installations.

F-4.2 All critical areas within the data centre, including server rooms, network rooms, UPS and battery areas, and under-floor and overhead spaces, must be covered comprehensively by the fire suppression system.

F-4.3 The suppression agents should be ozone-friendly and compliant with international environmental norms. The recharge process must be easy, with minimal downtime, and the equipment should be easy to test periodically.

F-4.4 An early warning fire detection and suppression system should be integrated with the fire alarm and building management system (BMS) for real-time monitoring and response. The system should be engineered to offer reliable and quick suppression to minimize damage and downtime.

F-5 ELECTRICAL AND HVAC FIRE SAFETY (*See also* Part D/Sec 2 and Part D/Sec 3 of this NBCS)

F-5.1 UPS, transformer, and generator rooms should be separated with fire-rated partitions/doors and have independent suppression systems. Should the need arise, the generators can be placed one over the other/stacked (suggested upto 5 numbers) parallel to the data centre building, but adequate fire safety should be ensured for which OEM's advice and specialist literature should be referred.

F-5.2 Wherever batteries are provided, the same should be segregated by 120 min fire rated construction. Ventilation to the room should be provided as per manufacturer's instructions.

F-5.3 Air conditioning and ventilating systems should be so installed and maintained as to minimize the danger of spread of fire, smoke or fumes from one floor to other or from outside to any occupied building or structure.

F-5.4 Supply air ducts, fresh air and return air ducts/passages must include fire dampers and smoke detectors (*see* **3.5.7.4**).

F-5.5 Insufficient power capacity design for a data centre can result in various issues such as system downtime, data loss, increased cost, reduced performance, regulatory non-compliance, etc. Ensuring a robust power capacity design is crucial for the reliable and efficient operation of data centres.

F-6 MEANS OF EGRESS

F-6.1 Exit Access

Exits should be provided on each floor or compartment in accordance with **4.4.2**. All exits should be unobstructed, illuminated, and clearly marked.

F-6.2 Staircases and Corridors

Staircases must be enclosed, fire-rated, and positively pressurized to prevent smoke ingress. Staircases should be of minimum 1.5 m in width, and 2 numbers of it will be required in the datacentre building. Staircase for administrative building should be arrived at using **4**; in any case, minimum 2 staircases are required.

F-6.3 Emergency Lighting and Signage

Emergency lighting consistent with emergency system for the building should be provided. Addressable emergency exit lighting system is recommended, adaptive type exit signages can also be used.

F-7 MEP, FIREFIGHTING AND SEISMIC SUPPORT REQUIREMENT

F-7.1 Earthquakes can cause downtime, data loss, service disruptions, fire, etc. Seismic bracing is essential to secure MEP equipment and systems, safeguarding them against the threats posed by earthquakes.

F-7.2 Non-structural measures focus on protecting operational components. These include seismic-rated mounting systems for equipment racks, secure cable pathways, MEP and firefighting services to avoid disconnections, and reinforced architectural features like ceilings and raised floors. These elements must meet seismic standards to ensure systems stay operational during and after an earthquake.

F-7.3 Seismic analysis/calculations should be carried out based on Part C 'Structural Design, Section 1 Loads and Load Effects' of this NBCS and good practice [F(32)]. Each non-structural component's seismic interactions with all other connected components and with the supporting structure should be accounted for in the design. The component should accommodate drifts, deflections, and relative displacements determined in accordance with the applicable seismic requirements of standards.

F-7.4 Each straight pipe/duct/cable containment run with two or more supports requires a minimum of two transverse braces (perpendicular to the run) and one longitudinal brace (parallel to the run).

F-7.5 Wire rope angular bracing should be seismic certified/tested by third party accredited lab as per method of testing for rating seismic and wind restraints. Rigid angular bracing and modular support system should be

analyzed for both tensile and compressive loads for strength and serviceability for the maximum length of element being used in worst case condition as per load combination as mentioned in standards.

F-7.6 Calculate the static and dynamic loading due to wind forces that is required to select/design vibration isolators, bases and seismic and wind restraints for outdoor and roof top equipment's/services. The calculation of wind load should be as per Part C 'Structural Design, Section 1 Loads and Load Effects' of thi NBCS. Worst case between seismic loads and wind loads should be considered for supporting and vibration isolation.

F-8 SECURITY

F-8.1 It is recommended that all doors should be access controlled or should be as per best suitable secure design requirement.

F-8.2 Doors should send an alarm if left open.

F-8.3 In line with safety requirements, access should be open for the fire affected area.

F-9 OPTIONAL PERFORMANCE INDICATORS

For guidance on the performance indicators of datacentres, the following good practices may be referred.

IS/ISO/IEC 30134-1 : 2016	Information technology — Data centres — Key performance indicators: Part 1 Overview and general requirements
IS/ISO/IEC 30134-2 : 2016	Information technology — Data centres — Key performance indicators: Part 2 Power usage effectiveness (PUE)
IS/ISO/IEC 30134-3 : 2016	Information technology — Data centres — Key performance indicators: Part 3 Renewable energy factor (REF)
IS/ISO/IEC 30134-4 : 2017	Information technology — Data centres — Key performance indicators: Part 4 IT equipment energy efficiency for servers (ITEEsv)
IS/ISO/IEC 30134-5 : 2017	Information technology — Data centres — Key performance indicators: Part 5 IT equipment utilization for servers (ITEUsv)
IS/ISO/IEC 30134-6 : 2021	Information technology — Data centres — Key performance indicators: Part 6 Energy reuse factor (ERF)
IS/ISO/IEC 30134-8 : 2022	Information technology — Data centres — Key performance indicators: Part 8 Carbon usage effectiveness (CUE)
IS/ISO/IEC 30134-9 : 2022	Information technology — Data centres — Key performance indicators: Part 9 Water usage effectiveness (WUE)

ANNEX G

[*Clauses* 6.4.2.2(e) *and* 6.8.1.5]

CAR PARKING FACILITIES

G-1 The provisions given in **G-2** to **G-5** should apply to parking structures of the closed or open type, within buildings above or below grade.

G-2 GENERAL

a) Where both parking and repair operations are conducted in the same building, the entire building should comply with the requirements for Group G occupancies, unless the parking and repair sections are effectively separated by separation walls of 120 min fire rating.

b) Floor surfaces should be non-combustible, sloping towards drains to remove accumulation of water.

c) Those parts of parking structures located within, immediately above or below, attached to, or less than

3 m away from a building used for any other purpose should be separated by fire resistant walls and floors having fire resistance rating of not less than 120 min. This should exclude those incidental spaces which are occupied by cashier, attendant booth or those spaces used for toilets, with a total area not exceeding 200 m^2.

d) Vehicle ramps should not be considered as exits unless pedestrian facilities are provided.

e) Other occupancies like fuel dispensing, should not be allowed in the building. Car repair facilities, if provided, should be separated by 120 min fire resistant construction.

f) In addition to fire protection requirements as per Table 7A to Table 7J, appropriate fire detection and suppressions systems should be provided for the protection of hydraulic oil tank and pumps located below ground level for operation of car lifts.

g) Means of egress should meet the requirements specified in **4**.

G-3 OPEN PARKING STRUCTURES (INCLUDING MULTI-LEVEL PARKING AND STILT PARKING)

a) The term open parking structure specifies the degree to which the structure's exterior walls must have openings. Parking structures that meet the definition of the term open parking structure provide sufficient area in exterior walls to vent the products of combustion to a greater degree than an enclosed parking structure.

b) A parking structure having each parking level wall openings open to the atmosphere, for an area of not less than 0.4 m^2 for each linear metre of its exterior perimeter should be construed as open parking structure. Such openings should be distributed over 40 percent of the building perimeter or uniformly over two opposing sides. Interior wall lines should be at least 20 percent open, with openings distributed to provide ventilation, else, the structure should be deemed as enclosed parking structures.

NOTE — A car park located at the stilt level of a building (not open to sky) can be considered an open or an unenclosed car park if any part of the car park is within 30 m of a permanent natural ventilation opening and any one of the following is complied with towards the permanent natural ventilation requirement:

1) 50 percent of the car park perimeter should be open to permanent natural ventilation.

2) At least 75 percent of the car park perimeter is having the 50 percent natural ventilation opening.

c) All stilt parking is required to be provided with sprinkler system where such buildings are required to be sprinklered.

d) Open parking structures are not required to be provided with compartmentation.

e) Open car parking (open to sky) within building complex having fire hydrant system should also need to be protected with yard hydrant installation system in accordance with good practice [F(29)].

G-4 ENCLOSED PARKING STRUCTURES

a) Those car parking structures which are enclosed on all sides and on top, not falling within the definition of open car parking [*see* G-3(b)] and also those situated in the basements should be known as enclosed car parking structures.

b) All sprinklers in car parking should be standard response type with minimum K-factor of 80, area coverage of 9 m^2 and designed as per good practice [F(20)].

c) For smoke ventilation requirement of car parking, *see* **4.6**.

d) All fire exit doors from the car parking to exits should be painted green and should display exit signage.

G-5 AUTOMATED CAR PARKING UTILIZING MECHANICAL OR COMPUTERIZED/ ROBOTIC MEANS

a) Automated car parking structure can be of open parking type or enclosed types.

b) Automated car parking facilities pose more hazard compared to manual parking due to following reasons:

1) High density of cars due to close stacking one over another.

2) Lack of provision on fire separation/compartmentation horizontal or vertical leading to rapid fire spread.

3) Non-availability of any person to notice/control the fire in initial stages.

4) Limited access to firefighting personnel.

5) Extensive height and depth involved with highly combustible load.

c) All basements should deploy sprinkler system with not less than K 115 quick response sprinklers, with a minimum of 2 sprinkler for each vehicle with not more than 7.2 m^2 coverage per sprinkler. The area of operation for basement sprinkler should not be less than 230 m^2. This should be applicable to both internal combustion engines (ICE) and electric battery operated or hybrid vehicles. All the sprinklers installed should be protected with a sprinkler guard.

d) All basements that deploy stack parking with one car above the other, where 2 sprinklers cannot be installed for the car below, a quick response extended coverage horizontal side wall of K 115 should be deployed. The pressure rating for this sprinkler should be based on original equipment manufacturers (OEM) recommendation based on the length and width covered. This sprinkler coverage should be within the OEM listing and approvals. Electric or hybrid car should not be parked on stack parking at any level. All the sprinklers installed should be protected with a sprinkler guard.

e) All buildings with automated puzzle parking without human interface should deploy sprinklers as applicable for normal parking. However, the riser should be limited to 24 m height, and additional risers with isolation valves should be added for each riser of 15 m thereon. This is to facilitate maintenance and isolation in case of false activation of sprinklers. All the sprinklers installed should be protected with a sprinkler guard.

f) Fire escape staircases, at least 1 250 mm wide should be provided at appropriate locations so that no place is more than 45 m from the nearest staircase. Horizontal walkways, at least 1 000 mm wide for access to all the areas should be provided at every parking level.

g) Travel distance and means of egress should be governed by the respective sections of this NBCS.

h) The hazardous areas like DG sets, transformers, HT/LT panels for the parking lot should be suitably segregated from other areas as per requirements given in this NBCS and all such areas should be protected by suitable automatic fire suppressions systems.

G-6 REQUIREMENTS FOR ELECTRIC VEHICLES (EV) CAR PARKING

See also **10.7** of Part D 'Building Services, Section 2 Electrical and Allied Installation' of this NBCS, including regarding electrical safety and location.

EV car parking are best planned in outdoors in well ventilated condition or in separate parking building at/above ground level having naturally cross-ventilated sides. Wherever EVs are designated in the regular car parking they should be segregated from other vehicles using both passive means and active measures of fire protection. The preferred locations are in the ground level and in no case below the first basement. Charging points for EVs may not be permitted below the ground level; and when permitted the same should be restricted to first basement. To enable immediate attention, the EV charging points for the EVs should be available at the entrance/first opportunity of the basement. Isolation cut-off switches (and fireman's emergency switch) should preferably be of the automated type or when manually operated should be located at the ground level also.

Active protection measure includes one or more of: water mist sprinkler system, and smart detection/monitoring system that enables early detection of thermal runaway issues that can flare up the fire should it happen. Fire suppressing materials using vermiculite/clay/mica based encapsulating agents that provide satisfactory performance may also be used.

The passive protection measures include fire rated walls (preferred over fire curtains/smoke curtains), fire doors, etc and additional protection measures to protect the structural elements from possible rising heat due to fire/hot gases. In the case of basements, maximum sizes of such a compartment for the EV parking (and charging) stations should be 1 000 m^2.

NOTE — The above provisions may be modified based on the availability of more suitable/better extinguishing media that proves effective against such fires.

ANNEX H

(*Clause* 6.4.4)

FIRE AND LIFE SAFETY REQUIREMENTS FOR METRO STATIONS

H-1 APPLICATION AND SCOPE

The provisions of this Annex relate to the buildings constructed as part of the metro stations/metro rail systems.

H-2 TERMINOLOGY — *See* 2.46.

H-3 GENERAL

H-3.1 Classification

Metro stations can be classified under 'Assembly occupancies'. These include any station building or part thereof, permanent or temporary, through which people transit for the duration of time required to enter the building and board the train to depart the station platform or to alight from the train and depart from the station building.

H-3.2 Sub-classification

Metro rail system buildings can be further classified under the following headings:

a) Elevated and enclosed stations,

b) Elevated and open stations,

c) Underground (enclosed) stations, and

d) Train depots.

NOTE – The above includes all open and enclosed metro stations along with their associated ancillary structures and train depots. Elevated should mean to include 'at-grade' stations as well.

H-3.3 Fire Zones

Metro stations, that is, mass rapid transit, may be constructed in any Fire Zone No. 1, 2 or 3, as per the transportation requirement/policy.

H-3.4 Type of Construction

Metro stations should conform to Type 1 or Type 2 or combinations of Types 1 and 2 non-combustible constructions, as defined in 3.4.

H-4 LIFE SAFETY REQUIREMENTS

H-4.1 Occupant Load

a) Main occupant load in a transit station is the platform occupant load, on which basis the life safety provisions of transit stations are designed. Occupant loads in transit stations are mainly a function of the train carrying capacities rather than the areas of a station.

b) For calculating platform occupant loads for a multiline, multilevel or multiplatform station, maximum occupant load for each platform should be considered separately for determining the egress capacity from that platform.

c) At levels where egress routes from separate platforms converge, occupant loads of all platforms should be considered to calculate egress capacity from that level. Simultaneous loads should be considered for all egress routes passing through each level of that station.

d) Platform occupant load should be based on the greater of the AM or PM 'peak hour loads' generated by the system and train loads.

e) Peak hour load should be converted to peak minute loads by dividing by 60 and multiplying further by a system surge factor varying from 1.3 to 1.5, as defined by the transit system authority. Surge factor may require to be further enhanced where increased footfalls are anticipated, like stations catering to sports complex, transit oriented development, and stations serving two or more lines.

NOTE — Surge factors should be based on actual calculations by transit system authority and in no case it should be less than 1.3.

f) Platform occupant load should be determined by factoring in the peak hour entraining loads at platform edges and train loads, in emergency evacuation scenario, as defined here:

1) *Train on Fire* – It is assumed that a train loaded to crush capacity/link load as may be decided by the transit system authority, travelling in peak direction at peak hour has caught fire, and as per the operating procedure it is brought to the next station, whereupon it should require to be evacuated.

2) The train in this case being called the 'incident train' and the platform on which it is arriving being called 'incident platform' of the 'incident station'.

3) Passengers waiting on all the platforms of the 'incident station' should require to be evacuated as well.

4) Number of passengers should be determined as defined in (g) below.

5) Only one source of fire, that is, train fire should be assumed at a time.

6) It is assumed that the train on non-incident platform should not stop at the incident station and should stop only at previous/next station.

g) Platform occupant load for emergency evacuation scenario, should be the addition of two headway entraining loads for peak direction platform, one headway entraining load for off-peak direction platforms and one crush train load/link load.

NOTE — *See* also **H-4.1**(b) and **H-4.1**(c).

h) *Occupancy in Non-public Areas*:

1) Use of designated non-public areas by station staff whose work assignments require their presence in the station structures should be permitted.

2) Unmanned plant rooms and any other areas where usual occupancy is less than 10 persons at any given time should be treated as unoccupied areas.

j) *Segregation with Non-transit Occupancy*:

Non-transit (and incidental) occupancies, of area up to 300 m^2 (total area of all floors), should be permitted to be accommodated within the station building. Occupant load of areas under non-transit occupancies should be in accordance with Table 2.

H-5 EGRESS PROVISIONS

H-5.1 Evacuation Time

a) *Means of Egress–public Areas* — Egress from metro station should be designed to facilitate the evacuation of a pre-defined platform occupant load to a designated point of safety in pre-defined emergency scenario(s), as defined by the transit system authority.

b) *Evacuation Time from Platform* — Enough egress capacity should be provided to evacuate the platform occupant load within 4 min from enclosed stations and within 5.5 min from open stations.

c) *Evacuation Time to Point of Safety* — Further, station design should permit evacuation of the remotest person on platform to a point of safety within 6 min in case of enclosed stations and within 8 min in case of open stations.

NOTE – Evacuation time specified in (b) and (c) may be modified based on actual engineering analysis by evaluating material heat release rates, station geometry and emergency ventilation systems.

d) For open stations where the concourse is below or protected from the platform by distance or materials as determined by an appropriate engineering analysis, that concourse should be permitted to be defined as a point of safety.

e) For enclosed stations equipped with an emergency ventilation system and where the emergency ventilation system provides protection for the concourse from exposure to the effects of a train fire at the platform as confirmed by engineering analysis, that concourse is permitted to be defined as a point of safety.

H-5.2 General Arrangement

a) Means of egress from each station platform should be provided so that they are equally distributed as far as possible, in capacity and placement, throughout the length of platform.

b) There should be at least two means of egress remote from each other.

c) Means of egress may however, be allowed to converge at concourse or subsequent levels with sufficient capacity to achieve the required evacuation time.

d) As far as possible, all the egress capacity required for emergency evacuation should be provided with the unenclosed stairs and escalators which are used for normal circulation.

H-5.3 Travel Distance

The maximum travel distance on the platform to a point at which a means of egress route leaves the platform should not be more than 100 m. This should, however be subject to fulfilling the egress requirements specified in **H-5.2**.

H-5.4 Means of Egress

H-5.4.1 *Non-public Areas*

Means of egress from unoccupied non-public areas should be permitted to be merged into public means of egress.

H-5.4.2 *Non-transit Occupancies*

Separate means of egress should be provided for such non-transit occupancies which are segregated from the station's public area to ensure independent evacuation from either occupancy. Such means of egress may be allowed to converge beyond station concourse area with the approval of the competent authority. Travel distance and other egress provisions of such non-transit occupancies should be in accordance with **4.4**.

H-5.4.3 *Platform*, *Corridors*, *Ramps*

Platforms, corridors and ramps serving as means of egress should be designed as per the following criteria:

a) A minimum clear width of 1 200 mm should be provided along all platforms, corridors, and ramps serving as means of egress

b) In computing the means of egress capacity available on platforms, corridors, and ramps, 300 mm should be deducted at each side wall and 450 mm should be deducted at platform edges that are open to the trainway.

c) The maximum means of egress capacity of platforms, corridors, and ramps should be computed at 0.0820 people/mm-min.

d) The maximum means of egress travel speed along platforms, corridors, and ramps should be computed at 38.0 m/min.

e) The means of egress travel speed for concourses and other areas where a lesser pedestrian density is anticipated should be computed at 60.0 m/min.

H-5.4.4 *Stairways*

a) Unenclosed stairs and escalators should be permitted to be counted as contributing to the means of egress capacity in stations.

b) Minimum widths of such unenclosed staircases should be 1 800 mm for unidirectional stairs, and 2 400 mm for bidirectional stairs.

c) Wall or floor-mounted railings on both sides should be permitted on stairs without affecting the widths stated in (b) above by more than 300 mm.

d) Enclosed stairs in the means of egress should be minimum 1 200 mm wide.

e) Capacity and travel speed for stairs should be computed at 0.0555 people/mm-min and 14.6 m/min, respectively.

H-5.4.5 *Escalators*

a) Escalators should not account for more than one-half of the means of egress capacity at any one level.

b) In calculating the egress capacity of escalators,

1) one escalator at each level should be considered as being out of service, and

2) the escalator chosen should be the one having the most adverse effect upon egress capacity.

c) Where escalators are permitted as a means of egress in stations, the following criteria should be complied with:

1) The escalators should be constructed of non-combustible materials (exceptions like rollers and handrails should be permitted with intimation to the Competent Authority).

2) Escalators running in the direction of egress should be permitted to remain operating.

3) Escalators running in reverse to the direction of egress should be capable of being stopped either locally by a manual stopping device at the escalator or remotely by a manual stopping device at a remote location or remotely as part of a pre-planned evacuation response. A stopped escalator should be counted as equivalent to 1 m wide staircase.

d) Where provision is made for remote stopping of escalators counted as means of egress, one of the following should apply:

The stop should be delayed until it is preceded by a minimum 15 s audible signal or warning message sounded at the escalator; wherein (1) the signal or message should have a sound intensity that is at least 15 dBA above the average ambient sound level for the entire length of the escalator, (2) the signal should be distinct from the fire alarm signal, and (3) the warning message should meet audibility and intelligibility requirements.

OR

Where escalators are equipped with the necessary controls to decelerate in a controlled manner under the full rated load, the stop should be delayed for at least 5 s before beginning deceleration, and the deceleration rate should be no greater than 0.052 m/s^2.

e) Escalators with or without intermediate landings should be acceptable as a means of egress, regardless of vertical rise.

f) Escalators exposed to the outdoor environment should be provided with slip-resistant landing and floor plates.

g) Stopped escalators should be permitted to be started in the direction of egress in accordance with the requirements for stopping of escalators described in **H-5.4.5**(c)(3) and **H-5.4.5**(d).

h) Capacity and travel speed for escalators should be computed at 120 people/min and 18.5 m/min (vertical component of travel speed), respectively.

H-5.4.6 *Lifts*

Lifts meeting the following requirements should be counted as one of the means of egress in stations.

H-5.4.6.1 *Capacity of lifts*

Where lifts are counted as contributing to the means of egress capacity;

a) lifts should have a minimum of 60 min fire resistance rating;

b) they should account for no more than 50 percent of the required egress capacity;

c) at least one lift should be considered out of service, and one lift should be reserved for fire service; and

d) the capacity of each lift should be the carrying capacity of the lifts within 30 min.

H-5.4.6.2 *Holding area for lifts*

Lifts counted as one of the means of egress from any level of a station should be accessed through holding areas or lobbies at that level, which should be designed as follows:

a) The holding areas or lobbies should be separated from the platform by a smoke-tight fire separation having a fire resistance rating of at least 60 min but not less than the time required to evacuate the holding area occupant load.

b) At least one stair should be accessible from the holding area.

c) The holding area should be sized to accommodate one person per 0.2 m^2.

d) If the holding area includes portions of the platform, the area within 600 mm of the trainway should not be considered in the calculation;

e) Upon activation of smoke control in the platform or adjacent trainway areas, the holding area should be pressurized to a minimum of 25 Pa.

f) The holding area should be provided with emergency voice alarm devices with two-way communication to the system operations control centre.

H-5.4.6.3 *Design features of lifts*

Lifts counted as one of the means of egress should be designed as follows:

a) Shaft enclosures should be constructed as fire separations having a 120 min fire resistance rating.

b) The design should limit water flow into the shaft.

c) No more than two lifts used for means of egress or fire department access should share the same machine room or lift pit.

d) Machine rooms should be separated from each other by fire separation having a minimum fire resistance rating of 120 min.

e) The lifts should be connected to back-up power supply.

f) During emergency evacuation, the lifts should travel only between the incident level and a point of safety.

H-5.4.7 *Doors and Gates*

The egress capacity for doors and gates in a means of egress serving public areas should be computed as,

a) 60 people per minute (p/min) for single leaf doors and gates;

b) 0.082 people/mm-min for bi-parting multi-leaf doors and gates measured for the clear width dimension; and

c) gates in a means of egress should be designed in accordance with the requirements for doors serving as a means of egress.

H-5.4.8 *Fare Barriers*

a) Fare barriers complying with the following provisions should be permitted in the means of egress serving the stations. Such barriers should be designed to release, permitting unimpeded travel in the direction of egress under all the following conditions:

   1) Power failure or ground fault condition;

   2) Activation of the station fire alarm signal; and

   3) Manual activation from a switch in a constantly attended location in the station or operations control centre.

b) Fare barriers that do not comply with the requirements of **H-5.4.8**(a) should be permitted in the means of egress where barriers in the equipment are designed to provide egress when a horizontal force not exceeding 66 N is applied in the egress direction.

c) Gate-type fare barriers in the means of egress should meet the following criteria:

   1) Each unit should provide a minimum of 450 mm clear width at and below a height of 1 000 mm and 530 mm clear width above that height.

   2) Each unit should be credited with a capacity of 50 p/min for egress calculations.

   3) Fare barriers should be designed so that their failure to operate properly will not prohibit the movement of passengers in the direction of emergency egress.

H-5.4.9 *Horizontal Exits*

Horizontal exits should be permitted for up to 100 percent of the number of horizontal exits and required egress capacity, provided that not more than 50 percent of the number and required capacity is into a single building and provided they comply with the following provisions:

a) Width of the horizontal exit should at least be the same as that of the exit doorways.

b) A horizontal exit should be equipped with at least one fire/smoke door of a minimum 60 min fire resistance, of self-closing type. Further, it should have direct connectivity to the egress staircase for evacuation.

c) Where there is a difference in level between connected areas for horizontal exits or ramps, slope not more than 1 in 12 should be provided.

d) Doors in horizontal exits should be able to open at all times from both sides.

H-5.4.10 *Platform Screen and Edge Door*

Horizontal sliding platform screen or platform edge doors should be permitted to separate the platform from the trainway in stations, provided that the doors permit emergency egress from the train to the platform regardless of the stopping position of the train; and the doors provide egress when a force not exceeding 220 N is applied from the train side of the doors. The doors should be designed to withstand positive and negative pressures caused by passing trains.

H-5.4.11 *Access for Fire Brigade Personnel*

A dedicated access staircase for firemen should be provided in each underground station. This access should be arranged so as to provide uninterrupted access from ground level to station concourse and platform levels. If continuous access is not feasible, smoke sealed lobbies should be provided at concourse or other intermediate

levels and such lobbies should be protected with fire doors of adequate rating. Firemen staircases should be maintained under positive pressure at all times.

H-5.4.12 Emergency and escape lighting and illumination of means of all exits should comply with the various provisions under **3.5.6** and **H-9**.

H-6 FIRE SEPARATION AND COMPARTMENTATION

H-6.1 Fire compartments should be provided in transit stations in accordance with the provisions of this section. Fire ratings of various occupancies within open stations and enclosed stations should be as indicated in Table 30.

H-6.2 Further transit station should be divided into fire compartments by means of compartment walls and compartment floors by a fire separation of at least 120 min between the following occupancies:

a) Public areas and non-public areas,

b) Transit and non-transit areas, and

c) Ancillary areas located beneath and within 3 m of the trainway in open stations.

H-6.3 No fire separation should be required for occupancies like ticketing offices, toilets, other offices and the like.

H-6.4 Incidental kiosks inside stations for other purposes like commercial use, etc should be provided with detection and a suitable automatic suppression system, if areas occupied by such occupancies exceed 10 m^2.

H-6.5 Fire Doors

Fire doors should comply with the following requirements:

a) Fire doors should be constructed of non-combustible material having appropriate fire resistance, and two fire doors may be fitted in an opening if each door by itself is capable of closing the opening and the two doors together achieve the required level of fire resistance.

b) All fire doors should be fitted with an automatic self-closing device, of same fire rating as the door, which is capable of closing the door from any angle and against any latch fitted to the door.

c) Any fire door fitted within an opening which is provided as a means of escape should be capable of being opened manually or by an electromagnetic or electro-mechanical device which can be activated by the presence of smoke and/or the fire alarm system, including the case of fire doors opening into pressurised exit staircases.

H-6.6 Smoke Compartmentation

a) Smoke compartments should be created to ensure that in case of a fire scenario, the escape routes are not full of smoke and a safe passage is provided to firefighters to reach the fire location.

b) Smoke barriers should be provided within the ceiling at platform and concourse levels at locations and spacing as determined by the engineering analysis and should be designed to withstand temperatures up to 250 °C for 60 min.

c) Smoke barriers should also be provided around all openings containing staircases, escalators and lifts in public areas connecting platform to levels above or below them.

d) Multiple smoke compartments catered by a combined ductwork should be provided with fire dampers for a fire barrier.

Table 30 Fire Ratings for Mass Rapid Transit Station Occupancies

(*Clause* H-6.1)

Sl No.	Occupancies	Fire Rating of Enclosures h		Fire Rating of Doors h	
		Open Station	Enclosed Station	Open Station	Enclosed Station
(1)	(2)	(3)	(4)	(5)	(6)
i)	Auxiliary substation, electrical UPS/battery room	2	2	2	2
ii)	Signalling equipment room, telecom equipment room, S&T (signalling and train control) UPS/battery room, electrical cable shafts, S&T cable shafts	2	2	1.5	1.5
iii)	Environmental control system (ECS) plant room, tunnel ventilation room, firemen's staircase, emergency equipment store, CDMA room, GSM room, sewage ejector room, sump pump room, chiller plant room, pump room, DG panel room	2	2	1.5	1.5
iv)	Station manager room, security room, stores, cleaners room, refuse storage, plumbing shafts, staff mess rooms, distribution board room and the like.	1	2	0.5	1.5

H-7 OTHER SPECIFICS REGARDING SAFETY REQUIREMENTS

a) Materials used as interior wall and ceiling and other decorative features in enclosed stations should be non-combustible.

b) For protection against intrusion of flammable and combustible liquids and flooding of underground transit systems, any structure including emergency egress or access stairs or vent or fan shaft structure utilized for ventilation of underground system should be permitted to be terminated at grade, provided that the level at which it is terminated is at least 450 mm above the surrounding ground level/footpath level.

c) Emergency ventilation fans, their motors, and all related components exposed to the exhaust airflow should be rated for 250 °C for a minimum of 120 min. Emergency ventilation fans should be connected to a secondary power supply.

d) Operation of the emergency ventilation system components should be initiated from the central supervising station.

e) All types of kiosks like ticketing booth, information counter, commercial, if any, etc, should be constructed with non-combustible materials.

f) Stations should be provided with power supply as per **H-8**.

g) Emergency lighting should be provided throughout the station as per **3.5.6.1** and **H-9**.

h) Voice evacuation/public address system should be provided throughout the station, and ancillary buildings as per requirements.

j) Equipment rooms should be protected by fire suppression systems as per relevant standards.

k) Emergency command centres and emergency response procedures should be in place.

m) Evacuation should take place under the guidance and control of authorized, trained system employees or other authorized personnel as warranted under an emergency situation.

n) Adequate warning signs, directional signs, exit signs should be provided throughout the facility.

H-8 POWER SUPPLY SYSTEM

H-8.1 General

The auxiliary substation at metro stations can be provided at any location, for example, ground level, concourse level, platform level, etc. The access for dismantling and replacement in future and ease of operation and maintenance of the equipment are to be ensured.

H-8.2 Uninterrupted Power Supply (UPS) System

The UPS should be an online parallel redundant system with battery backup for emergency power supply. The batteries should provide backup for a minimum 90 min. If, DG set power backup to UPS is provided, the battery backup time should be suitably selected.

H-8.3 Back-up or Emergency Power Supply

a) The back-up/emergency power supply should have a capacity to cater all critical loads such as emergency lighting, protective signalling system, communication system, station control room/fire command centre, lifts providing required egress capacity, etc.

b) Power supply to these systems and equipment should be from normal and emergency (standby generator power sources with changeover facility).

c) If the power supply is taken from HT source and HT generation, the transformer should be selected with standby capacity to ensure continuity of power supply to such systems. Where parallel HV/LV supply from a separate independent source is provided with appropriate transformer for emergency, the provision of diesel generator for emergency supply may be waived off at the discretion of metro Authority. In such a scenario, in case of failure of mains power, the transfer to emergency power supply should be automatic and within 10 s for ensuring uninterrupted supply to emergency systems.

H-8.4 Cables

a) Fire resistant/survival, low smoke zero halogen, copper conductor, armoured, cross linked polyethylene (XLPE) insulated cables should be used at enclosed stations for fire and life safety equipment like fire alarm system (FAS), tunnel ventilation fans, smoke extraction fans, staircase pressurization fans, fire pumps, emergency lighting, etc.

b) All cables and wiring used for fire and life safety equipment should have a 3 h fire survival capability at 950 °C.

c) For all other essential services at enclosed stations like chillers, AHU, normal lighting, chilled water pumps etc. flame retardant, low smoke zero-halogen (LSZH), armoured, XLPE insulated aluminium/copper conductor cables should be used.

d) At open stations, flame retardant, low smoke halogen free (FRLSH), armoured, XLPE insulated aluminium/copper conductor cables should be used for power supply.

H-9 EMERGENCY LIGHTING SYSTEM

a) LED lighting fixtures should be used for lighting at metro stations.

b) Emergency illumination should include illumination of means of egress, illuminated exit signs, and all other luminaires specified as necessary to provide required illumination. Emergency lighting systems should be designed and installed so that the failure of any illumination source cannot leave in total

darkness any space that requires emergency illumination. Emergency lighting should not provide less than average of 10 lux. Minimum illumination of 10 lux should be maintained on egress route.

c) Fire resistant, low smoke and zero halogen (FS) copper conductor wires should be used for wiring of emergency lighting system at underground stations. Emergency lighting system circuit should have 3 h fire survival capability at 950 °C.

d) Out of total light fixtures installed at any station, at least 30 percent of the total lights, all uniformly distributed should be connected to emergency power source, that is, UPS.

e) Emergency lighting should be powered from a source independent of that supplying the normal lighting.

H-10 FIRE PROTECTION FACILITIES

The following requirement should apply to all open (elevated and at-grade), and enclosed metro stations and depots.

H-10.1 The details of the protection and facilities required for open (elevated and at-grade) stations and depots are given hereunder.

H-10.1.1 *Pumping Arrangements*

Each station should be provided with two pumps having a minimum discharge capacity of 1 620 litre/min with different prime movers. It is possible to provide two electrically driven pumps, if assured back-up power is available for driving the pumps. Jockey pumps having a capacity of 180 litre/min should also be provided to take care of minor system leakages, (*Also refer* to **H-10.1.9**).

H-10.1.2 *Fire Extinguishers*

a) Water CO_2 type, CO_2/ABC type fire extinguisher(s) should be provided in each platform and distributed in such a way that an the extinguisher is available within a travel distance of 30 m from any point;

b) Water CO_2 type, CO_2/ABC type fire extinguisher(s) should be provided in each concourse for every 300 m^2 floor area and distributed in such a way that an extinguishers are available within a travel distance of 30 m from any point; and

c) At least one extinguisher should be provided for each equipment room and other enclosure for every 300 m^2 floor area.

H-10.1.3 *Small Bore Hose Reels*

a) One hose reel should be provided for every 1 000 m^2 floor area of station platform or part thereof, subject to a travel distance of 30 m to the nearest hose reel.

b) One hose reel should be provided for every 1 000 m^2 floor area, concourse or part thereof subject to a travel distance of 30 m to the nearest hose reel.

c) Where equipment rooms not covered by hose reel's reach from FHCs located at concourse and platform locations, additional hose reel points should be provided to ensure its coverage.

H-10.1.4 *Fire Alarm System*

a) Fire detection system should be of the addressable type. Detectors are required to be provided only in areas where there is false ceiling(s)/ false floor(s) and areas for equipment rooms. Wherever there are false ceilings/false floors with perforation less than 70 percent, the detectors should be provided both above and below false ceiling/false floor, giving due consideration to the depth of false ceiling/flooring. In open stations, in areas having high heights and cross-ventilation, detectors will not be effective and hence it can be dispensed. Detector(s) should be provided in lift shaft(s) and escalator pit(s) also.

b) Spacing of detectors and devices should be as per [4(26)].

c) Manual call stations(s) should be provided at central location(s) on each platform (near emergency stop plunger) and at least two on the concourse, on each sidewall. When the concourse is in two halves, at least one manual call station should be provided on each side.

H-10.1.5 Inert Gas/CO_2/ *based fire Suppression System*

AIS HT, Main LT and panel supplying power to UPS, DG change-over, fire pump panel and transformers at the stations should be protected with the inert gas/ CO_2 based fire suppression system in accordance with IS 15506/ IS 15525/IS 15501/IS 15528. A suitable detection mechanism should be provided for triggering the suppression system automatically.

H-10.1.6 *Provision of Hydrants and Wet Risers*

a) Minimum two hydrants should be provided at each platform with a hose box containing two lengths of hose pipes (15 m each with a nozzle) subject to a travel distance of 30 m to reach the nearest hydrant. Location of hydrants should be staggered for better coverage. The hydrants should cover the entire length of the platform when two hose pipes are coupled to the landing valves and used. If not fully covered, additional hydrant(s) should be provided.

b) Minimum two hydrants should be provided for each concourse, including commercial area, if any, with a hose box containing two lengths of hose pipes (15 m each with a nozzle), subject to a travel distance of 30 m to reach the nearest hydrant.

c) Hydrants should be provided at each entry to the station at ground and upper levels near the staircase. At least two hydrants for parking area should be provided subject to a travel distance of 30 m to the nearest hydrant.

d) In depots, fire piping should be provided along the depot boundary as ring main. The ring main should be provided with a yard hydrant every 60 m. The building should be provided with a yard hydrant, preferably at its entry, through a branch from the ring main. The inside of the building should be provided with a number of FHCs required for coverage and maintaining a maximum travel distance of 30 m to the nearest FHC. Yard hydrant in the depot should be provided as per Table 31 through branches from ring main. Other provision(s) of fire detection and suppression in the depot should be as per Table 31.

H-10.1.7 *Automatic Sprinkler System*

Sprinklers are required to be provided only in the commercial areas and any combustible storage area within the station (also refer **H-10.1.9**). Alternatively, automatic fire suppression system instead of water-based sprinkler system, as per application, is also acceptable.

H-10.1.8 *Water Requirement*

a) For stand-alone open metro stations, exclusive water requirement for the fire protection system for the installed pumping capacity, as stated in **H-10.1.1** should be at least 50 000 litre.

b) However, when commercial areas are present within open metro stations, firefighting facilities should need augmentation as in **H-10.1.9**.

H-10.1.9 In case of other types of occupancy like commercial areas inside metro stations and combustible storage areas, if any, within open stations, the pumping/water requirement should be as per Table 32.

The volume of water stated in Table 32 should be stored in more than one interconnected compartments/tanks. Wherever existing structures are upgraded to include a commercial area and additional water requirement as per Table 32 if any, may be met by additional tank or overhead tanks as permissible by structure. Size of the main header should not be less than 150 mm diameter in all cases. Entire fire protection system should be designed and installed as per the relevant Indian Standards.

Table 31 Requirement of Firefighting Installations in Depot Building

(*Clause* H-10.1.6)

Sl No.	Name/Part of the Building	Occupancy	Fire Extinguisher	First Aid Hose Reel	Wet Riser	Down Comer	Yard Hydrant	Automatic Sprinkler System Installation	Manually Operated Electronic Fire Alarm System	Automatic Detection and Alarm System	Underground Static Water Storage Tank Combined Capacity for Wet Riser, Yard Hydrant and Sprinklers per Set of Pumps	Terrace tank over Respective Tower Terrace	Pump near Underground Static Water Storage Tank (Fire Pump) with minimum pressure of 3.5 Kg/cm^2 at Remotest Location	Pump at the Terrace Tank level with minimum pressure of 3.5 Kg/cm^2	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
i)	Live OHE areas/third rail areas (like inspection bay, workshop bay, stabling lines, auto coach washing plant, covered electrical substation, etc)	Assembly	R	R	R	NR	R	NR	R	NR	2 00 000 litre	NR	2 850 lpm main and standby electric pumps, and 180 lpm jockey pump	NR	
ii)	Areas having engineering workshops and offices [Inspection offices, workshop offices, (ETU) workshop, P-way offices, depot control centre, PPIO, other administrative offices, etc]		R	R	R	NR	R	NR	R	R		NR		NR	
iii)	Storage areas (DCOS, Store rooms, scrap yards within buildings, lubricant and any other combustible storage areas)		R	R	R	R	R	R	R	R		R (10 000 litre) For main store building		NR	

Table 31 (*Concluded*)

Sl No.	Name/Part of the Building	Occupancy	Fire Extinguisher	First Aid Hose Reel	Wet Riser	Down Comer	Yard Hydrant	Automatic Sprinkler System Installation	Manually Operated Electronic Fire Alarm System	Automatic Detection and Alarm System	Underground Static Water Storage Tank Combined Capacity for Wet Riser, Yard Hydrant and Sprinklers per Set of Pumps	Terrace tank over Respective Tower Terrace	Pump near Underground Static Water Storage Tank (Fire Pump) with minimum pressure of 3.5 Kg/cm^2 at Remotest Location	Pump at the Terrace Tank level with minimum pressure of 3.5 Kg/cm^2	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
iv)	Miscellaneous areas (canteen, time office, security rooms, open scrap yards, sewage treatment plants, contractor rooms, training establishments, commercial areas, etc)		(*See* Note 2)				R	(*See* Note 2)							

R – Required NR – Not Required

NOTES

1 Automatic sprinkler system is required in every storage areas and scrap yard inside the buildings. The same wet riser pumps can be used for feeding sprinkler system, if any.

2 Miscellaneous areas or any other building structure within the depot premise (separated from other depot establishments) can be considered an individual occupancy and minimum requirements for firefighting provisions for these occupancies should be adopted as given in Table 7A to Table 7J.

Table 32 Water Capacity

(*Clause* H-10.1.9)

Sl No.	Area Occupied by Commercial Occupancies	Hydrant Pump Capacity (Minimum Pressure of 3.5 kg/cm^2 at the Remotest Location)	Sprinkler Pump Capacity	Jockey Pump	Common Standby Pumps	Water Capacity
	m^2	litre/min	litre/min	litre/min	litre/min	litre
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Up to and including 300	2 280	Common pump	180	2 280	75 000
ii)	More than 300 and up to 1 000	2 850	Common pump	180	2 850	1 00 000
iii)	More than 1 000	2 850	2 850	180 each	2 850	2 00 000

H-10.2 Details of Protection and Facilities Required for Enclosed Metro Stations

H-10.2.1 *Hydrant System*

a) *Pumping Arrangements* — Each station should be provided with two pumps having a minimum discharge flow rate of 2 850 litre/min with different prime movers. It is possible to provide two electrically driven pumps, if assured back-up power is available for driving the pumps. Jockey pump having a capacity of 180 litre/min should also be provided to take care of minor system leakages.

b) *Flow of Hydrant Pump* — For hydrant system, having three or more hydrants on any floor, the minimum flow rate for the most demanding horizontal hydrant should be 2 850 litre/min.

c) *Requirement of Residual Pressure at Remotest Hydrant* — Hydraulically designed hydrant system should be designed to provide the water flow rate required at a minimum residual pressure of 7 bar at the remotest located hydrant.

d) *Flow of each Hydrant* — A hydraulically designed hydrant system supplying three or more hydrants on any floor, hydraulic calculations and pipe sizes should be calculated by providing 946 litre/min at the three most remote hydrants and at the minimum residual pressure of 7 bar.

e) *Water Requirement for Hydrant System* — The minimum water supply should be capable of providing the system demand for at least 60 min.

f) *Orifice plate* — Required to be installed when the static pressure at the hydrant exceeds 12.1 kg/cm^2.

g) *Distance of Fire Hydrant* (*FHC*) — FHC should be provided with hose box containing two lengths of hose pipes (15 m each with a nozzle). The travel distance to any hydrant should not exceed 30 m.

H-10.2.2 *Manual Medium Velocity Spray Nozzle Systems*

a) *Design Density* — A general range of water spray application rates that should apply to most ordinary combustible solids or liquids should be from 6.1 lpm/m^2 to 20.4 lpm/m^2 of protected surface.

b) The horizontal distance between spray nozzles/open head sprinklers should not exceed 2.5 m.

c) *Water Requirement for Spray System* — The water supply duration for an exposure protection sprinkler system should be for a minimum of 60 min.

H-10.2.3 *Water Requirement*

The enclosed station should be provided with water storage of 2 00 000 litre capacity. The underground fire water storage tanks should not be more than 7 m in depth from the level having fire brigade draw-out connection, while the draw-out connection should not be more than 5 m away from tank wall. In case any of the above criteria could not be met, one additional booster pump of suitable rating should be provided to support fire brigade vehicle for proper suction of water from the tank.

H-10.2.4 *Fire Extinguishers — See* **H-10.1.2**

H-10.2.5 *Inert Gas/CO_2 based Fire Suppression System — See* **H-10.1.5**

H-10.2.6 *Automatic Sprinkler System — See* **H-10.1.7**

H-10.2.7 *Station Control Room/Fire Command Centre*

a) The station control room should have the main fire alarm panel with communication system (suitable public address system) to aid floors and facilities for receiving the message from different floors.

b) Fire command centre (FCC)/station control room (SCR) should be provided with emergency lighting. All controls and monitoring of fire alarm systems, pressurization systems, smoke management systems should be done from FCC/SCR. Monitoring of integrated building management systems, CCTVs or any other critical parameters in building may also be from the FCC/SCR.

c) Details of all floor plans along with the details of firefighting equipment and installations (2 sets laminated and bound) should be maintained in fire command centre.

H-10.2.8 *Fire Alarm System*

An addressable fire detection and alarm system should be provided. Major components of fire alarm system should be as per IS 2189 and as specified herein :

a) *FACP Battery Backup*

FACP should have provision of battery for power backup in case of power failure.

The secondary power supply should have sufficient capacity to operate the system under quiescent load (system operating in a non-alarm condition) for a minimum of 24 h and, at the end of that period, should be capable of operating all alarm notification appliances used for evacuation or to direct aid to the location of an emergency for 5 min.

Battery calculations should include a minimum 20 percent safety margin above the calculated required amp-hour capacity.

In case of availability of emergency generator or two reliable sources of power supply from two separate transformers, 4 h of power backup may be taken in place of 24 h.

b) *Response Indicator*

Generally, response indicators are provided to identify the location of detectors which are installed at unapproachable/concealed locations. Response indicator should not be provided with addressable type fire alarm system.

H-11 STATION SMOKE MANAGEMENT SYSTEM

H-11.1 The subsequent clauses give the requirement of smoke extraction and smoke purging system required in enclosed metro stations. Smoke management system is not required for open (elevated and at-grade) stations.

H-11.2 Station Public Area Smoke Extraction Systems

Station public area should be provided with active smoke extraction system to maintain tenable environment for the time required for safe evacuation of passenger(s).

The smoke extraction system should be an engineered smoke control system and its design should be based on the following:

a) *Fire size*

The capacity of the engineered smoke extraction system should be calculated based on the incidence of a likely minimum baggage fire size of 1 MW.

b) *Smoke clear height*

The design smoke clear height should be above the heads of people escaping beneath it. The minimum height should be 2.0 m.

c) *Perforated ceiling*

For cases where the smoke reservoir is above the false ceiling, the ceiling should be of perforated type with at least 70 percent opening.

d) *Makeup air*

Makeup air should be drawn directly from the external space/air shaft, through inlet air ventilators or door-ways.

e) *Mode of activation*

1) *Automatic activation*

The engineered smoke extraction system should have provision of automatic activation by smoke detectors located in the fire zone. Use of smoke detectors for activation should 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.

2) *Manual activation*

A remote manual activation and control switches, as well as visual indication of the operation status of the smoke ventilation system, should also be provided at the station control room (SCR).

f) *Interlocking with other systems*

1) Except for smoke extraction system, all other air conditioning and mechanical ventilation systems within the areas served should be shut down automatically upon activation of the smoke extraction system.

g) *Standby fans/multiple fans*

Either a standby fan or multiple fans with excess capacity should be provided for each mechanical smoke extraction 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 should be automatically activated in the event the duty fan fails.

h) Emergency ventilation fans, their motors, and all related components exposed to the exhaust airflow should be rated for 250 °C for a minimum of 120 min. Emergency ventilation fans should be connected to a secondary power supply.

H-11.3 Smoke Purging System

a) For extraction of cold smoke after the extinguishing of fire, smoke purging system should be provided.

b) Smoke purging system should be provided in the following areas of underground station:

1) Station control room;

2) S and T rooms;

3) Fire pump rooms;

4) UPS rooms; and

5) Auxiliary sub-station.

For other back of house rooms, normal ventilation system may be utilized to remove the cold smoke.

c) *Design of smoke purging system*

Smoke purging system, where provided in station and ancillary building, should comply with all the following requirements:

1) The smoke purging system need not be a dedicated system.
2) The purging system should have purge rate of not less than 9 air changes per hour (ACPH) or room ventilation ACPH, whichever is higher.
3) Makeup air should be drawn from adjacent area or corridor free from smoke or can be supplied by a separate mechanical system.
4) Smoke purging fans, their motors, and all related components exposed to the exhaust airflow should be fire rated and designed to operate in smoke of 250°C for a minimum of 120 min. Smoke purging fans should be connected to a secondary power supply.
5) In case of smoke/fire in entries subway, it should be rendered out of use and evacuation should be dealt procedurally.

H-11.4 Tenability Criteria

A tenable environment should be maintained in the path of egress. The tenability criteria considerations are given hereunder:

a) Smoke obstruction:
   1) Internally illuminated signage (80 lux) discernible at 30 m.
   2) Walls and doors or externally illuminated signage discernible at 10 m.

b) Heat effects:
   1) Exposure temperature (occupied zone) ≤ 60 °C for 10 min.
   2) Radiant heat exposure ≤ 2.5 kW/m^2

c) Carbon monoxide – The smoke extraction system to be designed to maintain fractional effective dose (FED) of less than 0.3. The permissible exposure to carbon monoxide should be as per following table:

Sl No.	*Time* min	*Maximum Carbon Monoxide Exposure* ppm
(1)	(2)	(3)
i)	4	1 706
ii)	6	1 138
iii)	10	683
iv)	15	455
v)	30	228
vi)	60	114
vii)	240	28

d) Velocity – Air velocity should be greater than or equal to 0.75 m/s and less than or equal to 11 m/s along the path of egress.

e) Noise – Noise level along the path of egress should not exceed 85 dBA at any point 1.5 m above walking surface.

ANNEX J

(*Clause* 6.4.4)

FIRE AND LIFE SAFETY REQUIREMENTS FOR METRO TRAINWAYS

J-1 APPLICATION

Provisions of this Annex should apply to all portions of underground, elevated and at-grade metro trainway including tail buffer tracks and sidings not intended to be occupied by the passengers. These provisions may be amended, if required, as per the approval of the Competent Authority.

J-2 USE AND OCCUPANCY

J-2.1 Passengers should be allowed to enter the trainway only in the case it becomes necessary to evacuate a train.

J-2.2 Passenger evacuation from train onto the trainway should take place only under the guidance and control of authorized, trained system employee or other authorized personnel as warranted under an emergency situation.

J-2.3 Warning signs in accordance with **J-4.4.1** should be posted at locations where unauthorized personnel might trespass.

J-3 CONSTRUCTION

J-3.1 Construction Type

J-3.1.1 *Cut and Cover*

Where trainways are to be constructed by cut and cover method, perimeter walls, base and roof slabs and other related constructions should be of not less than Type 1 or Type 2 or combination of Types 1 and 2 non-combustible constructions as defined in this Part. The type of construction should be further determined by an engineering analysis of potential fire exposure hazards to the structure.

J-3.1.2 *Bored Tunnels*

Where trainway sections are to be constructed by a tunnelling method through earth, unprotected steel liners, reinforced concrete, shotcrete, or equivalent should be permitted to be used.

J-3.1.3 *Rock Tunnels*

Where trainway sections are to be constructed by a tunneling method through rock, steel bents with concrete liner, if lining is required, should be permitted to be used.

J-3.1.4 *Underwater Tunnels*

Underwater tunnels should be not less than Type 2 construction.

J-3.1.5 *Mid Tunnel Ventilation Shaft and Trainway Exit structures*

Mid tunnel ventilation shafts and trainway emergency egress or access stairs should not be less than Type 1 construction.

J-3.1.6 *At-Grade Construction*

Materials used for at-grade construction should not be less than Type 2 materials. The type of construction should be further determined by an engineering analysis of potential fire exposure hazards to the structure.

J-3.1.7 *Elevated Viaduct or Portals*

All elevated structures necessary for trainway support and all structures and enclosures on or under the trainway should be of not less than Type 1 or Type 2 or combination of Type 1 and Type 2 construction. The type of construction should be further determined by an engineering analysis of potential fire exposure hazards to the structure.

J-3.2 Protection against Intrusion of Flammable and Combustible Liquids and Flooding of Enclosed Trainway

Any structure including emergency egress or access stairs or vent or fan shaft structure utilized for ventilation of underground system should be permitted to be terminated at grade, provided that the level at which it is terminated is at least 450 mm above the surrounding ground level/footpath level.

J-3.3 Compartmentation

J-3.3.1 Ancillary areas should be separated from trainway areas within underwater trainway sections by construction having a minimum 180 min fire resistance rating.

J-3.3.2 Ancillary areas should be separated from trainway areas within enclosed trainway sections by construction having a minimum 120 min fire resistance rating.

J-3.4 Combustible Components

Where combustible components not specifically mentioned here are installed in a trainway, a fire hazard analysis should be conducted to determine that the level of occupant fire safety is not adversely affected by the contents.

J-3.5 Walking Surfaces

Walking surfaces designated for evacuation of passengers should be constructed of non-combustible materials.

J-4 EMERGENCY EGRESS

J-4.1 Location of Egress Routes

J-4.1.1 The system should incorporate a walking surface or other approved means for passengers to evacuate a train at any point along the trainway so that they can proceed to the nearest station or other point of safety.

J-4.1.2 Walkway continuity should be maintained at special track sections like cross over or pocket tracks. Walkway continuity should be provided by cross walks at track level.

J-4.1.3 Within enclosed trainways, the maximum distance between emergency exits/exit stairways should not exceed 750 m.

J-4.1.4 For trainways in twin bore tunnels or trainways in a tunnel divided by a minimum 120 min fire rated wall separation, cross-passageways should be permitted to be used in-lieu of emergency exit stairways.

J-4.1.5 Where cross passageways are utilized in-lieu of emergency exit stairways, the following requirements should apply:

a) First cross-passageway should be provided not farther than 500 m from the end of platform of an enclosed station or from the tunnel portal or from a mid-tunnel exit way.

b) Distance between any two cross-passageways should not be more than 250 m.

c) The crossover in an enclosed trainway should be considered as cross-passageway. The distance between crossover and subsequent cross-passageway should not be more than 250 m.

d) Cross-passageways should be separated from each trainway with separate self-closing fire door assemblies having a fire protection rating of minimum 90 min.

e) A tenable environment should be maintained in the portion of the trainway that is not involved in an emergency and that is being used for evacuation.

f) A ventilation system for the incident trainway should be designed to control smoke in the vicinity of the passengers.

g) Provisions should be made for evacuating passengers via the non-incident trainway to a nearby station or other emergency exit.

h) The provisions should include measures to protect passengers evacuating from non-incident tunnel from oncoming traffic and from other hazards.

j) Where cross-passageways are used in-lieu of emergency exit stairways, the interior of the cross-passage should not be used for any purpose other than as an area of refuge or for access/egress to the opposite tunnel, except for installation of non-combustible equipment inside the cross passageways, provided that such equipment does not infringe the required clear space of the cross-passage.

J-4.1.6 *Level of Cross Passage*

The level of cross-passage inside the tunnel should be designed in accordance to the following requirements:

a) In trainways where passengers have to walk on the track bed during evacuation, the floor of the cross-passages in such trainways should be kept close to the level of the track bed. The maximum permitted level difference between the level of track bed and the floor of the cross-passage should be 250 mm. Further, a smooth surface for transition of level difference should be provided at such cross-passages.

b) In trainways where passengers have to walk on a walkway mounted at the level of the train floor during evacuation, the floor of the cross-passages in such trainways should be kept in level with the walkway. Further, such walkways should always be provided on the cross-passageway side of the trainway for unobstructed access to the cross-passageway.

J-4.1.7 For open-cut trainways, an engineering analysis should be conducted to evaluate the impact of the trainway configuration on safe egress from a train fire to a point of safety.

J-4.1.8 Where the engineering analysis indicates that the configuration will impact tenability beyond the immediate vicinity of the fire, egress routes should be provided such that the maximum distance from any point within the open-cut section to a point of egress from the trainway should not be more than 380 m.

J-4.1.9 All the distances mentioned in J-4.1.3, J-4.1.5 and J-4.1.8 should be permitted with a maximum variation of $^{+10}_{-0}$percent.

J-4.2 Size of Egress Routes

J-4.2.1 Cross-passageways should be a minimum of 1 200 mm in clear width and 2 100 mm in height.

J-4.2.2 The width of exit stairs should not be required to exceed 1 200 mm for enclosed trainways.

J-4.2.3 If double leaf doors wider than 1 200 mm are provided in egress routes serving trainways, then size of active leaf should not be less than 810 mm.

J-4.3 Egress Components

J-4.3.1 Walking surfaces serving as egress routes within guide ways should have a uniform, slip-resistant design except as permitted herein:

a) Where the trainway track bed serves as the emergency egress pathway, it should be nominally level and free of obstructions.

b) Walkways that are more than 750 mm above the floor or grade below should be provided witha continuous handrail along the side opposite the trainway.

c) Raised walkways that are greater than 1 200 mm wide and located between two trainways should not be required to have a handrail.

d) Doors in the means of egress, except cross-passageway doors, should open in the direction of exit travel.

e) Doors in the means of egress should,

1) open fully when a force not exceeding 220 N is applied to the latch side of the door, and

2) be adequate to withstand positive and negative pressures caused by passing trains and the emergency ventilation system.

J-4.3.2 Horizontal sliding doors should be permitted in cross-passageways.

J-4.4 Signage, Illumination and Emergency Lighting

J-4.4.1 Warning signs posted on entrances to the trainway and on fences or barriers adjacent to the trainway

should clearly state the hazard (for example, DANGER: HIGH VOLTAGE, 25 000 V) with letter sizes and colours in conformance with requirements of *Metro Railway Rules*.

J-4.4.2 System egress points should be illuminated.

J-4.4.3 Points of exit from elevated and enclosed trainways should be marked with internally or externally illuminated signs.

J-4.4.4 Tunnel lighting should be 100 percent on emergency power source, that is, UPS. Minimum illumination of 10 lux should be maintained on tunnel egress routes. Emergency lighting should be powered from a source independent of that supplying the normal lighting.

J-4.4.4 *Identification*

Emergency exit facilities should be identified and maintained to allow for their intended use.

J-4.4.5 Enclosed trainways greater in length than the minimum length of one train should be provided with directional signs as appropriate for the emergency procedures developed for the metro system.

J-4.4.6 Directional signs indicating station or portal directions should be installed at maximum 25 m intervals on either side of the enclosed trainways.

J-4.4.7 Directional signs should be readily visible by passengers for emergency evacuation.

J-5 FIRE PROTECTION AND LIFE SAFETY SYSTEMS

J-5.1 Emergency Access

J-5.1 Except as described herein, points of egress and exits from the guide way should serve as emergency access routes.

J-5.2 If security fences are used along the trainway, access gates should be provided in security fences.

J-5.3 Access gates should be a minimum 1 200 mm wide and should be of the hinged or sliding type.

J-5.4 Access gates should be placed as close as practicable to the portals to permit easy access to tunnels.

J-5.5 Information that clearly identifies the route and location of each gate should be provided on the gates or adjacent thereto.

J-5.6 Access to the elevated trainway should be from stations or by mobile ladder equipment from roadways adjacent to the track way.

J-5.7 If no adjacent or crossing roadways exist for the elevated trainway, access roads at a maximum of 750 m intervals should be required.

J-5.8 Where the configuration of an open-cut trainway prevents or impedes access for firefighting, provisions should be made to permit fire fighter access to that section of trainway at intervals not exceeding 750 m.

J-5.9 All the distances mentioned in J-5.7 and J-5.8 above should be permitted with a maximum variation of $^{+10}_{0}$ percent.

J-5.10 Distance between Tunnel Hydrants

Double headed type hydrants should be provided inside tunnels.

a) The travel distance to tunnel hydrant should not be more than 30 m.

b) Tunnel hydrant should be installed on a pipe having diameter of not less than 100 mm.

J-6 EMERGENCY VENTILATION SYSTEM FOR TRAINWAY

J-6.1 General

J-6.1.1 The following defines the requirements for the mechanical ventilation systems used in passenger trainway area.

J-6.1.2 Mechanical emergency ventilation should be provided in underground or enclosed trainways exceeding 300 m.

J-6.1.3 *Exemption*

a) A mechanical emergency ventilation system is not required for underground or enclosed trainways at most 60 m in length.

b) An engineering analysis is required for underground or enclosed trainways more than 60 m in length but less than 300 m to determine if a mechanical emergency ventilation is required; and

c) Emergency ventilation meeting the tenability criteria for occupied areas should not be required in storage track area like stabling line, depot line, Y-siding, etc where the storage track has no openings along its length to passenger trainway areas and where a fire hazard analysis indicates that a fire on a train in the storage track area will not impact passengers or passenger areas.

J-6.1.4 *Engineering Analysis*

The analysis should take into consideration all the factors that affect fire safety. A report of the analysis should be submitted. If the engineering analysis is not carried out, then a mechanical ventilation system should be provided.

J-6.2 The engineering analysis of the emergency ventilation system should include the following:

a) A validated trainway analytical simulation program that provides a quantitative analysis of airflow dynamics produced in the fire scenario, a validated computational fluid dynamic (CFD) technique, or both, as approved; and

b) The no-fire (or cold) air velocities that can be measured during commissioning to confirm that a mechanical ventilation system as built meets the requirements determined by the analysis.

J-6.2.1 Where required by J-6.1.2, the mechanical ventilation system should make provision for the protection of passengers, employees, and emergency personnel from fire and smoke during a fire emergency.

J-6.3 Design

J-6.3.1 The emergency ventilation system should be designed to cater the following:

a) Provide a tenable environment along the path of egress from a fire incident in enclosed station and enclosed trainways;

b) Produce sufficient airflow rates within enclosed trainways to meet critical velocity;

c) Be capable of reaching full operational mode within 180 s;

d) Address the maximum number of trains that could be between ventilation shafts during an emergency; and

e) Maintain the required airflow rates for a minimum of 2 h.

J-6.3.1.1 Where the airflow rates required to accomplish J-6.3.1 (a), J-6.3.1 (b), or approved alternative performance criteria are dependent upon the unimpaired function of the air distribution system, that system should be designed to continue operation when exposed to the conditions generated during the design incident for the duration of 2 h.

J-6.3.1.2 Where the airflow rates required to accomplish J-6.3.1(a), J-6.3.1(b), or approved alternative performance criteria are dependent upon the continued integrity of structural and architectural features, those features should be designed to remain intact when exposed to the conditions generated during the design incident for the duration determined as per J-6.3.1(e).

J-6.3.2 *Additional Design Requirements*

The design should encompass the following:

a) The heat release rate from a vehicle and any other combustible materials (if permitted) in the trainways that could contribute to the fire load at the incident site, subject to the approval of the Metro Rail Administration;

b) The rate of fire growth

c) Fire scenarios and fire profiles.

d) Station and trainway geometries.

e) The effects of elevation, elevation differences, ambient temperature differences and ambient wind.

f) A system of fans, shaft and devices for directing airflow in stations and trainways.

g) Predetermined procedures for initiating quick response from the OCC/SCR during fire.

h) A ventilation system reliability engineering analysis that, as a minimum considers the following subsystems:

   1) Electrical;

   2) Mechanical; and

   3) Supervisory control.

j) Criteria for the system reliability analysis in **6.3.2** (h) should be established and approved.

k) The analysis should consider as a minimum of the following events:

   1) Fire in the trainway or station;

   2) Local incident within the electrical utility that interrupts power to the emergency ventilation system;

   3) Derailment; and

   4) The loss of a fan that results in the most adverse effect on the ventilation system performance.

J-6.3.3 The design and operation of the signalling system, and ventilation system should be coordinated to match the total number of trains that could be between ventilation shafts during an emergency.

J-6.3.4 Emergency ventilation air distribution system should be permitted to serve more than one trainway.

J-6.4 Emergency Ventilation Fans

a) The emergency ventilation system fans that are designated for use in fire and similar emergency should be capable of satisfying the emergency ventilation requirements to move train-way air in directions to provide the needed ventilation response as per engineering analysis.

b) Individual emergency ventilation fan motors should be designed to achieve their full operating speed in no more than 30 s from a stopped position when started across the line and in no more than 60 s for variable speed motors.

c) Emergency ventilation fans, their motors, and all related components exposed to the exhaust airflow should be designed to operate at 250 °C for a minimum of 2 h.

d) Local fan motor starter and related operating control device should be located away from the direct airstream of the fans to the greatest extent practical.

e) Thermal overload protective devices in fan motors, damper motors, or on motor controls used for emergency ventilation should not be permitted.

f) Non-emergency ventilation airflows that do not impact the emergency ventilation airflows should be permitted to be left operational where identified in the engineering analysis.

g) The ventilation system designated for use in emergencies should be capable of operating at full capacity in either the supply mode or exhaust mode to provide to provide the needed ventilation response where dilution of noxious products is to be maximized.

h) The ventilation system designated for use in emergencies should be capable of being turned off and dampers closed to provide the needed ventilation response where dispersion of noxious products is to be minimized.

j) Fan should be rated in accordance with the ANSI/AMCA 300, AMCA 250/ISO 13350, ASHRAE Handbook-Fundamentals, ISO 5801, and ASHRAE 149.

k) Fans that are associated only with the passengers or employee comfort and that are not designed to function as a part of emergency ventilation system should shut down automatically on identification and initiation of a fire emergency ventilation program so as not to jeopardize or conflict with emergency airflows.

J-6.5 Airflow Control Devices

a) Devices that are interrelated with the emergency ventilation system and that are required to meet the emergency ventilation system airflow should be structurally capable of withstanding both maximum repetitive and additive piston pressure of moving trains and emergency airflow velocities.

b) Devices in the emergency ventilation system that are exposed to the exhaust airflow and are critical to the system's effective functioning in the event of an emergency should be constructed of materials suitable for operation in an ambient atmosphere at the design condition of 250 °C for 2 h.

c) Finishes applied to non-combustible devices should not be required to meet the provisions of **J-6.5(b)**.

d) Other devices should be designed to operate throughout the anticipated temperature range. Over current elements in devices or on device controls required to support the emergency ventilation should not be permitted where such over current elements are subject to false operation due to exposure to elevated temperatures during a fire emergency.

K-6.6 Testing

a) Equipment used for emergency ventilation (including fans, dampers and airflow control devices and associated electrical equipment) should be approved in accordance with the requirements of a recognized standard for the type of equipment to be installed and should be factory acceptance tested.

b) The non-fire (or cold) airflows provided by the installed mechanical ventilation system should be measured during commissioning to confirm that the airflow meets the requirement determined by the engineering analysis.

L-6.7 Emergency Ventilation Openings

a) Emergency ventilation openings should be positioned or designed to minimize recirculation of smoke into the station or enclosed trainway through any openings, such that a tenable environment is maintained along the path of egress for the time of tenability and as required for designated points of safety.

b) Adjacent structures and property uses should also be considered.

M-6.8 Emergency Ventilation System

a) Operation of the emergency ventilation system should be initiated from the operations control centre.

b) The operations control centre should receive verification of proper response by emergency ventilation fan(s) and an interrelated device(s).

c) Local controls should be permitted to override the operations control centre becomes inoperative or where the operation of the emergency ventilation system is specifically redirected to another site.

N-6.9 Power Supply for Emergency Ventilation System

a) The design of the power for the emergency ventilation system should comply with the requirements of **H-8** of this Part.

b) Overcurrent elements that are designed to protect conductors serving motors for both emergency fans and related emergency devices should not be permitted where such overcurrent elements are subject to false operation due to exposure to elevated temperatures during a fire emergency. All other motor and

fan protection device should be bypassed during a fire emergency, except for motor overcurrent and excessive vibration.

c) The emergency ventilation circuits routed through the station public areas and trainway should be protected from physical damage by fixed guideway transit or passenger rail vehicles or other normal operations and from fire.

J-6.10 Critical Velocity

a) The minimum steady-state velocity of the ventilation airflow moving toward the fire within an enclosed trainway or enclosed passageway that is required to control back layering at the fire site, such that a tenable environment is maintained along the path of egress upstream of the fire, and as required for designated points of safety.

b) The equation for critical velocity is as follows:

$$V_c = K_1 K_g \left(\frac{gHQ}{\rho C_\rho A T_I}\right)^{\frac{1}{3}}$$

$$T_\mathrm{f} = \left(\frac{Q}{\rho C_\rho A V_c}\right) + T$$

$$K_\mathrm{g} = \{1 + 0.0374\,(G)^{0.8}, 1, \begin{matrix} G < 0 \\ G \geq 0 \end{matrix}$$

where

V_c = critical velocity (m/s or fpm)

A = the annulus area (not including the area of blockages, such as vehicles) perpendicular to the flow (m^2 or ft^2)

C_p = the specific heat of the air (kJ/kg/K or Btu/lb/R)

g = acceleration due to gravity (m/s^2 or ft/s^2)

G = absolute value of tunnel grade, as a percent

K_g = grade factor

H = height from the base of the fire to the tunnel ceiling at the fire site (not tunnel height) (m or ft)

K_1 = Critical Froude number factor with a constant value of 0.606 (critical Froude number of the negative one-third power)

ρ = average density of the approach (upstream) air (kg/m^3 or lb/ft^3)

Q = convective heat the fire adds directly to the air at the fire site (kW or Btu/s)

T = temperature of the approach air (K or R)

T_f = Average temperature of the fire site gases (K or R)

ANNEX K

(*Clause* 6.7.3)

FIRE PROTECTION CONSIDERATIONS FOR VENTING IN INDUSTRIAL BUILDINGS

K-1 APPLICATION

K-1.1 The provisions given below are applicable only to single storey industrial buildings (factories and storage buildings) covering large floor areas without sub-dividing/separating walls which are usually designed to meet modern production methods.

K-1.2 The requirements of fire and explosion venting of industrial buildings, as dealt with in this section, fall under two categories:

a) Smoke and fire venting; and

b) Explosion relief vents.

K-2 SMOKE AND FIRE VENTING

K-2.1 The basic considerations for formulating the design and other requirements for smoke and fire vents are as given in **K-2.1.1** to **K-2.1.20**.

K-2.1.1 The smoke and hot combustion products from a fire, being lighter than the surrounding air, tend to rise, and on reaching the roof or ceiling spread out (mushroom) on all sides and form a layer which floats on top of the cold air beneath. In the absence of vents, this layer becomes progressively deeper until the whole building is filled with hot smoky gases. The time consumed for this to happen may be only a few minutes, depending on variables like, type of materials on fire, process/storage conditions involved, etc.

K-2.1.2 The hot gases at the roof level moved by convection currents contribute to rapid lateral spread of fire.

K-2.1.3 The provision of properly designed and suitably located vents in adequate number helps the speedy removal of smoke and hot gases, thereby preventing spread of fire, besides reducing risks of explosion of unburnt gases, and reducing damage to the contents and structure of the building by heat and smoke. In addition, they facilitate firefighting operations, and minimize personal hazards to the firemen.

K-2.1.4 The time taken for accumulation of smoke and hot gases within a building on fire being very short, the venting devices installed should be designed to operate in the early stage of the fire and must be automatic so as to ensure speed and efficiency in their operation.

K-2.1.5 The smoke and fire venting system should be designed in such a manner as to keep the temperature of the combustion products from the fire as low as possible, preferably below approximately 150 °C.

K-2.1.6 Automatic venting systems are complementary to the fire extinguishing systems, and automatic sprinklers, where provided, should operate before the operation of the vents; otherwise, venting may delay sprinkler operation.

K-2.1.7 It is easier to vent a building of smoke than clear it of smoke once it has been filled.

K-2.1.8 Venting is particularly desirable in large area industrial buildings or warehouses, windowless buildings, underground structures or in areas housing hazardous operations. Automatic fire vents should be provided for all industrial occupancies (including storage buildings) classified as medium hazard or above having floor areas exceeding 750 m^2, irrespective of whether they are compartmentalized or not.

K-2.1.9 These provisions do not cover other aspects, of ventilation (or lighting) designed for regulation of temperature within a building for personal comfort or meeting process needs.

K-2.1.10 Similarly, fire and smoke venting requirements as given here under are also not applicable to multi-storeyed buildings, as their requirements are different and more complex.

K-2.1.11 It is difficult to determine precise venting requirements on account of the many variables involved. For instance, the rate of combustion varies appreciably according to the nature, shape, size, and packaging of the combustible materials as well as the size, height, and disposition of the stacks of materials.

K-2.1.12 In industrial buildings of floor area less than 750 m^2 and used as low fire hazard occupancies, conventional ventilators fitted high up near the eaves of the external walls may serve as vents for smoke and hot gases, provided care is taken to ensure that they are kept open at all times or are designed to open automatically in case of fire.

K-2.1.13 Extinction of fires by closing the doors and windows is not likely in the case of industrial buildings because of their large size, where sufficient air to sustain the fire at least in the initial stages can be expected to be present.

K-2.1.14 Of the two types of building ventilation, namely, vertical, and horizontal, vertical ventilation is the one commonly adopted in the case of single storey industrial buildings.

K-2.1.15 Since 70 percent to 80 percent of heat produced in a fire is convective heat, the ventilation system has to be suitably designed to ensure early outflow of the heat and thereby minimize fire spread.

K-2.1.16 Combustible roof linings should be avoided, as they themselves will contribute to the spread of fire, thereby multiplying the venting problems.

K-2.1.17 A wind blowing across a flat roof or a roof with a pitch under 40° produces a negative pressure, that is, it tends to draw gases out of the building and so aids venting of hot gases. Wind blowing across a roof of pitch greater than 40° will draw gases out on the leeward side, but oppose outward flow on the windward side of the roof.

K-2.1.18 For vents to work at full efficiency, the area of the inlets for cold air entering the compartment must equal at least the total area of the vents. Ideally, the inlets should be as close to the ground as possible.

K-2.1.19 Where roof vents are installed in a single-storey building any neighbouring buildings, particularly those of more than one storey, will be subject to some degree of exposure hazard either from flying birds or radiation, or both, as a result.

K-2.1.20 If vents are to be installed, the size, design, number and disposition of the vents and the associated roof screens/curtain boards have to be assessed after careful analysis of the various factors stated under **K-2.1.11**, as well as other related factors like type of building construction, nature and height of roof, process hazards, exposure hazard, etc.

K-2.2 Venting Area

K-2.2.1 The estimated requirements for ventilation are largely based on the assumed build-up of the fire from the time of initial outbreak to the time of effective firefighting action by fire brigade.

K-2.2.2 The vent area required to be provided should be approximately proportional to the perimeter of the fire area, because the entrained air forms the bulk of the vented gases.

K-2.2.3 The effective area should be the minimum cross-sectional area through which the hot gases must flow out to the atmosphere.

K-2.2.4 No consideration should be given to the increased air movement obtained by power operated fans, since it must be assumed that in the event of fire, power will be interrupted, or fans damaged by heat.

K-2.2.5 The total vent areas to be provided should be as per the following ratios of effective area of vent openings to floor area for various occupancy classifications indicated:

a) Low heat release content (Sub-division G-1) — 1 : 150

b) Moderate heat release content (Sub-division G-2) — 1 : 100

c) High heat release content (Sub-division G-3) — 1 : 30 to 1 : 50

K-2.3 Types of Vents

K-2.3.1 Venting should be accomplished by any of the types such as monitors, continuous gravity vents, until type vents or sawtooth roof skylights.

K-2.3.2 Where monitor type vents are installed, wire glass or metal panels should be used only if the sash is arranged to open automatically.

K-2.3.3 The use of plain thin glass for venting should be avoided on account of its unpredictable behaviour during fire. However, if glass or other suitable plastic sheet materials with early disintegration characteristics are used, they should be designed for automatic operation.

K-2.3.4 Where monitors or unit type vents are used, the panels should be hinged at the bottom and designed to open automatically. Both sides of the vents should be designed to vent simultaneously to ensure that their effectiveness at the time of fire is not in any way impeded by wind direction.

K-2.3.5 Where movable shutters are provided for continuous gravity vents, these should open automatically in the event of fire.

K-2.3.6 Unit type vents should be of relatively small area, ranging between 1 m^2 and 9 m^2, having light weight metal frames and housing with hinged dampers which should be designed for both manual and automatic operation.

K-2.3.7 Sawtooth roof skylight should be considered as satisfactory for venting purposes only when designed for automatic operation.

K-2.3.8 Likewise, exterior wall windows should not be reckoned as satisfactory means for venting of fire gases and smoke in industrial buildings. However, they may be reckoned as additional means of venting when, they are located close to the eaves and are provided with ordinary glass or movable sash arranged for both manual and automatic operation.

K-2.3.9 Baffles should not be installed inside vents, as they greatly reduce the effective area for venting.

K-2.4 Vent Operation

K-2.4.1 The vents should be automatic in operation, unless where specified in these provisions that they should be designed for both manual and automatic operation.

K-2.4.2 The release mechanism should be simple for operation and independent of electrical power since electrical services may be interrupted by fire.

K-2.4.3 The automatic operation of vents should be achieved by actuation of fusible links or other types of heat and smoke detectors, or by interlocking with operation of sprinkler system or any other automatic fire extinguishing system covering the area. Following their release, the vents should be designed to open by a system of counterweights and associated equipment utilizing the force of gravity or spring loaded levers.

K-2.4.4 Automatic fire alarm system, where installed, should be coupled to the automatic vents to ensure simultaneous operation.

K-2.4.5 Automatic sprinklers, where installed, should operate before the vents open in order to avoid any likely delay in sprinkler operation. However, heat actuated devices used for vent release should be suitably shielded from sprinkler discharge so that water does not delay their action. Further, provision of operating the vents manually may also be provided.

K-2.4.6 Premises where height of roof apex is 10 m or more or where the materials handled or stored have high smoke producing characteristics, in addition to fusible links, the vent release mechanism should be interlinked to smoke actuated automatic fire detectors to ensure early operation of vents.

K-2.4.7 Non-corrosive materials should be used for hinges, hatches and other related parts to ensure long fail-safe operation of the vents.

K-2.4.8 In case of any doubts regarding the types of vents required to be installed for any particular occupancy, authorities having jurisdiction should be consulted.

K-2.5 Size, Spacing and Disposition of Vents

K-2.5.1 Vents should be correctly sited to ensure their functional efficiency. Ideally, they should be sited at the highest point in each area to be covered.

K-2.5.2 They should, as far as possible, be located immediately above the risk to be protected so as to allow free and speedy removal of smoke and other combustion products in the event of fire.

K-2.5.3 The minimum dimension for an effective vent opening should be not less than 1.25 m in any direction.

K-2.5.4 The spacing of the individual vent should be based on the principle that more number of well distributed smaller vents are more effective than fewer number of badly located larger vents.

K-2.5.5 The maximum spacing between vents for the three occupancy classifications should be as follows:

a) Low heat release content : 45 m between content centres

b) Moderate heat release content : 36 m to 37 m between release content centres

c) High heat release content : 22.5 m to 30 m between content centres, depending on the severity of fire potential.

K-2.5.6 Vents should be placed in a sheltered situation where advantage can be taken of the prevailing wind. The design of the vent should be such as to produce a suction effect. A wind blowing across a flat roof or one with a pitch of 40° produces a negative pressure, that is, it tends to draw gases out of the building and so aids venting of hot gases. Wind blowing across a roof of pitch greater than 40° will draw gases out of the leeward side, but oppose outward flow on the windward side of the roof.

K-2.5.7 Low level inlets, with total area not less than the total area of vents, should be provided to permit outside air to be drawn in to aid automatic venting. These inlets, which may be in the form of doors, windows, or such other openings, should be designed for manual operation when desired.

K-2.6 Roof Screens or Curtain Boards

K-2.6.1 Industrial buildings with large areas and having no subdivision/separating walls limiting the area of individual compartments to 750 m^2 or less, should be provided with roof screens or curtain boards.

These screens which extend from the roof downwards at specific intervals not only prevent lateral spread of heat and smoke in the event of fire below, but substantially assist in early operation of automatic sprinklers and vents.

K-2.6.2 They should be of sheet metal or any other substantially non-combustible material strong enough to withstand damage by heat or impact.

K-2.6.3 They should be reasonably gas-tight, although small openings for passage of pipes, conduits, etc, should be permitted.

K-2.6.4 They should extend down from the roof/ceiling for a minimum depth of 2.2 m. Around specific hazards, the depth should be 4 m. Where roof/ceiling height exceeds 15 m they should extend down to within 3 m of the floor. For pitched sawtoothed roofs, they should extend down to truss level dividing the roof into compartments.

K-2.6.5 In moderate hazard occupancies, the distance between the screens/curtain boards should not exceed 75 m and the curtained areas should be limited to a maximum of 4 500 m^2.

K-2.6.6 In high hazard occupancies, the distance between screens should not exceed 30 m and the curtained area should be limited to 750 m^2.

K-2.6.7 The curtained roof area should be so arranged that they effectively aid in the venting of smoke and hot gases through the automatic vents provided in each area.

K-2.6.8 In sprinklered buildings, the screens should preferably be so located as to coincide with the individual sprinkler system areas.

K-3 EXPLOSION RELIEF VENTS

K-3.1 Industrial premises where combustible dusts can accumulate or where flammable gases, vapours or mists in explosive concentrations may be present are constantly exposed to explosion hazards. Pressures developed by such explosions may be of the order of 7×10^5 Pa and ordinary buildings will not be able to withstand the shock of such pressures. Hence, such buildings require explosion relief vents for preventing structural damage.

K-3.2 Basic Principle/Considerations

K-3.2.1 Most ordinary building walls will not withstand a sustained internal pressure as great as 6.9×10^3 Pa. Hence, explosion relief vents for buildings must be designed to operate at pressures well below those at which the building walls will fail.

K-3.2.2 There is a rise in pressure during an explosion within an enclosure even with open, unobstructed vents, and any delay in opening the venting devices increases that pressure.

K-3.2.3 Structural damage can be minimized by locating hazardous operations or equipment outside buildings and cut-off from other operations by a pressure resisting wall. Such isolated processes or equipment should be housed in single-storey buildings properly vented and a device provided at the inlet of the collector which will prevent an explosion from blowing back through the duct work and into the building.

K-3.2.4 Where highly hazardous operations cannot be located outside of main buildings, they should be segregated by pressure resisting walls and each such unit should be ventilated outdoors. External walls may be of heavy construction, if equipped with suitable vents or high weight panels which blow out easily.

K-3.2.5 Operations or equipment involving explosion hazards should not be permitted in basements or areas partially below grade.

K-3.2.6 Fire can be expected to follow an explosion in most occupancies, so that any fixed fire extinguishing equipment, like sprinklers, if installed, should be such that only the minimum damage is caused to it.

K-3.2.7 For a given material, the finer the particle size of the dust, the more violent is the explosion. Some materials, such as aluminium powder, hydrogen, and acetylene, are difficult to vent effectively due to the rapid rate of pressure rise. Some slow burning materials, such as coal dust in a confined space, may do much damage because of the longer duration of their presence. Some dusts, such as magnesium, titanium and zirconium and several metal hydrides may react with and ignite in some common inert gases, such as nitrogen and carbon dioxide.

K-3.2.8 The maximum explosion pressure in a vented structure decreases as the size of the vent increases but is independent of the rupturing pressure of a diaphragm.

K-3.2.9 The most effective vent for the release of explosion pressures is an unobstructed vent opening.

K-3.2.10 Pressure required to rupture diaphragms of the same area and material directly varies with the thickness of the material.

K-3.2.11 The slower the rate of pressure rise, the more easily can the explosion be vented.

K-3.2.12 The degree of venting required is directly proportional to the degree of explosion hazard.

K-3.2.13 Experience has shown that most explosions of dusts, vapours and gases do not involve a large part of the total volume of the enclosure, and frequently occur near the upper or lower limits of the explosive range. Consequently, such explosions are relatively weak compared with the optimum.

K-3.2.14 Rectangular unrestricted vents are as effective as square vents of equal area.

K-3.3 Types of Explosion Relief Vents

K-3.3.1 The explosion relief vents should be any one or more of the following types, depending on individual requirements as assessed by the Authority. Open or unobstructed vents, louvres, open roof vents, hanger type doors, building doors, windows, roof or wall panels or movable fixed sash.

K-3.3.2 The effect or external wind pressure or suction on these devices should be taken into consideration while designing and selecting the type of vents, since wind pressures may reach over 2×10^5 Pa in severe windstorms.

K-3.3.3 The type of vent for explosion relief for any occupancy should be selected with life safety as the primary aim followed by minimum damage to property.

K-3.3.4 Where large hanger type doors of metal curtain doors inside walls are used as vents, care should be taken to ensure that they are kept wide open during operations.

K-3.3.5 Where weather hoods are used to cover roof vents, they should be as light as possible and lightly attached so as to enable them to be blown off quickly when an explosion occurs.

K-3.3.6 Doors and windows when used as explosion vents should be installed to swing outwards. Doors should have friction, spring or magnetic latches that will function automatically to permit the door to open under slight internal pressure.

K-3.3.7 Movable sash should be of the top or bottom hinged or protected type. These should be equipped with a latch or friction device to prevent accidental opening due to wind action or intrusion. Such latches or locks should be well maintained.

K-3.3.8 Fixed sash should be set in place with very light wall anchorages, or, if tight, should be securely fitted and glazed with plastic panes in plastic putty.

K-3.3.9 Where the process is such that the whole of a building or a room may be desirable to arrange for a lightly constructed wall or roof to collapse and thus avert the worst effects of an explosion.

K-3.4 Design, Size and Disposition of Vents

K-3.4.1 The required area of explosion vents should ordinarily depend on the expected maximum intensity of an explosion in the occupancy, the strength of the structure, the type of vent closure and other factors.

K-3.4.2 Venting should be planned in such a manner as to prevent injury to personnel and damage to exposure. In congested locations, substantial ducts or diverters should be provided to direct the blast.

K-3.4.3 When ductwork is used, the ducts should be of sufficient strength to withstand the maximum expected explosion pressure.

K-3.4.4 Where explosions are likely within duct and piping systems, they should be vented by the use of suitable diaphragms designed to blow out at a predetermined pressure. There should be no physical connection between ductwork system for more than one collector.

K-3.4.5 In large structures, the position of vents should be relative to the point of origin of explosion, when it can be determined.

K-3.4.6 Where relatively slow explosions involving coal dust, chlorinated solvents, etc are involved, light, hinged swinging panels may be preferred to diaphragm type of vents.

K-3.4.7 Obstructions of any kind blocking the vents from the risk covered should be avoided, particularly where risks of rapid violent explosions are present.

K-3.4.8 Counterweights add to the inertia of the vents and so should be avoided.

K-3.4.9 Various relieving devices, including devices actuated by detonators, should start to open at as low a pressure as possible. They should be of light construction, so that full opening can be quickly attained.

K-3.4.10 Vents should be of such size and design as to prevent rupture of the protected device or apparatus.

K-3.4.11 Skylights or monitors with movable sash that will open outwards, or fixed sash containing panes of glass or plastic that will blow out readily under pressure from within, can be used to supplement wall vents or windows, provided resistance to their displacement or opening is kept as low as consistent with the requirements for structural strength.

K-3.4.12 Flexible plastic sheets when used for vent closures should be installed in slotted frames in such a way that pressure from within bulges the sheets and releases them from the holding frame.

K-3.4.13 Fragile sheets made of plastic, when used for vent closures, should be thin sheets that will crack or rupture under less pressure, than single strength glass. For this reason, use of transparent or translucent plastic sheets is more advantageous than use of glass in window sash.

K-3.4.14 If closed vents are used, they should be larger in area than unenclosed vents to provide equivalent explosion pressure relief.

K-3.4.15 Small enclosures, such as machines, should be vented more generously than buildings, because if an explosion occurs in a machine, its entire volume may be involved.

K-3.4.16 Vents for the protection of buildings and equipment should be installed on the following basis:

a) Small enclosures of less than 30 m^3, machines and ovens of light construction: 1 000 cm^2 for each 0.3 m^3 to 0.9 m^3.

b) For small enclosures of more substantial construction having reasonably high bursting strength: 1 000 cm^2 for each 0.9 m^3.

c) Fairly large enclosures of 30 m^3 to 700 m^3, such as bins, silos, rooms, storage tanks, etc: 1 000 cm^2 for each 0.9 m^3 to 1.5 m^3. In these cases, attempt should be made to the extent possible to predict the likely point of origin of the explosion in relation to the vent.

d) Large rooms and buildings over 700 m^3 containing hazardous equipment comprising a small fraction of the entire volume:

   1) For heavy reinforced concrete, walls: 100 cm^2 for each 2.25 m^3.

   2) For light reinforced concrete, brick, or wood construction: 1 000 cm^2 for each 1.65 m^3 to 2.25 m^3.

   3) For lightweight construction such as prefabricated panels: 1 000 cm^2 for each 1.5 m^3 to 1.65 m^3.

e) Large rooms or building over 700 m^3 containing hazardous equipment comprising a large part of the entire volume of a room or building should be vented as generously as possible: 1 000 cm^2 for each 0.3 m^3 to 1.05 m^3.

f) In order to obtain these ratios, the size of the building or room must be limited. For some hazardous materials, such as hydrogen, acetylene, carbon disulphide, etc, these limits are extremely low.

g) Emphasis should always be placed on segregating hazardous areas by means of firewalls or separating walls to prevent spread of fire.

h) Interior walls of light construction, such as tile, should be avoided in hazardous locations since they can cause injuries to personnel in the event of an explosion.

ANNEX M

(*Clause* 1.4)

PERFORMANCE BASED DESIGN

M-1 GENERAL

M-1.1 Performance based design may be applicable under following conditions to any occupancy, subject to:

a) Approval from state/local authority, where they have resource (local/shared/outsourced) to evaluate a performance-based design for any building;

b) The performance-based design should meet the goals and objectives of this Annex and should be carried out by a registered professional;

c) The local authority having jurisdiction should make the final determination whether the performance objectives have been met; and

d) All necessary documentation as per this annex pre- and post-construction should be part of the submission and should be retained during the entire life of the building.

M-1.2 The provisions of this Annex provides performance based design (PBD) which is applicable only to validate the fire safety aspects for heritage buildings (constructed well before the first version of NBC) that are either made available to public or are converted to other building occupancy (and constrained to add additional staircase/refuge that damages it heritage nature).

The Authority may exempt compliance (of such heritage buildings as above constructed before the publication of the first NBC) with the relevant requirements in this NBCS, if the alternate design(s) proposed based on performance-based solutions duly validated by engineering calculations/computational fluid dynamics (CFD)

modelling, achieve the objectives.

PBD is an engineering approach to fire protection design based on (1) agreed upon fire safety goals and objectives, (2) deterministic and/or probabilistic analysis of fire scenarios, and (3) quantitative assessment of design alternatives against the fire safety goals and objectives using accepted engineering tools, methodologies, and performance criteria.

M-1.3 The application of performance-based fire engineering is highly individualized, excluding its universal adoption across different structures. Due to its reliance on custom-built environmental and occupancy variables, any implementation should undergo a unique validation process by the relevant jurisdiction.

Implementing a performance-based approach necessitates a rigorous assessment of site-specific data to ensure all fire dynamics calculations reflect the unique hazards of the structure. The proponent is responsible for establishing safety parity with prescriptive standards through quantitative evidence. Due to the sophisticated nature of computational fluid dynamics (CFD) modelling, an independent technical audit is recommended to validate the integrity of the design's assumptions and outcomes.

The implementation of PBD requires a multilateral agreement on risk thresholds involving all key stakeholders, including the authority having jurisdiction (AHJ). Due to the sophisticated nature of these designs, specialized fire science expertise is mandatory to ensure that the transition from a theoretical model to a specific environment is technically sound.

NOTE — Computational models, particularly CFD simulations, should be recalculated to reflect the unique spatial geometry and airflow dynamics of the site. Also, the analysis must incorporate local emergency response variables, ensuring the design aligns with the actual equipment and arrival times of the area's fire services.

M-2 MINIMUM CRITERIA

M-2.1 The minimum criteria to accept the PBD solutions should be the compliance to the following:

a) Safe egress (ASET > RSET) through validated evacuation modelling.

b) Controlled fire and smoke spread, maintaining tenable conditions; and

c) Reliable fire suppression and detection exceeding the minimum requirements of this Part.

NOTE — ASET = Available Safe Egress Time; and RSET = Required Safe Egress Time

M-2.2 Tenability refers to the conditions within a space that allow occupants to survive and potentially evacuate safely during a fire. Various factors contribute to tenability, and recommendations suggested is limiting the exposure to the most life-threatening hazards. Thus, to ensure occupant safety in fire scenarios, maintaining tenability criteria at a height of 1.8 m from the floor level is a crucial consideration.

Where possible, the toxicity effects (life threatening hazard) is arrived by obtaining the amount of fractional effective dose (FED) of asphyxiant gases (like, carbon monoxide, hydrogen cyanide); and fractional effective concentration (FEC) of the irritant gases (like, HCl, NO, SO_2). The requirements are:

a) Maintaining FED < 0.3 (recommended to prevent incapacitation of sensitive individuals); and

b) Maintaining FEC < 0.3 (recommended).

FEC is used to assess the combined effect of multiple irritant gases (present in the fire effluent) expressed as:

$$FEC = \sum(Ci/Fi)$$

where

Ci = the concentration of each individual irritant gas (i).

Fi = the concentration of that specific irritant gas (i) that is expected to cause a significant reduction in the possibility of escape and survivability. These Fi values are typically based on experimental data and toxicological studies.

NOTE — Specialist literature be referred to obtain the values of Fi.

M-2.3 In addition, the following thermal exposure limits are recommended:

a) *Convective Heat Exposure* — Air temperature should not exceed 60 °C to prevent heat stress; and

b) *Radiant Heat Exposure* — Maintain below 2.5 kW/m² to avoid skin burns and incapacitation.

M-2.4 Also, the visibility through smoke criteria is essential and the same is suggested as minimum visibility of 5 m to 10 m should be maintained for safe evacuation and wayfinding.

M-2.5 The PBD involves iterative process in arriving at the desired outcome. *See* Fig. 23 for the typically accepted flowchart.

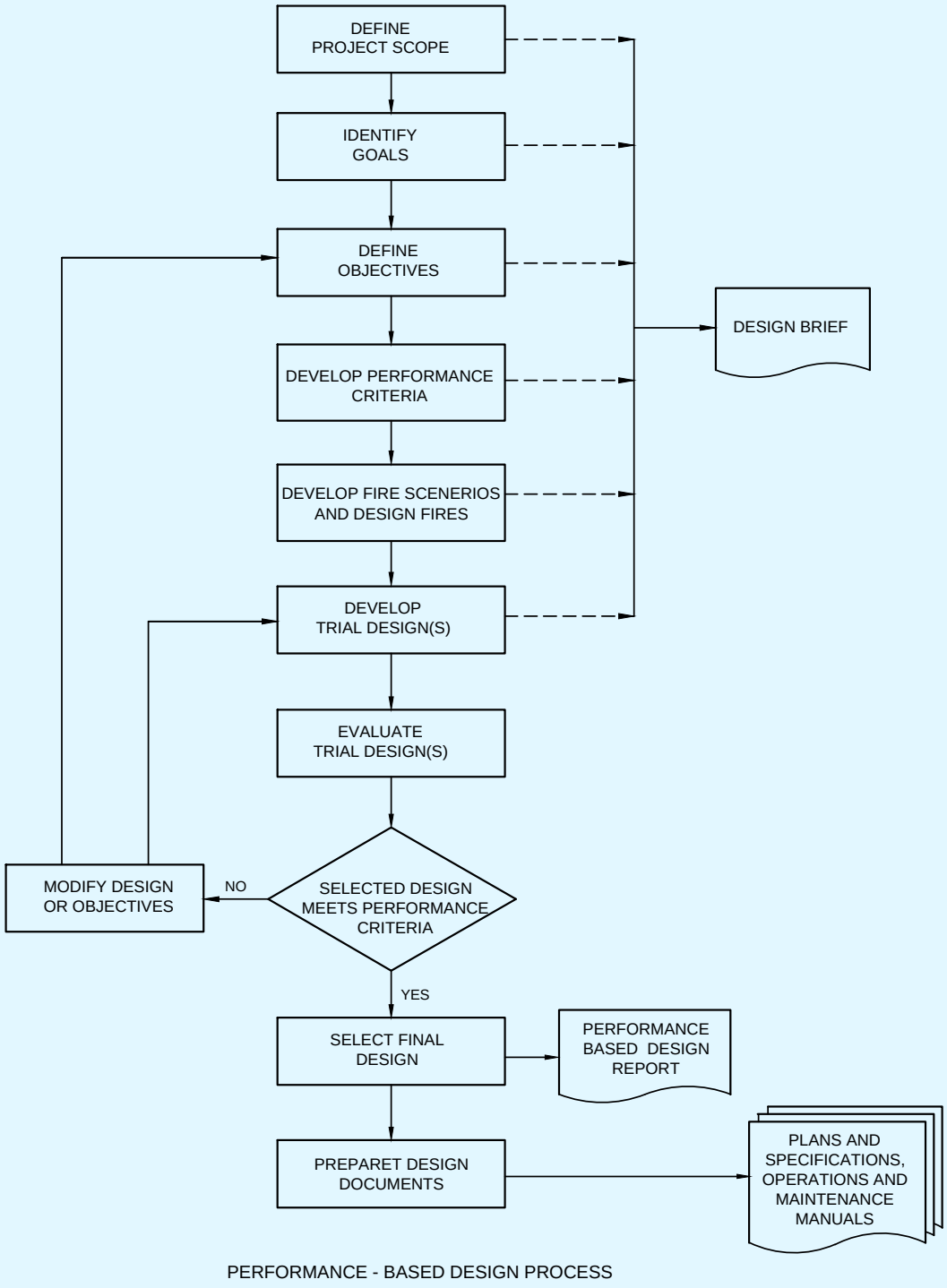


FIG. 23 FLOWCHART DEPICTING THE PROCESS IN PERFORMANCE BASED DESIGN

ANNEX N

(*Table* 7G)

(*Informative*)

SUGGESTED REQUIREMENTS OF FIRE PROTECTION FOR SPECIFIC INDUSTRIES
(Supplementary to Table 7G)

Sl No.	Type of Factory	Type of Installation								Recommended Water Supply litre		Recommended Pump Capacity litre per minute
		Extinguisher	Small Bore Hose Reels	Wet Riser	Down Comer	Yard Hydrant	Automatic Sprinkler System	Manual Fire Alarm System	Automatic Fire Detection & Alarm System	Static Tank at Ground Level	Overhead / Terrace Tank	Fire Pump Ground Level
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Minimum Firefighting Requirements for Factories/Industries – LOW HAZARD (Notes 1, 2a, 3, 4, 5 and 13)												
i)	Artisans workshops, village and cottage industries, tiny sector industries (duly licensed by the Govt. of India)	R	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
ii)	Aggregate built-up area less than 500 m^2	R	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
iii)	Aggregate built-up area from 500 m^2 to less than 1 500 m^2	R	R	NR	NR	NR	NR	NR	NR	15 000	5 000 (Note 12)	R (Note 7a)
iv)	Aggregate built-up area from 1 500 m^2 to less than 2 500 m^2	R	R	NR	NR	NR	NR	NR	NR	25 000	5 000 (Note 12)	R (Note 7a)

Sl No.	Type of Factory	Type of Installation								Recommended Water Supply litre		Recommended Pump Capacity litre per minute
		Extinguisher	Small Bore Hose Reels	Wet Riser	Down Comer	Yard Hydrant	Automatic Sprinkler System	Manual Fire Alarm System	Automatic Fire Detection & Alarm System	Static Tank at Ground Level	Overhead / Terrace Tank	Fire Pump Ground Level
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
v)	Aggregate built-up area more than 2 500 m^2	Pl. see Appendix "1" and also Notes 8, 9, 10 and 11										
Minimum Firefighting requirements for Factories/Industries – ORDINARY HAZARD (Notes 1, 2b, 3, 5 and 13)												
vi)	Aggregate Built-up area less than 500 m^2	R	R	NR	NR	NR	NR	NR	NR	20 000	5 000 (Note 12)	R (Note 7a)
vii)	Aggregate Built-up area from 500 m^2 to less than 1 500 m^2	R	R	NR	NR	R	NR	NR	NR	40000	10 000 (Note 12)	R (Note 7b)
viii)	Aggregate Built-up area from 1 500 m^2 to less than 2 500 m^2	R	R	R	R	R	NR	R	R	60 000	15000 (Note 12)	R (Note 7c)
ix)	Aggregate Built-up area more than 2 500 m^2	Pl. see Appendix "2" and also Notes 8, 9, 10 and 11										
Minimum Firefighting requirements for Factories/Industries – High Hazard 'A' (Notes 2c, 5 and 13)												
x)	Aggregate built-up area less than 1 000 m^2	R	R	R	R	R	R	R	R	75 000	10 000 (Note 12)	R (Note 7d)

Sl No.	Type of Factory	Type of Installation								Recommended Water Supply litre		Recommended Pump Capacity litre per minute
		Extinguisher	Small Bore Hose Reels	Wet Riser	Down Comer	Yard Hydrant	Automatic Sprinkler System	Manual Fire Alarm System	Automatic Fire Detection & Alarm System	Static Tank at Ground Level	Overhead / Terrace Tank	Fire Pump Ground Level
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
xi)	Aggregate built-up area from 1 000 m^2 to less than 2 500 m^2	R	R	R	R	R	R	R	R	1 00 000	15 000 (Note 12)	R (Note 7d)
xii)	Aggregate built-up area more than 2 500 m^2	Pl. *see* Appendix '3' and also Notes 8, 9, 10 and 11										
Minimum Firefighting requirements for Factories/Industries – High Hazard "B" (Notes 2c and 6)												
Please *see* Appendix '4' and also Notes 8, 9, 10 and 11												
Firefighting provisions should comply with various provisions contained in Note 8. In addition, all factories/industries should be protected as per the applicable standards like oil industry safety directorate (OISD) or others as specified in Note 6.												
R - Required. NR - Not Required.												

NOTES

1 The aggregate built up area of all floors of the facility could be a process building or a storage, a utility building or open storage and any other facilities as the case may be.

2a Buildings above 9 m are not permitted for factories/industries mentioned in Sl No. 1, 2 and 3 of low hazard of Annex 'A' Table.

2b Buildings/Plants above 18 m in height are not permitted for factories/industries mentioned in Sl No. 1 to 4 of ordinary hazard of Annex 'A' Table. However, where nature of process within the Plants demand heights beyond 18 m (for example, where there are tall machinery, vessels, columns, reactors, etc are involved) and occupant load is less (for example, power plants, boiler installations, etc), increase in heights can be allowed. Non-industrial occupancies within the complex but beyond operational area such as offices, residential and the like should comply with respective provisions in this NBCS according to the occupancy.

2c Buildings/plants above 15 m in height are not permitted for high hazard factories/industries. However, where there are vessels, columns, reactors, etc, are involved and specifically related to the process requirements, the heights can be more than 15 m. However, where nature of process within the building/plants demand heights beyond 15 m (for example, where there are tall machinery, vessels, columns, reactors, etc are involved) and occupant load is less (for example, power plants, boiler installations, etc), increase in heights can be allowed. Non-industrial occupancies within the complex but beyond operational area such as offices, residential and the like should comply with respective provisions in this NBCS according to the occupancy.

3 In case, the factories/industries complex consists of building(s) with occupancies having mixed hazards, fire protection systems should be governed by the highest hazard.

4 Those factories/industries which were defined or licensed as "Artisans workshops, Village and Cottage Industries, Tiny sector industries" by the Government of India should need to provide only extinguishers and buckets, their quantity and distribution should comply with IS 2190.

5 Multiple occupancy industrial estates (all in one building) should be protected according to the requirements for 'Ordinary' hazard industries. No high hazard occupancies should be allowed in such buildings.

6 In case of high hazard industries-A (where applicable) and high hazard industries-B like Petrochemical industries, Refineries and the like, compliance with the requirements of other agencies like Oil Industry Safety Directorate (OISD), Petroleum and Explosives Safety Organisation (PESO), Petroleum and Natural Gas Regulatory Board (PNGRB), Oil Mines Regulations (OMR), Central Electricity Authority (CEA) should be necessary in addition to those from Annex 'A' Table.

7a Entire occupancy should be protected by one electric driven main pump of at least 450 lpm discharge capacity at 50 m head, one standby pump of similar capacity (with reliable back-up power supply like DG Set).

7b Entire occupancy should be protected by one electric driven main pump of at least 900 lpm discharge capacity at 50 m head, one standby pump of similar capacity (with reliable back-up power supply like DG Set).

7c Entire occupancy should be protected by one electric driven main pump of at least 1 620 lpm discharge capacity at 70 m head, one standby diesel engine driven pump of similar capacity and one jockey pump of capacity of at least 180 lpm.

7d Entire occupancy should be protected by one electric driven main pump of at least 2 280 lpm discharge capacity at 70 m head, one standby diesel engine driven pump of similar capacity and one jockey pump of capacity of at least 180 lpm.

8 Entire occupancy should be protected by hydrant, sprinkler, water spray, water mist, clean agent, foam, fire alarm systems, etc as applicable in accordance with the current versions of IS 13039, IS 15105, IS 15325, IS 15519, IS 12385, IS 15693, IS 2189, IS 15908, etc in all respects that include design and installation of pumps, pipelines, etc.

9 Certain occupancies may also be protected by automatic water mist systems with appropriate (pressure) applications. Installation and design of such systems should comply to IS 15519.

10 For all occupancies, pumping capacities and water requirements should need to be provided wherever indicated in respective columns in Annex 'N' Table. However, where pumping capacities and water requirements are not indicated in the respective columns, reference should be made to the concerned Indian Standard codes of practices for hydrant/sprinkler/water spray, etc, for details. In either case, design and installation of systems like hydrant, sprinkler, spray systems, etc, should strictly be carried out as per provisions in respective Indian Standards stated in Note 8 above.

11 Where application of water as extinguishing medium is not appropriate due to the presence of water-reactive materials or other valid acceptable reasons, a suitable alternative extinguishing system and method should be provided in accordance with relevant Indian Standards.

12 Overhead fire water tank should be connected to hose reels and also sprinkler system (where applicable).

13 Classifications of various occupancies shown in Annex 'B' is only indicative for ready reference and understanding. While designing hydrant and sprinkler systems, classifications for the purpose of design and installation should strictly adhere to those available in IS 13039 and IS 15105 respectively.

Appendix '1' to Annex N

Low Hazard Factories/Industries with Aggregate Built-up area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	Abrasive manufacturing premises	R	R	R	NR	Required for packing material/other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
ii)	Aerated water factories, mineral water factories	R	R	R	NR	Required for packing material/ bottles and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
iii)	Agarbatti manufacturing	R	R	R	NR	Required for packing material/Finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
iv)	Analytical and/or quality control laboratories (without pilot plant)	R	R	R	Required if the combined floor area of the building is more than 5 000 m^2	NR	Suitable detection system backed up by manual call stations should be provided for the entire factory where combined area of the process/Storage blocks	

Appendix '1' to Annex N

Low Hazard Factories/Industries with Aggregate Built-up area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
							exceeds 5 000 m^2	
v)	Areca nut slicing and/or betel nut factories	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
vi)	Asbestos steam packing and lagging manufac-turers	R	R	R	NR	NR	Suitable detection system backed up by manual call stations should be provided for the entire factory where combined area of the process/storage blocks exceeds 5 000 m^2	
vii)	Battery charging/battery service station	R	R	R	R	R	Suitable detection system backed up by manual call stations should be provided for the entire factory where combined area of the process/storage blocks exceeds 5 000 m^2	Water mist systems as per IS 15519

Appendix '1' to Annex N

Low Hazard Factories/Industries with Aggregate Built-up area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
viii)	Battery manufacturing	R	R	R	R	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Suitable detection system backed up by manual call stations should be provided for the entire factory where combined area of the process/storage blocks exceeds 5 000 m^2	Water mist systems in battery charging stations as per IS 15519
ix)	Breweries	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
x)	Brick works	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xi)	Canning factories	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	

Appendix '1' to Annex N

Low Hazard Factories/Industries with Aggregate Built-up area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
xii)	Cardamom factories	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xiii)	Cement factories and/or asbestos or concrete products manufacturing	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	Clean agent-inert gas systems (CO_2, Nitrogen) for bag filters, mill house, coal bins
xiv)	Ceramic factories and crockery and stoneware pipe manufacturing	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xv)	Clay works	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xvi)	Clock and watch manufacturing	R	R	R	NR	Raw Material godowns should be sprinklered if the value of plastic/rubber and other similar commodities in the storage area exceeds 20 percent of the total	Manual fire alarm system should be provided throughout, operations like spray painting, wood working, solvent cleaning etc, should need to be spot-protected if combined area	

Appendix '1' to Annex N

Low Hazard Factories/Industries with Aggregate Built-up area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
						value of the storage building	occupied by such operations exceed 10 percent of the total manufacturing area	
xvii)	Coffee curing, roasting and grinding premises	R	R	R	Required if the area occupied by process building exceeds 2 000 m^2	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	If combined area of the entire factory is more than 2 000 m^2, manual fire alarm system should be required, Suitable detection system backed up by Manual call stations should be provided for the entire factory where combined area of the process/storage blocks exceeds 5 000 m^2	If combined area of process and storage blocks in the same building exceeds 2 000 m^2, sprinkler installation will be required in the entire area
xviii)	Condensed milk factories, milk pasteurising plant and dairies	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xix)	Confectionery manufacturing	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	

Appendix '1' to Annex N

Low Hazard Factories/Industries with Aggregate Built-up area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
xx)	Crockery and stoneware pipe manufacturing	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxi)	Electric generating houses (Hydro electric)	R	R	R	NR	Sprinkler protection for storage areas not forming part of main occupancy if area exceeds 2 000 m^2	Auto fire alarm system for all areas except detached storage buildings and utility blocks where manual alarm systems should be provided	Water spray system for transformers, FDS/NIFPS system, cable galleries, conveyors including transfer towers, etc as per IS 3034 and IS 15325
xxii)	Electric Lamps (Incandescent and Fluorescent) and TV Picture Tube Manufacturing	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxiii)	Electric Sub-Station/ Distribution Station	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	Water spray system for transformers if capacity thereof is more than 10 MVA or oil capacity exceeds 2 000 litre.

Appendix '1' to Annex N

Low Hazard Factories/Industries with Aggregate Built-up area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
								(As per CEA Regulations and IS 3034, IS 15325)
xxiv)	Electro Plating Works	R	R	R	NR	NR	NR	
xxv)	Electronic and/or Computer equipments Assemble and Manufactures	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxvi)	Engineering workshops heavy (Structural Steel Fabricators, Sheet Metal Fabricators (Tin Printing excluded), Hot or Cold Rolling, Pipe Extruding, Stamping, Pressing, Drawing (other than wire Drawing) or Forging Mills, Ore Crushing Mills, Ferrous and non Ferrous Metal Smelting or Extraction Works and Foundries (allowing storage of Wooden	R	R	R	NR	Raw material godowns should be sprinklered if the value of plastic/rubber and other similar commodities in the storage area exceeds 20 percent of the total value of the storage building.	Manual fire alarm system should be provided throughout, operations like manufacture of plastic/rubber components, powder coating/spray painting, drying of painted goods, use or storage of flammable liquids having flash point of 23 °C and below, wood working, upholstering, engine testing and flammable gas plant should need to be spot-protected by appropriate means if combined area	

Appendix '1' to Annex N

Low Hazard Factories/Industries with Aggregate Built-up area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Patterns only) and galvanizing works and the like)						occupied by such operations exceed 10 percent of the total manufacturing area. Else such areas should be fire separated from the main operations	
xxvii)	Engineering workshops Light (Blacksmiths, Electroplating, Anodizing or Lead, Zinc or other Metal Coating Works, Machine Shops, Heat Treatment shops, Electro Magnets manufacturing, Electrical and Mechnical Machinery Assemblers/Manufacturers, General Engineering Goods and Merchandise Manufacturers, Maintenance and Repair Workshops, Mfrs. of Welding Electrodes and Wire drawing, Automobile factories and the like)							

Appendix '1' to Annex N

Low Hazard Factories/Industries with Aggregate Built-up area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
xxviii)	Fruits and vegetables dehydrating/drying factories	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxix)	Fruit products and condiment factories	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxx)	Glass and glass Fibre manufacturing	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxxi)	Gold thread factories/ gilding factories	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxxii)	Granite manufacturing	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	If inflammable liquids having a flash point of less than 65° are used, manual foam spray

Appendix '1' to Annex N

Low Hazard Factories/Industries with Aggregate Built-up area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
								system should be used in the areas concerned
xxxiii)	Gum and/or Glue and Gelatine Manufacturing	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxxiv)	Ice Candy and Ice-cream Manufacturing	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxxv)	Ice Factories	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxxvi)	Ink (excluding Printing Ink) Factories	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	

Appendix '1' to Annex N

Low Hazard Factories/Industries with Aggregate Built-up area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
xxxvii)	Laundries	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxxviii)	Mica products manufacturing	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxxix)	Pottery works	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xl)	Poultry farms	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xli)	Salt Crushing Factories and Refineries	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	

Appendix '1' to Annex N

Low Hazard Factories/Industries with Aggregate Built-up area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
xlii)	Sugar Candy Manufacturing	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xliii)	Sugar Factories and Refineries	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xliv)	Tanneries/Leather Goods Manufacturers	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xlv)	Tea Blending and Tea Packing Factories	R	R	R	Required if the area occupied by process building exceeds 2 000 m^2	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	If combined area of the entire factory is more than 2 000 m^2, manual fire alarm system should be required, suitable detection system backed up by manual call stations should be provided for the entire factory where combined area of the process/ storage blocks exceeds 5 000 m^2	If combined area of process and storage blocks in the same building exceeds 2 000 m^2, sprinkler installation will be required in the entire area

Appendix '1' to Annex N

Low Hazard Factories/Industries with Aggregate Built-up area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
xlvi)	Umbrella Assembling Factories	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xlvii)	Vermicelli Factories	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xlviii)	Water Treatment/Water Filtration Plants and Water Pump House	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xlix)	Zinc/Copper/Aluminium Factories	R	R	R	NR	NR	Suitable detection system backed up by manual call stations should be provided for the entire factory where combined area of the process/storage blocks exceeds 5 000 m^2	
	R – Required. NR – Not Required.							

Appendix '2' to Annex N

Ordinary Hazard Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	Airport and other transportation terminal building	R	R	R	To be fully sprinklered	To be fully sprinklered (cargo)	To be fully protected by automatic intelligent fire alarm system	Kitchen hoods and ducts should be protected with wet chemical systems as per this NBCS. Also, systems as per ICAO standards.
ii)	Aluminium factories	R	R	R	NR	NR	NR	
iii)	Bakeries	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
iv)	Beedi factories	R	R	R	NR	NR	NR	
v)	Biscuit factories	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
vi)	Bobbin factories	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	

Appendix '2' to Annex N

Ordinary Hazard Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
vii)	Bookbinders, envelopes and paper bag manufacturers	R	R	R	Required when a single un-compartmented area is more than 2 000 m^2	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
viii)	Cable manufacturing	R	R	R	Required when a single un-compartmented area is more than 2 000 m^2	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
ix)	Carbon paper/typewriter ribbon manufacturers	R	R	R	Required when a single un-compartmented area is more than 2 000 m^2	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
x)	Cardboard box manufacturing	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xi)	Carpenters, wood wool and furniture manufac-turers. Basket weavers, cane furniture manufactuirng	R	R	R	Required when a single un-compartmented area is more than 2 000 m^2	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	

Appendix '2' to Annex N

Ordinary Hazard Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
xii)	Carpet and drugget factories	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xiii)	Chemical manufacturing involving chemicals, dyes, intermediates, pigments, acids, medicinal/ pharma-ceuticals formulation and toilet preparation including soap manufac-turing, chemical mixing and blending factories using no chemicals/ solvents having flash point below 23 °C	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	If the quantity of chemicals/ solvents having flash point below 23 °C is less than 200 litre in process and there is no storage of such solvents/chemicals more than 200 litre then such industries can be considered under this table. Else, *see* High hazard
xiv)	Cigar and cigarette factories	R	R	R	Required in full	Required in full	Automatic fire alarm system should be provided for godown buildings, manual system for process blocks	

Appendix '2' to Annex N

Ordinary Hazard Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
xv)	Coffee grinding premises	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xvi)	Coir, carpets, rugs and tobacco, hides and skin presses	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xvii)	Cork products manufacturing	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xviii)	Dry cleaning, dyeing, laundries	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xix)	Electric generating stations (other than hydel)	R	R	R	NR	Sprinkler protection for storage areas not forming part of main occupancy if area exceeds 2 000 m^2	Automatic fire alarm system for all areas except detached storage buildings and utility blocks where manual alarm systems should be provided	Water spray system for transformers, FDS/NIFPS system, cable galleries, conveyors including transfer towers, etc as per IS 3034 and IS 15325

Appendix '2' to Annex N

Ordinary Hazard Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
xx)	Enamelware factories	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxi)	Filter and wax paper manufacturing	R	R	R	Required when a single un-compartmented area is more than 2 000 m^2	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxii)	Flour mills	R	R	R	Required if combined floor plate area exceeds 2 000 m^2	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxiii)	Garment makers	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxiv)	Ghee factories (other than vegetable)	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	

Appendix '2' to Annex N

Ordinary Hazard Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
xxv)	Grain and/or seeds disintegrating and/or crushing factories	R	R	R	Required if combined floor plate area exceeds 2 000 m^2	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxvi)	Grease manufacturing	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxvii)	Hat and topee factories	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxviii	Hosiery, lace, embroidery and thread factories	R	R	R	Required if combined floor plate area exceeds 2 000 m^2	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxix)	Incandescent gas mantle manufacturers	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	

Appendix '2' to Annex N

Ordinary Hazard Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
xxx)	Industrial gas manufacturing Including halogenated hydrocarbon gases	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2000 m^2	
xxxi)	Linoleum factories	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxxii)	Man-made yarn/fibre manufacturing (except acrylic)	R	R	R	Required if combined floor plate area exceeds 2 000 m^2	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Automatic fire alarm system should be provided when combined floor plate exceeds 5 000 m^2, else manual systems should be provided	
xxxiii)	Manure and fertiliser works. (blending, mixing and granulating only)	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxxiv)	Mineral oil blending and processing	R	R	R	Required when a single un-compartmented area is more than 2 000 m^2	Required for packing material/finished goods and other raw materials godowns if exceeding	Manual fire alarm system for entire unit if area of single largest building	

Appendix '2' to Annex N

Ordinary Hazard Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
						2 000 m^2 in area	exceeds 2 000 m^2	
xxxv)	Oil and leather cloth factories	R	R	R	Required when a single un-compartmented area is more than 2 000 m^2	Required for Packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxxvi)	Oxygen plants	R	R	R	Required for manufacturing blocks	Required for storage blocks	Automatic fire alarm system should be provided throughout	
xxxvii)	Plywood manufacturing/wood veneering factories	R	R	R	Required when a single un-compartmented area is more than 2 000 m^2	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xxxviii)	Paper and cardboard mills	R	R	R	NR	Raw material and Finished goods storage should be provided with sprinklers	Automatic fire alarm system should be provided throughout	
xxxix)	Plastic goods manufacturing polytetra fluoroethylene, flourinated ethylene-	R	R	R	Required if combined floor plate area exceeds 2 000 m^2	Raw material and finished goods storage should be provided with sprinklers if area exceeds	Manual fire alarm system for entire unit if area of single largest building	

Appendix '2' to Annex N

Ordinary Hazard Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	propylene, poly-chlorotrifluroethylene, polyvinyl chloride, polyvinyl acetate, polyvinylidene chloride, vinyl chloride-vinylidene, chloride copolymer, polyvinylidene flouride, polycarbonate, phenylene oxide polymer, polysulfone, chlorinated polyether, phenolics, melamine formaldehyde, urea formaldehyde, silicones, phenol furfural, phenol formaldehyde, tetraflouro ehtylene, polyvinyl fluoride, cresol formaldehyde, ploy amide (nylon). rope works, assembling of plastic goods such as toys and the like					2 000 m^2	exceeds 2 000 m^2	
xl)	Plastic goods manufacturing polyethylene,	R	R	R	Required if combined floor plate area exceeds	Raw material and finished goods storage should be provided with	Manual fire alarm system for entire unit if area of bulding(s) exceeds	Many chemicals are water reactive with water and alternative systems

Appendix '2' to Annex N

Ordinary Hazard Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	polypropylene, polybutylene, ethylenemethacrylic acid ionomer, polyvinyl alcohol, polyvinyl butyrate, polyvinyl formaldehyde, polystyrene, styrene-acrylonitrile copolymer, acrylonitrile- butadiene-styrene, polymethyl methacrylate, cellulose acetate, cellulose acetate butyrate, cellulose propionate, Cellulose triacetate, ethyl cellulose, acetal, epoxy, polyesters, polyurethanes, acid monomer, acrylate, allyl, methyl methacrylate, polythene				2 000 m^2	sprinklers	2 000 m^2	(not involving water) should be used
xli)	Plastic goods manufacturing foamed plastics	R	R	R	R	Raw material and finished goods storage should be provided with sprinklers	Manual fire alarm system for entire unit	

Appendix '2' to Annex N

Ordinary Hazard Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
xlii)	Printing press premises	R	R	R	Required if area of building(s) exceeds 2 000 m^2	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system required if area of building(s) exceeds 2 000 m^2	
xliii)	Pulverising and crushing mills of metal and metallic ores (excluding aluminium and magnesium metals)	R	R	R	NR	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system is required if the floor area exceeds 2 000 m^2	
xliv)	Pulverising and crushing mills of metallic ores of aluminum and magnesium and coal	R	R	R	Required if area of building(s) exceeds 2 000 m^2	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Automatic fire alarm systems if the floor area exceeds 2 000 m^2	Depending on the circumstances like water reacting chemicals, open-sided structure, etc, sprinklers may be replaced with water mist systems
xlv)	Rice mills	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
xlvi)	Rope works (other than plastic)	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	

Appendix '2' to Annex N

Ordinary Hazard Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
xlvii)	Rubber tyres and tubes manufacturing	R	R	R	Required if area of building(s) exceeds 2 000 m^2	Required for packing material/finished goods godowns	Automatic fire alarm systems if the floor area exceeds 2 000 m^2	
xlviii)	Shellac factories	R	R	R	NR	NR	Manual fire alarm system required	Only local protection, that is, where chemicals used, have a flash point below 23 °C, with medium velocity water spray for manufacturing blocks, similar protection for the area where materials are stored (raw material as well as finished goods)
xlix)	Silk filatures and cocoon stores	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
l)	Spray painting	R	R	R	R	NR	NR	If area of the building exceeds 500 m^2, protection systems like sprrinklers, inert gas agents should be installed

Appendix '2' to Annex N

Ordinary Hazard Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
li)	Soaps and glycerine factories	R	R	R	NR	Raw material and finished goods godowns should be sprinklered if the storage area is more than 2 000 m^2	Automatic fire alarm systems if the floor area exceeds 2 000 m^2	
lii)	Starch factories	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
liii)	Steel plants	R	R	R	NR	NR	Automatic fire alarm systems if the floor area exceeds 2 000 m^2	
liv)	Tanneries/leather goods manufac- turers	R	R	R	Required if area of building(s) exceeds 2 000 m^2	Required for packing material/finished goods and other raw materials godowns if exceeding 2 000 m^2 in area	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
lv)	Tank farms other than those categorised under high hazard 'A'	R	R	R	Water spray/foam system as applicable should be provided for all tanks			

Appendix '2' to Annex N

Ordinary Hazard Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
lvi)	Textile mills	R	R	R	Required for all process blocks from mixing operations till weaving shed	Required for raw material and finished goods godowns	Automatic fire alarm systems should be provided for raw materials and finished goods godowns	Hazardous areas like singeing, raising, polymerizing, etc should be fire separated (2 h) from adjoining blocks. Concealed spaces/return air ducts/plenum in all process blocks upto weaving should be provided with quick response sprinklers. Diversion systems should be provided where the chute feed machines are installed between blow and carding sections
lvii)	Tea factories	R	R	R	Required if area of building(s) exceeds 2 000 m^2	Required if area exceeds 2 000 m^2	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
lviii)	Tobacco (chewing) and pan-masala making	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	

Appendix '2' to Annex N

Ordinary Hazard Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
lix)	Tobacco grinding and crushing	R	R	R	NR	Required if the area of building exceeds 2 000 m^2	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
lx)	Tobacco redrying factories	R	R	R	Required if the area of building exceeds 2 000 m^2	Required if the area of building exceeds 2 000 m^2	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	
lxi)	Woollen mills	R	R	R	Required for all processing areas	Required for raw material/finished goods godowns	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	

R – Required. NR – Not Required.

Appendix '3' to Annex N

High Hazard "A" Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	Aircraft hangers	R	R	R	Required in full	Required in full	Automatic intelligent fire alarm system with flame detectors	High expansion foam systems should need to be installed. Also, systems as per ICAO standards
ii)	Aluminium/magnesium powder plants	R	R	R	NR	NR	Manual fire alarm system for entire unit if area of single largest building exceeds 2 000 m^2	Special dry powder systems
iii)	Bituminized paper and/or hessian cloth manufacturing including tar felt manufacturing	R	R	R	Required if area of the building exceeds 2 000 m^2	Raw material and finished goods godowns should be sprinklered	Manual fire alarm system for entire unit	
iv)	Chemical manufacturing involving chemicals, dyes, intermediates, pigments, acids, medicinal/ pharma-ceuticals formulation and toilet preparation including soap manufacturing, chemical mixing and blending factories using chemicals/ solvents having flash point below 23 °C and metallic	R	R	R	MV spray systems and/or foam system should be provided locally as applicable for vessels, pumps, compressors, reactors, columns, etc where chemicals having flash point below 23 °C are in process. (Suitable care should taken to check whether chemicals are water reacting)	MV spray systems and gaseous protection systems as applicable for godowns storing materials with flash points below 23 °C. (Suitable care should taken to check whether chemicals are water reacting)	Manual fire alarm systems should be provided for entire unit	All tanks having a diameter of 9 m or more, storing Class A or B chemicals should be provided with medium velocity spray systems and foam systems as applicable backed up with suitable detection systems

Appendix '3' to Annex N

High Hazard "A" Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	nitrates, coal tar and wood distillation plant							
v)	Cotton waste factories	R	R	R	Entire area should be sprinklered if the combined area of all buildings exceed 2 000 m^2		Manual fire alarm systems should be provided for entire unit	
vi)	Coal and/or coke and/or charcoal ball briquettes manufacturing	R	R	R	NR	Raw materials and finished goods godown should be sprinklered when area is more than 2 000 m^2	Manual fire alarm systems should be provided for entire unit	
vii)	Celluloid goods manufacturing	R	R	R	NR	NR	Manual fire alarm systems should be provided for entire unit	Alcohol resistant foam, carbon dioxide (CO_2), dry chemicals where applicable for all process areas and godowns
viii)	Cigarette filter manufacturing	R	R	R	Required for all process areas	Raw materials and Finished goods godown should be sprinklered when area is more than 2 000 m^2	Manual fire alarm systems should be provided for entire unit	
ix)	Cinema films and t.v. production studios	R	R	R	Required for all process areas	Godowns should be sprinklered if area is more than 2 000 m^2	Automatic fire alarm system should be provided	
x)	Cotton seed cleaning or de-linting factories, cotton ginning and pressing units	R	R	R	Required for all process areas	Godowns should be sprinklered if area is more than 2000 m^2	Manual fire alarm systems should be provided for entire unit	

Appendix '3' to Annex N

High Hazard "A" Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
xi)	Distilleries	R	R	R	Local protection with medium velocity spray/foam systems as applicable should be provided for process areas	NR	Automatic fire alarm system should be provided	
xii)	Duplicating and stencil paper manufacturing	R	R	R	Required for all process areas	Godowns should be sprinklered if area is more than 2 000 m^2	Manual fire alarm systems should be provided for entire unit	
xiii)	Fire-works manufacturing	R	R	R	Required for all process areas	Required for all raw material and finished goods godowns	Manual fire alarm systems should be provided for entire unit	
xiv)	Foamed plastics manufacturing and/or converting plants	R	R	R	Required for all process areas	Required for all raw material and finished goods godowns	Manual fire alarm systems should be provided for entire unit	
xv)	Jute mills and jute presses	R	R	R	Required for all process areas	Required for all raw material and finished goods godowns	Manual fire alarm systems should be provided for entire unit	
xvi)	LPG bottling plants	R	R	R	Required for all process areas	Required for all storage and decantation, truck loading areas	Manual fire alarm systems should be provided for entire unit	LPG storage tankage like bullets and spheres should be protected with medium velocity water spray systems backed up with suitable detection systems as per IS 15325.

Appendix '3' to Annex N

High Hazard "A" Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
								Also, systems as per OISD- STD-144 and other applicable OISD standards
xvii)	Match factories	R	R	R	Required for all process areas	Required for all raw material and finished goods godowns	Manual fire alarm systems should be provided for entire unit	
xviii)	Man made fibres (acrylic fibres/yarn making)	R	R	R	Required for all process areas	Required for all raw material and finished goods godowns	Automatic fire alarm systems should be provided for entire unit	
xix)	Mattress and pillow making	R	R	R	Required for all process areas if area of the building is more than 2 000 m^2	Required for all raw material and finished goods godowns having area more than 2 000 m^2	Manual fire alarm systems should be provided for entire unit	
xx)	Metal or tin printers	R	R	R	Required for all process areas if area of the building is more than 2 000 m^2	Required for all raw material and finished goods godowns having area more than 2 000 m^2	Manual fire alarm systems should be provided for entire unit	
xxi)	Oil mills	R	R	R	Required for all process areas if area of the building is more than 2 000 m^2	Required for all raw material and finished goods godowns having area more than 2 000 m^2	Automatic fire alarm systems should be provided for entire unit	Local protections such as medium velocity spray or foam systems as applicable should be provided in process and storage areas

Appendix '3' to Annex N

High Hazard "A" Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
xxii)	Oil extraction plants (other than those forming part of ghee factories and oil refining factories)	R	R	R	Required for all process areas if area of the building is more than 2 000 m^2	Required for all raw material and finished goods godowns having area more than 2 000 m^2	Automatic fire alarm systems should be provided for entire unit	Local protections such as medium velocity spray or foam systems as applicable should be provided in process and storage areas
xxiii)	Oil terminals/depots handling flammable liquids having flash point of 23 °C and below	R	R	R	Automatic medium velocity water spray and /or foam systems should be provided as applicable for all tanks backed up with suitable automatic detection systems. Also, systems as per OISD-STD-117 and other applicable OISD standards			
xxiv)	Paints and varnish factories	R	R	R	Required for all process areas if area of the building is more than 2 000 m^2	Required for all raw material and finished goods godowns having area more than 2 000 m^2	Automatic fire alarm systems should be provided for entire unit	Local protections such as medium velocity spray or foam systems as applicable should be provided in process and storage areas
xxv)	Printing ink manufacturing	R	R	R	Required for all process areas if area of the building is more than 2 000 m^2	Required for all raw material and finished goods godowns having area more than 2 000 m^2	Automatic fire alarm systems should be provided for entire unit	Local protections such as medium velocity medium velocity spray or foam systems as applicable should be provided in process and storage areas
xxvi)	Saw mills	R	R	R	NR	NR	Manual fire alarm system should be provided for entire unit	

Appendix '3' to Annex N

High Hazard "A" Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
xxvii)	Solvent extraction plants	R	R	R	NR	NR	Automatic fire alarm systems should be provided for entire unit	Entire factory and storage tanks to be protected by medium velocity water spray system and/or foam system
xxviii)	Surgical cotton manufacturers	R	R	R	Required for all process areas	Required for all raw material and finished goods godowns	Automatic fire alarm systems should be provided for entire unit	
xxix)	Tank farms storing flammable liquids having flash point of 23 °C and below	R	R	R	Automatic medium velocity water spray and /or Foam systems should be provided as applicable for all tanks backed up with suitable automatic detection systems. Also, systems as per OISD-STD-116 and other applicable OISD standards			
xxx)	Tarpaulin and canvas proofing factories	R	R	R	Required for all process areas where building area is more than 2 000 m^2	Required for all raw material and finished goods godowns where the building area is more than 2 000 m^2	Automatic fire alarm systems should be provided for entire unit	
xxxi)	Turpentine and rosin distilleries	R	R	R	NR	NR	Automatic fire alarm systems should be provided for entire unit	Local protections such as medium velocity water spray or foam systems as applicable should be provided in process and storage areas

Appendix '3' to Annex N

High Hazard "A" Factories/Industries with Aggregate Built-up Area more than 2 500 m^2

Sl No.	Description	Extinguisher	Hose Reel	Hydrant System	Sprinkler System		Fire Alarm System	Special Protection
					Process Blocks	Storage Blocks		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
xxxii)	Tyre retreading and resoling factories	S	R	R	Required for all process areas where building area is more than 2 000 m^2	Required for all Raw material and finished goods godowns where the building area is more than 2 000 m^2	Automatic fire alarm systems should be provided for entire unit	
	R – Required. NR – Not Required. S – Suitable							

Appendix '4' to Annex N

High Hazard 'B' Factories/Industries (All Chemicals, Petroleum, Gas Processing, Petrochemicals, Fertilizer Plants, Thermal Power Plants, etc)

Sl No.	Description	Fire Extinguishers, Firefighting Equipment	Hydrant System, Fire Monitors, Hose Reels	Fire Alarm System	Sprinkler System	High Volume Long Range (HVLR) Monitors	Gas/HC/Fire/Heat Detection System	Automatic Heat/Fire Detection and Suppression System	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
i)	Process units (columns, boilers, furnaces, reactors, vessels, drums, etc)	R	R (Note 1)	R	R (Note 2)	Refer Note 3	R (Note 4)	NR	
ii)	Tank farm areas (storage of liquid/gas flammable	R	R	R	R	R	R	R	High volume long range monitors of capacity 500 to

Appendix '4' to Annex N									
High Hazard 'B' Factories/Industries (All Chemicals, Petroleum, Gas Processing, Petrochemicals, Fertilizer Plants, Thermal Power Plants, etc)									
Sl No.	**Description**	**Fire Extinguishers, Firefighting Equipment**	**Hydrant System, Fire Monitors, Hose Reels**	**Fire Alarm System**	**Sprinkler System**	**High Volume Long Range (HVLR) Monitors**	**Gas/HC/Fire/Heat Detection System**	**Automatic Heat/Fire Detection and Suppression System**	**Remarks**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	products Class A and cluster of Class A and B products)				(Note 5, 6)	(Note 7, 8)		(Note 9)	4 000 gpm (variable flow) as required as per Standards; HVLR monitors of 10 500 gpm should be considered to fight fire in large dia tanks. Fire water monitors around the tank farm area as per IS/OISD standards
iii)	Pump house area (Pumps and Compressors - rotary equipment)	R	R	R	R	NR	R (Note 4)	NR	
iv)	Loading/unloading gantry (tank wagon and tank truck loading/unloading)	R	R	R	R	R	R (Note 4)	NR	Water sprinkler throughout the length of Gantry. Hydrocarbon (HC) detectors at drains
v)	LPG filling stations	R	R	R	R	NR	R	NR	LPG storage – Mounded storage, Horton spheres, Bullets should have water sprinklers with medium velocity spray

Appendix '4' to Annex N

High Hazard 'B' Factories/Industries (All Chemicals, Petroleum, Gas Processing, Petrochemicals, Fertilizer Plants, Thermal Power Plants, etc)

Sl No.	Description	Fire Extinguishers, Firefighting Equipment	Hydrant System, Fire Monitors, Hose Reels	Fire Alarm System	Sprinkler System	High Volume Long Range (HVLR) Monitors	Gas/HC/Fire/Heat Detection System	Automatic Heat/Fire Detection and Suppression System	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
vi)	Conveyor belt areas	R	R	R	R	NR	NR	R (Note 10)	Handling flammable dusts like coal / lignite dust, etc
vii)	Sub-station and electrical panels	R	NR	R	NR	NR	NR	R (Note 11, 12)	Substation to be air pressurized
viii)	Chlorination plant	R	NR	NR	R	NR	R (Note 13)	NR	
ix)	Transformers	R	R	R	R	NR	NR	R (Note 14)	
x)	Cable trenches, racks and cable galleries	R	NR	R	NR	NR	R	R (Note 11 and 12)	Adequate ventilation and sealing in cable gallery housing
xi)	Quality control lab	R	R	R (Note 15)	R	NR	R	NR	

Appendix '4' to Annex N

High Hazard 'B' Factories/Industries (All Chemicals, Petroleum, Gas Processing, Petrochemicals, Fertilizer Plants, Thermal Power Plants, etc)

Sl No.	Description	Fire Extinguishers, Firefighting Equipment	Hydrant System, Fire Monitors, Hose Reels	Fire Alarm System	Sprinkler System	High Volume Long Range (HVLR) Monitors	Gas/HC/Fire/Heat Detection System	Automatic Heat/Fire Detection and Suppression System	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
xii)	Admin. building	R	R	R (Note 15)	R	NR	NR	NR	
xiii)	Control room	R	NR	R	R	NR	NR	R (Note 16)	
xiv)	Firefighting pumps and fire water system	Electric and diesel/HSD driven pumps of similar capacity and same head. Jockey pump with 3 percent to 5 percent capacity of main pumps. Overhead fire water tanks and reservoir with adequate capacity to fight two simultaneous fires.							
xv)	Fire tenders	Independent fire station equipped with water, foam, dry chemical power tenders and rescue vehicles - response time on fire call must be within 05 min.							

R – Required. NR – Not Required.

NOTES

1 Fire water network with fire hydrants, monitors all around the process unit and tank farm areas should be provided in accordance with relevant Indian Standards, OISD. Fire hydrants should be at different platforms/levels in TPH/boilers/furnaces/columns/reactors.

2 Water sprinklers in technological platforms for all static equipment normally reflux drums, air-fin fan coolers, etc should be provided in accordance with relevant Indian Standards, OISD.

3 Elevated fire water monitors (variable flow) to fight fires at tall columns / boiler house / reactors / technological platforms, etc should be provided in accordance with relevant Indian Standards, OISD.

4 Hydrocarbon detectors, gas detectors, heat sensors at strategic / critical locations normally drain points of vessels, columns, pump drain, tank drain points, etc should be provided in accordance with relevant Indian Standards, OISD.

5 Fixed foam pourer system for Class-A products storage tanks should be provided in accordance with relevant Indian Standards, OISD.

6 Water Sprinklers ring at top and middle of tanks for water cooling in all storage tanks should be provided in accordance with relevant Indian Standards, OISD.

7 HVLR - Remote/manual operated variable flow monitors having discharge of 500 gpm to 4 000 gpm capacity should be provided as per requirement. HVLR Monitor of 10 500 gpm should be considered for large dia tanks (for > 60 M and above). Fire robot may be considered for fighting multiple tank/area fires as per the relevant Indian Standards.

8 Medium expansion foam generators (MEFG) may be provided to fight fire due to accidental spillage of flammable materials in tank dykes/spill fires.

9 Automatic site configurable linear heat detection and foam suppression system should be provided for EFR tanks (rim seal areas) Class A products.

10 Linear heat detection system, site configurable type with water mist/spray system should be provided in all conveyor belts for early detection of rise in temperature.

11 Linear heat detection system, site configurable type should be provided in all cable cellars, trenches, for early detection.

12 All electrical panels should be provided with linear heat detection and inert gas suppression system (environment friendly halon free).

13 Chlorine leakage kit, chlorine protective suit, sensors, neutraliser, etc should be provided.

14 Water mist /deluge system and nitrogen injection fire prevention system (NIFPS) with site configurable linear heat sensing detector should be provided for oil filled transformers.

15 Wireless heat and smoke detection with alarm and notification to concerned should be provided.

16 Clean agent inert gas fire suppression system (environment friendly halon free) should be provided in all control rooms.

LIST OF STANDARDS

The following list records those standards which are acceptable as 'good practice' and 'accepted standards' in the fulfilment of the requirements of this Part. The latest version of a standard should be adopted at the time of enforcement of this Part. The standards listed may be used by the Authority for conformance with the requirements of the referred clauses in this Part.

In the following list, the number appearing in the first column within parentheses indicates the number of the reference in this Part.

	IS No.	*Title*
(1)	IS 3808 : 1979	Method of test for non-combustibility of building materials (*first revision*)
(2)	IS/ISO 834-1 : 1999	Fire resistance tests — Elements of building construction: Part 1 General requirements
	IS/ISO 834-4 : 2000	Fire Resistance tests — Elements of building construction: Part 4 Specific requirements for load bearing vertical separating elements
	IS/ISO 834-5 : 2000	Fire resistance tests — Elements of building construction: Part 5 Specific requirements for load bearing horizontal separating elements
	IS/ISO 834-7 : 2000	Fire-resistance tests — Elements of building construction: Part 7 Specific requirements for columns
	IS/ISO 834-8 : 2003	Fire-Resistance tests — Elements of building construction: Part 8 Specific requirements for non-load bearing vertical separating elements
	IS/ISO 834-9 : 2003	Fire-resistance tests — Elements of building construction: Part 9 Specific requirements for non-load bearing ceiling elements
(3)	IS 8757 : 2021	Glossary of terms associated with fire safety (*second revision*)
	IS 7673 : 2004	Glossary of terms for fire fighting equipment (*first revision*)
(4)	IS 8758 : 2013	Recommendations for fire precautionary measures in the construction of temporary structures and pandals (*second revision*)
(5)	IS 9668 : 1990	Code of practice for provision and maintenance of water supplies and fire fighting
	IS 3844 : 1989	Code of practice for installation and maintenance of internal fire hydrants and hose reels on premises (*first revision*)
(6)	IS 1646 : 2015	Fire safety of buildings (General): Electrical installations — Code of practice(*third revision*)
(7)	IS 9457 : 2025	Safety colours, safety signs and accident prevention tags — Code of practice (*second revision*)
	IS 12349 : 1988	Fire protection — Safety sign
	IS 12407 : 1988	Graphic symbols for fire protection plan
(8)	IS/ISO 7240-7 : 2023	Fire detection and alarm systems Part 7: Point-type smoke detectors using scattered light, transmitted light, or Ionization (*first revision*)

	IS No.	*Title*
	IS/ISO 7240-12 : 2022	Fire detection and alarm systems: Part 12 Line type smoke detectors using a transmitted optical beam (*first revision*)
(9)	IS 655 : 2006	Specification for air ducts (*third revision*)
(10)	IS 1649 : 1962	Code of practice for design and construction of flues and chimneys for domestic heating appliances (*first revision*)
	IS 1642 : 2013	Code of practice for safety of buildings (general): Details of construction (*second revision*)
(11)	IS 12777 : 1989	Fire safety — Flame spread of products — Method for classification
(12)	IS 1642 : 2013	Code of practice for safety of buildings (general): Details of construction (*second revision*)
(13)	IS 16246 : 2015	Elastomer insulated cables with limited circuit integrity when affected by fire — Specification
(14)	IS 6044 (Part 1) : 2018	Liquefied petroleum gas storage installations — Code of practice: Part 1 Residential commercial and industrial cylinder installations (*third revision*)
	IS 6044 (Part 2) : 2021	Code of practice for liquefied petroleum gas storage installations: Part 2 Commercial, industrial and domestic bulk storage installations (*second revision*)
(15)	IS 2175 : 1988	Specification for heat sensitive fire detectors for use in automatic fire alarm system (*second revision*)
	IS/ISO 7240-5 : 2018	Fire detection and alarm systems: Part 5 Point-type heat detectors (*second revision*)
	IS/ISO 7240-7 : 2023	Fire detection and alarm systems: Part 7 Point-type smoke detectors using scattered light, transmitted light, or Ionization (*first revision*)
	IS/ISO 7240-11 : 2011	Fire detection and alarm systems: Part 11 Manual call points
	IS/ISO 7240-15 : 2014	Fire detection and alarm systems: Part 15 Point-type fire detectors using scattered light, transmitted light, or ionization sensor in combination with a heat sensor (*first revision*)
	IS/ISO 7240-12 : 2022	Fire detection and alarm systems: Part 12 Line type smoke detectors using a transmitted optical beam (*first revision*)
(16)	IS 2189 : 2026	Selection, installation and maintenance of automatic fire detection and alarm system — Code of practice (*third revision*)
(17)	IS 636 : 2018	Non-percolating flexible fire fighting delivery hose *(fourth revision)*
	IS 884 : 2025	First-aid hose-reel for fire fighting — Specification (*second revision*)

IS No.	*Title*
IS 901 : 1988	Specification for couplings, double male, and double female instantaneous pattern for fire fighting (*third revision*)
IS 902 : 1992	Specification for suction hose couplings for fire fighting purposes (*third revision*)
IS 903 : 2025	Fire hose delivery couplings, branch pipe, nozzles and nozzle spanner — Specification (*fifth revision*)
IS 904 : 1983	Specification for two-way and three-way suction collecting heads for fire fighting purposes (*second revision*)
IS 905 : 1980	Specification for delivery breechings, dividing and collecting, instantaneous pattern for fire fighting purposes (*second revision*)
IS 906 : 2024	Specification for revolving branch pipe for fire fighting (*fourth revision*)
IS 907 : 1984	Specification for suction strainers, cylindrical type for fire fighting purpose (*second revision*)
IS 908 : 1975	Specification for fire hydrant, stand post type (*second revision*)
IS 909 : 1992	Specification for underground fire hydrant: Sluice valve type (*third revision*)
IS 910 : 1980	Specification for combined key for hydrant, hydrant cover and lower valve (*second revision*)
IS 926 : 1985	Specification for fireman's axe (*second revision*)
IS 927 : 1981	Specification for fire hooks (*second revision*)
IS 928 : 1984	Specification for fire bells (*second revision*)
IS 937 : 1981	Specification for washers for water fittings for fire fighting purposes (*second revision*)
IS 939 : 1977	Specification for snatch block for use with fibre rope for fire brigade use (*first revision*)
IS 941 : 1985	Specification for blowers and exhauster for fire fighting (*second revision*)
IS 942 : 1982	Functional requirements for 275-l/min portable pump set for fire fighting (*second revision*)
IS 943 : 1979	Functional requirement for 680-l/min trailer pump for fire brigade use (*second revision*)
IS 944 : 1979	Functional requirement for 1800-l/min trailer pump for fire brigade use (*second revision*)
IS 947 : 1985	Functional requirement for towing tender for trailer fire pump for fire brigade use (*first revision*)

IS No.	*Title*
IS 948 : 1983	Functional requirement for water tender, Type A, for fire brigade use (*second revision*)
IS 949 : 2012	Functional requirement for emergency (rescue) tender for fire brigade use (*second revision*)
IS 950 : 2012	Functional requirements for water tender, Type B for fire brigade use (*third revision*)
IS 952 : 1986	Specification for fog nozzle for fire brigade use (*second revision*)
IS 955 : 1980	Functional requirements for dry power tender for fire-brigade use (150 kg capacity) (*first revision*)
IS 957 : 1967	Specification for control van for fire brigade
IS 1941 (Part 1) : 1976	Functional requirements for electric motor sirens: Part 1 AC, 3-phase 50 Hz, 415 Volts type (*second revision*)
IS 2097 : 2024	Specification for foam making branch pipe (*third revision*)
IS 2175 : 1988	Specification for heat sensitive fire detectors for use in automatic detectors for use in automatic fire alarm system (*second revision*)
IS 2546 : 1974	Specification for galvanized mild steel fire bucket (*first revision*)
IS 2696 : 1974	Functional requirements for 1125 l/min light fire engine (*first revision*)
IS 2745 : 1983	Specification for non-metal helmet for firemen and civil defence personnel (*second revision*)
IS 2871 : 2012	Specification for branch pipe, universal for fire fighting purposes (*second revision*)
IS 2930 : 1980	Functional requirements for hose laying tender for fire brigade use (*first revision*)
IS 3582 : 1984	Specification for basket strainers for fire fighting purposes (cylindrical type) (*first revision*)
IS 4308 : 2019	Specification for dry powder for fire fighting (*third revision*)
IS 4571 : 1977	Specification for aluminium extension ladders for fire brigade use (*first revision*)
IS 4643 : 1984	Specification for suction wrenches for fire brigade use (*first revision*)
IS 4927 : 1992	Specification for unlined flax canvas hose for fire fighting (*first revision*)
IS 4928 : 1986	Specification for delivery valve for centrifugal pump outlets (*first revision*)
IS 4947 : 2006	Specification for gas cartridges for use in fire extinguishers (*third revision*)

IS No.	*Title*
IS 4989 : 2018	Foam concentrate for producing mechanical foam for fire fighting — Specification (*fourth revision*)
IS 4989 (Part 4) : 2003	Multipurpose aqueous film forming foam liquid concentrate for extinguishing hydrocarbon and solvent fires
IS 5131 : 2002	Specification for dividing breeching with control, for fire brigade use (*second revision*)
IS 5290 : 2025	Specification for landing valve (*fourth revision*)
IS 5486 : 1985	Specification for quick release knife (*first revision*)
IS 5505 : 1985	Specification for multi-edged rescue axe (non-wedging) (*first revision*)
IS 5612	Specification for hose-clamps and hose-bandages for fire brigade use
(Part 1) : 1977	Hose clamps (*first revision*)
(Part 2) : 1977	Hose bandages (*first revision*)
IS 5714 : 1981	Specification for hydrant, stand-pipe for fire fighting (*first revision*)
IS 6026 : 1985	Specification for hand operated sirens (*first revision*)
IS 6067 : 1983	Functional requirements for water tender, Type `X' for fire brigade use (*first revision*)
IS/ISO 7240-5 : 2018	Fire detection and alarm systems: Part 5 Point-type heat detectors (*second revision*)
IS/ISO 7240-7 : 2023	Fire detection and alarm systems: Part 7 Point-type smoke detectors using scattered light, transmitted light, or ionization (*first revision*)
IS/ISO 7240-11 : 2011	Fire detection and alarm systems Part 11 Manual call points
IS 8090 : 1976	Specification for couplings, branch pipe, nozzle, used in hose reel tubing for fire fighting (*first revision*)
IS 8096 : 2005	Rubber or plastics coated fabrics for water resistant clothing — Specification (*second revision*)
IS 8423 : 1994	Specification for controlled percolating hose for fire fighting (*first revision*)
IS 8442 : 2024	Specification for stand post type water monitor for fire fighting (*second revision*)
IS 9972 : 2023	Specification for automatic sprinkler heads (*second revision*)
IS 10460 : 1983	Functional requirements for small foam tender for fire brigade use

IS No.	*Title*
IS 10993 : 1984	Functional requirements for 2 000 kg dry powder tender for fire brigade use
IS 11101 : 1984	Specification for extended branch pipe for fire brigade use
IS 11108 : 1984	Specification for portable fire extinguisher halon —1211 type
IS 11833 : 1986	Specification for dry powder fire extinguisher for metal fires
IS 12717 : 1989	Functional requirements of fire fighting equipment — High capacity portable pumpset (1 100-1 600 L/min)
IS 12796 : 1989	Specification for fire rake
IS 13039 : 2014	Code of practice for provision and maintenance of external hydrant system (*first revision*)
IS 14933 : 2001	Specification for high pressure fire fighting hose
IS 14951 : 2001	Specification for fire extinguisher, 135 l capacity mechanical foam type
IS 15051 : 2001	Specification for high pressure fire hose delivery couplings
IS 15105 : 2021	Design and installation of fixed automatic sprinkler fire extinguishing system (*first revision*)
IS 15220 : 2002/ ISO 7201-1	Specification for halon 1211 and halon 1301 — Fire extinguishing media for fire protection
IS 15683 : 2018	Portable fire extinguishers — Performance and construction — Specification (*first revision*)
IS 15493 : 2021	Gaseous fire extinguishing systems — General requirements *(first revision)*
IS 15505 : 2004/ ISO 14520-6	Gaseous fire extinguishing systems: HCFC Blend A extinguishing systems
IS 15506 : 2004/ ISO 14520-14	Gaseous fire extinguishing systems — IG 55 extinguishing systems
IS 15525 : 2004/ ISO 14520-13	Gaseous fire extinguishing systems — IG 100 extinguishing systems
IS 15501 : 2004/ ISO 14520-15	Gaseous fire extinguishing systems — IG 541 extinguishing systems
IS 15497 : 2004/ ISO 14520-12	Gaseous fire extinguishing systems — IG 01 extinguishing systems
IS 15519 : 2020	Code of practice for water mist fire protection systems — System design, installation, and commissioning (*first revision*)
IS 15528 : 2004	Gaseous fire extinguishing systems — Carbon dioxide, total flooding and

IS No.	*Title*
	local application including in cabinet subfloors systems
IS 15517 : 2004/ ISO 14520-9	Gaseous fire extinguishing systems — HFC 227ea (Hepta Fluoro Propane) extinguishing system
IS 16018 : 2012	Wheeled fire extinguisher — Performance and construction — Specification
(18) IS 2190 : 2024	Code of practice for selection, installation, and maintenance of portable first-aid fire (*fifth revision*)
(19) IS 884 : 2025	Specification for first aid hose reel for fire fighting *(second revision)*
(20) IS 15105 : 2021	Design and installation of fixed automatic sprinkler fire extinguishing system — Code of practice (*first revision*)
(21) IS 15325 : 2020	Design and installation of fixed automatic high and medium velocity water spray system — Code of practice (*first revision*)
(22) IS 12835 (Part 1) : 2021	Design and installation of fixed foam fire extinguishing system — Code of practice Part 1 Low expansion foam (*first revision*)
(23) IS 15517 : 2004	Gaseous fire extinguishing systems — Carbon dioxide, total flooding and local application including in cabinet subfloors systems
(24) IS 15519 : 2020	Water mist fire protection systems — System design, installation, and commissioning — Code of Practice (*first revision*)
(25) IS 15493 : 2021	Gaseous fire extinguishing systems — General requirements
IS 15505 : 2004	Gaseous fire extinguishing systems — HCFC blend A
IS 15506 : 2004	Gaseous fire extinguishing systems — IG 55 extinguishing systems
IS 15525 : 2004	Gaseous fire extinguishing systems — IG 100 extinguishing systems
IS 15501 : 2004	Gaseous fire extinguishing systems — IG 541 extinguishing systems
IS 15497 : 2004	Gaseous fire extinguishing systems — IG 01 extinguishing systems
IS 15517 : 2004	Gaseous fire extinguishing systems — Carbon dioxide, total flooding and local application including in cabinet subfloors systems
IS 9668 : 1990	Code of practice for provision and maintenance of water supplies and fire fighting
IS 3844 : 1989	Code of practice for installation and maintenance of internal fire hydrants and hose reels on premises (*first revision*)
(26) IS 2189 : 2026	Selection, installation and maintenance of automatic fire detection and alarm system — Code of practice (*second revision*)

	IS No.	*Title*
	IS 2190 : 2024	Selection, installation, and maintenance of portable first-aid fire extinguishers — Code of practice (*fifth revision*)
	IS 13039 : 2014	External hydrant systems — Provision and maintenance — Code of practice (*first revision*)
(27)	IS 4878 : 1986	Byelaws for construction of cinema buildings (*first revision*)
(28)	IS 2726 : 1988	Code of practice for fire safety of industrial buildings: Cotton ginning and pressing (including cotton seed delintering) factories (*first revision*)
	IS 3034 : 1993	Code of practice for fire safety of industrial buildings: Electrical generating and distributing stations (*second revision*)
	IS 3058 : 1990	Code of practice for fire safety of industrial buildings: Viscose rayon yarn and/or staple fibre plants (*first revision*)
	IS 3079 : 1990	Code of practice for fire safety of industrial buildings: Cotton textile mills (*first revision*)
	IS 3594 : 2024	Code of practice for fire safety of industrial buildings: General storage and warehousing including cold storage (*second revision*)
	IS 3595 : 2002	Code of practice for fire safety of industrial buildings: Coal pulverizers and associated equipment (*second revision*)
	IS 3836 : 2000	Code of practice for fire safety of industrial buildings: Jute mills (*second revision*)
	IS 4209 : 2013	Code of safety in chemical laboratories (*second revision*)
	IS 4226 : 1988	Code of practice for fire safety of industrial buildings: Aluminium/ Magnesium powder factories (*first revision*)
	IS 4886 : 1991	Code of practice for fire safety of industrial buildings: Tea factories (*first revision*)
	IS 6329 : 2000	Code of practice for fire safety of industrial buildings: Saw mills and wood works (*first revision*)
	IS 9109 : 2000	Code of practice for fire safety of industrial buildings: Paint and varnish factories
	IS 11457 (Part 1) : 1985	Code of practice for fire safety of chemical industries: Part 1 Rubber and plastic
(29)	IS 13039 : 2014	External hydrant systems — Provision and maintenance — Code of practice (*first revision*)
(30)	IS 18271 : 2023	Fire safety in commercial kitchen — Guidelines
(31)	IS 4963 : 2025	Accessibility in built environment for older adults and persons with disabilities — Requirements (*second revision*)

IS No.	*Title*
(32) IS 16700 : 2023	Criteria for structural safety of tall concrete buildings (*first revision*)
(33) IS 3614 : 2021	Fire doors and doorsets — Specification (*first revision*)
(34) IS 12458 : 2019	Fire resistance of through penetration firestops — Method of test (*first revision*)
(35) IS 18190 : 2023	Fire resistance of perimeter fire barrier joint system — Method of tests

INDEX OF TERMS

(Lists the terms appearing in the Part/Section of the NBCS)

A

B

C

Cellulose — Part C/Section 3B
Central Field – Part D/Section 1
Centre Internode — Part C/Section 3B
Centrifugal Fan — Part D/Section 1
Cesspool — Part E/Section 2
Chair — Part E/Section 1
Chair Rail — Part C/Section 8
*Channe*l — Part E/Section 1
Characteristic Load — Part C/Section 6A, Part C/Section 3B, Part C/Section 6B
Characteristic Strength — Part C/Section 3B
Characteristic Yield/Ultimate Stress — Part C/ Section 6A
Check — Part C/Section 3A
Circadian Lightning — Part D/Section 1
Circuit — Part D/Section 2
Circuit, Final Sub — Part D/Section 2
Circuit Breaker — Part D/Section 2
Circuit Breaker, Linked — Part D/Section 2
Circulating Hot Water System — Part E/Section 1
Clay — Part C/Section 2
Clay, Firm — Part C/Section 2
Clay, Soft — Part C/Section 2
Clay, Stiff — Part C/Section 2
Cleaning Eye — Part E/Section 2
Clear Design Sky — Part D/Section 1
Clear Glass — Part C/Section 8
Clear Waste Water — Part E/Section 2
Cleavability — Part C/Section 3B
Closely-spaced Modules — Part C/Section 1
Coaxial Cable — Part D/Section 6
Coefficient of Linear Expansion — Part C/Section 8
Coefficient of Performance, Compressor, Heat Pump — Part D/Section 3
Coefficient of Performance, Compressor, Refrigerating — Part D/Section 3
Coefficient of Performance (*Heat Pump*) — Part D/Section 3
Coefficient of Performance (*Refrigerating*) — Part D/Section 3
Collapse — Part C/Section 3B
Collection — Part E/Section 3
Collection Chamber — Part E/Section 2
Colour Rendering Index (*CRI*) — Part D/Section 1
Column — Part C/Section 1, Part C/Section 3B, Part C/Section 6A, Part C/Section 4
Comb — Part D/Section 5B
Comb Lighting — Part D/Section 5B
Comb Plate — Part D/Section 5B
Comb Plate Switch — Part D/Section 5B
Comb Teeth — Part D/Section 5B
Combined Piled Raft Foundation — Part C/Section 2
Combined System — Part E/Section 2
Combustible Material — Part F, Part C/Section 8
Common Path of Travel — Part F
Common Rafter — Part C/Section 3B
Communication Pipe — Part E/Section 1
Compact Section — Part C/Section 6A
Compact Substation or Prefabricated Substation — Part D/Section 2
Compensation Means — Part D/Section 5A
Competent Authority — Part E/Section 4
Competent Maintenance Person — Part D/ Section 5A, Part D/Section 5B
Competent Official — Part A
Component — Part C/Section 7
Composite Action — Part C/Sec 6 B
Composite Station — Part F
Composite Members — Part C/Section 7
Composting — Part E/Section 3
Compression Wood — Part C/Section 3A
Concrete buildings — Part C/Section 1
Concourse — Part F
Conductor of a Cable or Core — Part D/Section 2
Conductor, Aerial — Part D/Section 2
Conductor, Bare — Part D/Section 2
Conductor, Earthed — Part D/Section 2
Conductor, Insulated — Part D/Section 2
Conduit — Part D/Section 2
Connection — Part E/Section 2
Connecting Structure — Part C/Section 5
Connector — Part D/Section 2
Connector Box or Joint Box — Part D/Section 2
Connector for Portable Appliances — Part D/ Section 2
Consolidation Point (*CP*) — Part D/Section 6

D

E

F

G

H

I

J

K

L

M

N

O

P

Partition — Part C/Section 8

Partly Framed or Unframed Glazing — Part C/ Section 8

Passenger — Part D/Section 5A

Passenger Arrival Rate — Part D/Section 5A

Passenger Average Waiting Time (*AWT*) — Part D/Section 5A

Passenger Lift — Part D/Section 5A

Passive Cooling — Part D/Section 3

Passive Fire Protection — Part F

Passive Heating — Part D/Section 3

Passive Solar Gain — Part C/Section 8

Patterned Glass — Part C/Section 8

Pawl Device — Part D/Section 5A

Peak Ground Acceleration — Part C/Section 1

Peak Gust — Part C/Section 1

Peak to Peak Vibration Levels — Part D/Section 5A

Peat — Part C/Section 2

Plenum — Part F

Pelletization — Part E/Section 3

Percentile Level — Part D/Section 4

Performance Based Design — Part F

Performance Time/Door-to-Door Time — Part D/Section 5A

Perimeter Fire Barrier — Part C/Section 8

Period of Structural Adequacy under Fire — Part C/Section 6A

Period of Supply — Part E/Section 1

Peripheral Field — Part D/Section 1

Permanent Load — Part C/Section 2

Permissible Stress — Part C/Section 3A, Part C/Section 3B, Part C/Section 6A

Pessral — Part D/Section 5A

PEN Conductor — Part D/Section 2

Phase Conductor — Part D/Section 2

Pier — Part C/Section 4

Pile-Enhanced Raft — Part C/Section 2

Pile Foundation — Part C/Section 2

Pile-Pile Interaction — Part C/Section 2

Pile-Raft Interaction — Part C/Section 2

Pile-Raft Coefficient or Load Sharing Ratio (α_{CPRF}) — Part C/Section 2

Pile Spacing — Part C/Section 2

Partition Wall — Part C/Section 4

Pilot — Part E/Section 4

Pink Noise — Part D/Section 4

Pipe System — Part E/Section 2

Pipe Work — Part E/Section 1

Pit — Part D/Section 5B

Pitch — Part C/Section 6A and 6B

Pitch Pocket — Part C/Section 3A

Place of Comparative Safety — Part F

Plastic Collapse — Part C/Section 6A

Plastic Design — Part C/Section 6A

Plastic Hinge — Part C/Section 6A

Plastic Moment — Part C/Section 6A

Plastic Section — Part C/Section 6A

Plenum — Part D/Section 3

Plug — Part D/Section 2

Plumbing — Part E/Section 1, Part E/Section 2

Plumbing System — Part E/Section 1, Part E/ Section 2

Pocket Type Reinforced Masonry — Part C/Section 4

Podium — Part F

Point of Safety — Part F

Point (*in Wiring*) — Part D/Section 2

Poisson's Ratio — Part C/Section 6A

Pool — Part E/Section 1

Pool Depth — Part E/Section 1

Population — Part D/Section 5A

Portable Equipment — Part D/Section 2

Position and/or Direction Indicator — Part D/ Section 5A

Positive Drive Lift — Part D/Section 5A

Positive Ventilation — Part D/Section 1, Part D/Section 3

Potable Water — Part E/Section 1

Precast Concrete Piles in Prebored Holes — Part C/ Section 2

Precast Driven Pile — Part C/Section 2

Printable Concrete — Part C/Section 7

Prefabricate — Part C/Section 7

Prefabricated Building — Part C/Section 7

Preliminary Operation — Part D/Section 5A

Preloading — Part C/Section 2

Premises — Part E/Section 1, Part E/Section 2

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V

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