

**(BTS-015-2003)**

**Part Two  
Section 6  
Fire Protection**

## 1. SCOPE

This part of the Building Code covers the requirements for fire prevention, life safety in relation to fire and fire protection of buildings. The code specifies construction, occupancy and protection features that are necessary to minimize danger to life and property from fire.

## 2. TERMINOLOGY

2.0 For the purpose of this part, the following definitions shall apply

2.1 **Authority Having Jurisdiction** - The authority which has been created by a statute and which, for the purpose of administering the code/part, may authorize a committee or an official or an agency to act on its behalf; hereinafter called the 'Authority'

2.2 **Automatic Fire Detection and Alarm System** – Fire alarm system comprising components for automatically detecting a fire, initiating an alarm of fire and other actions as appropriate. The system may also include manual fire alarm call points

2.3 **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.

2.4 **Building** - Any structure for whatsoever purpose and of whatsoever materials constructed and every part thereof whether used as human habitation or not, including foundation, plinth, walls, floors, roofs, chimneys, plumbing and building services, fixed platforms, verandah, balcony, cornice or projection, part of a building or anything affixed thereto. Tents, tarpaulin shelters, etc, erected for temporary and ceremonial occasions with the permission of the Authority shall not be considered as building.

2.5 **Building, Height of** - The vertical distance measured in the case of pitched roofs, up to the point where the external surface of the outer wall intersects the finished surface of the sloping roof; and in the case of gables facing the road, the mid-point between the eaves level and the ridge, and in the case of flat roofs, from the average level of the ground around and contiguous to the building or as decided by the Authority to the roof of the last liveable floor of the building adjacent to the external wall. Architectural features serving no other function except that of decoration shall be excluded for the purpose of measuring heights.

2.6 **Combustible Material** - The material which either burns itself or adds heat to a fire, when tested for non-combustibility in accordance with IS 3808: 1979 – Method of test for non-combustibility of building materials

2.7 **Covered 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 round a tree, tank, fountain, bench etc.
- b. Drainage culvert, conduit, catch-pit, gully pit, chamber, gutter and the like;

- c. Compound wall, gate, un-storied porch and portico, slide, swing, uncovered staircases, ramp areas covered by sun/rain shades and the like; and
- d. Watchman's booth, pump-house, garbage shaft, electric cabin or sub-stations, 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.

- 2.8 **Down-comer** - An arrangement of fire fighting within the building by means of down-comer pipe connected to rooftop tank through rooftop 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.
- 2.9 **Dry Riser** - An arrangement of fire fighting 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.
- 2.10 **Emergency Lighting** - Lighting provided for use when the normal lighting supply fails.
- 2.11 **Emergency Lighting System** - A complete but discrete emergency lighting installation from the standby power source to the emergency lighting lamp(s), for example, self-contained emergency luminaries or a circuit from central battery generator connected through wiring to several escape luminaries.
- 2.12 **Escape Lighting** - That part of emergency lighting which is provided to ensure that the escape route is illuminated at all 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 escape routes.
- 2.13 **Fire Door** - A fire-resistive door approved for openings in fire separation.
- 2.14 **Fire Exit** - A way out leading to an escape route having panic bar hardware provided on the door.
- 2.15 **Fire Lift** - The lift installed to enable fire services personnel to reach different floors with minimum delay, having such features as required in accordance with this Part.
- 2.16 **Fire Load** - Calorific energy, of the whole contents contained in a space, including the facings of the walls, partitions, floors and ceilings.
- 2.17 **Fire Load Density** - Fire load divided by floor area.
- 2.18 **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

2.19 **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) Resistance to collapse,
- b) Resistance to penetration of flame and hot gases, and
- c) Resistance to temperature rise on the unexposed face up to a maximum of 180°C and/or average temperature of 150°C.

2.20 **Fire Separation** - The distance in metres measured from the eave boards of the projecting roof of the building concerned to that 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.

2.21 **Fire Separating Wall** - The wall provides complete separation of one building from another or part of a building from another or part of a building from another part of the same building to prevent any communication of fire or heat transmission to wall itself which may cause or assist in the combustion of materials on the side opposite to that portion which may be on fire.

2.22 **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 like as per the laid down criteria.

2.23 **Fire Tower** - An enclosed staircase which can only be approached from the various floors through landings or lobbies separated from both the floor areas and the staircase by fire-resisting doors and open to the outer air.

2.24 **Fire Resisting Wall** - A fire resistance rated wall, having protected openings, which restricts the spread of fire and extends continuously from the foundation to at least 1 m above the roof.

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

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

2.26 **High Rise Building** - For the purpose of this Part, all buildings 15 m or above in height shall be considered as high rise buildings.

2.27 **Horizontal Exit** - An arrangement which allows alternative egress from a floor area to another floor at or near the same level in an adjoining building or an adjoining part of the same building with adequate fire separation.

- 2.28 **Means of Egress** - A continuous and unobstructed way of travel from any point in a building or structure to a place of comparative safety.
- 2.29 **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 shall be deemed to include subsidiary occupancies which are contingent upon it.
- 2.30 **Plinth Area** - The built-up covered area measured at the floor level of the basement or of any storey.
- 2.31 **Roof Exits** - A means of escape on to the roof of a building, where the roof has access to it from the ground. The exit shall have adequate cut-off within the building from staircase below.
- 2.32 **Plot** - A piece of land enclosed by definite boundaries fixed by the implementing authority.
- 2.33 **Travel Distance** - The distance to be travelled from any point in a building to a protected escape route, external escape route or final exit.
- 2.34 **Ventilation** - Supply of outside air into, or the removal of inside air from an enclosed space.
- 2.35 **Venting Fire** - The process of inducing heat and smoke to leave a building as quickly as possible by such paths that lateral spread of fire and heat is checked, fire fighting operations are facilitated and minimum fire damage is caused.
- 2.36 **Volume to Plot Area Ratio (VPR)** - The ratio of volume of building measured in cubic metres to the area of the plot measured in square metres and expressed in metres.
- 2.37 **Wet Riser** - An arrangement for fire fighting within the building by means of vertical rising mains not less than 100 mm nominal diameter with landing valves on each floor/landing for fire fighting purposes and permanently charged with water from a pressurized supply.

### 3. FIRE PREVENTION

#### 3.1 Classification of buildings based on Occupancy

##### 3.1.1 General Classification

All buildings, whether existing or hereafter erected shall be classified according to the use or 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	Storage
Group J	Hazardous buildings
Group K	Heritage Buildings, Archaeological Monuments and Monasteries

3.1.1.1 Minor occupancy incidental to operations in another type of occupancy shall be considered as part of the main occupancy and shall be classified under the relevant group for main occupancy.

Examples of buildings in each group are given in 3.1.2 to 3.1.11

##### 3.1.2 Group A Residential Buildings

These shall 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 shall be further sub-divided as follows:

Sub- Division A-1	Lodging and rooming houses of not more than 40 persons
Sub- Division A-2	One or two family private houses of not more than 20 persons
Sub- Division A- 3	Dormitories
Sub- Division A- 4	Apartment houses (Flats)
Sub- Division A- 5	Hotels
Sub- Division A- 6	Hotels (Starred)

##### 3.1.3 Group B Educational Buildings

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

Buildings under Group B shall be further sub-divided as follows:

- Sub- Division B-1 Schools up-to higher secondary level for students not less than 20 in numbers under a single management
- Sub- Division B-2 All others/ training institutions for students not less than 100 in number under single management

In case of temporary buildings/structures which are utilized for educational purposes, the provisions of 3.3.2 shall apply

If residential accommodation is provided in the schools/institutions that portion of occupancy shall be classified as a building in sub-division A-3.

#### 3.1.4 Group C Institutional Buildings

These shall include any building or part thereof, 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 under Group C shall be further sub-divided as follows:

- Sub- Division C-1 Hospitals, Infirmaries, Sanatoria and Nursing homes
- Sub- Division C-2 Custodial Institutions like homes for the aged and infirm, convalescent homes and orphanages
- Sub- Division C-3 Penal and mental institutes like jails, prisons, mental hospitals, mental sanatoria and reformatories.

#### 3.1.5 Group D Assembly Buildings

These shall include any building or part of a building, where number of persons not less than 50 congregate or gather for amusement, recreation, social, patriotic, civil, travel and similar purposes, for examples theatres, motion picture houses, assembly halls, auditoria, exhibition halls, museums, skating rinks, gymnasiums, restaurants, dance halls, club rooms, passenger stations and terminals of air and surface public transportation services etc.

Buildings under Group D shall be further sub-divided as follows:

- Sub- Division D-1 Buildings having a theatrical or motion picture or any other stage and fixed seats for over 1000 persons.
- Sub- Division D-2 Buildings having a theatrical or motion picture or any other stage and fixed seats for up to 1000 persons.
- Sub-Division D-3 Buildings without a permanent stage having accommodation for 300 or more persons but with no permanent seating arrangement.

Sub-Division D-4	Buildings without a permanent stage having accommodation for less than 300 persons but with no permanent seating arrangement.
Sub-Division D-5	All other structures including temporary structures designed for assembly of people not covered by sub-divisions D-1 to D-4, at ground level.
Sub-Division D-6	Buildings having mixed occupancies providing facilities like shopping, cinema theatres and restaurants.
Sub-Division D-7	All other structures elevated or underground, for assembly of people not covered by sub-divisions D-1 to D-6.

### 3.1.6 Group E – Business Buildings

These shall include any building or part of a building, which is used for transaction of business (other than that covered by Group F and part of buildings covered by 3.1.1.1); for keeping of accounts and records and similar purposes, professional establishments, service facilities, etc. City Halls, Town Halls, court Houses and libraries shall be classified in this group so far as the principal function of these is transaction of public business and keeping of books and records.

Buildings under Group E shall be further sub-divided as follows:

Sub- Division E-1	Offices, Banks, professional establishments, like offices of architects, engineers, lawyers and police stations.
Sub- Division E-2	Laboratories, research establishments, libraries and test houses.
Sub-Division E-3	Computer Installations
Sub-Division E-4	Telephone Exchanges
Sub-Division E-5	Broadcasting Stations and T.V Stations

### 3.1.7 Group F- Mercantile Buildings

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

Buildings under Group F shall be further sub-divided as follows:

Sub- Division F-1	Shops, stores, departmental markets with area up to 500 m <sup>2</sup>
Sub- Division F-2	Shops, stores, departmental markets with area more than 500 m <sup>2</sup>
Sub- Division F-3	Underground shopping centres

Storage and service facilities incidental to the sale of merchandise and located in the same building shall be included under this group.

### 3.1.8 Group G – Industrial Buildings

This shall include any building or part of a building or structure in which products or materials of all kinds and properties are fabricated, assembled, manufactured or processed.

Buildings under Group G shall be further sub-divided as follows:

- |                  |   |
|------------------|---|
| Sub-Division G-1 | Buildings used for low hazard industries with contents of comparatively low combustibility, and the processes or operations conducted have hardly any possibility for any self propagating fire.                            |
| Sub-Division G-2 | Buildings used for moderate hazard industries with contents and processes or operations associated are liable to give rise to a fire which will burn with moderate rapidity giving rise to considerable volume of smoke.    |
| Sub-Division G-3 | Buildings used for high hazard industries with contents or industrial processes or operations associated give rise to a fire which will burn with extreme rapidity giving rise to poisonous fumes and gases and explosions. |

A broad classification of industrial and non-industrial occupancies into low, moderate and high hazard classes is given in annex B. Any occupancy not covered in Annex B, shall be classified in the most appropriate class depending on the degree of hazard.

### 3.1.9 Group H – Storage Buildings

These shall include any building or part of building used primarily for the storage or sheltering (including servicing, processing and repairs incidental to storage) of goods, ware or merchandise except hazardous materials and vehicles or animals such as cold storage, warehouses, freight depots, transit sheds, garages, barns and stables. Storage properties are characterised by the presence of small number of persons in proportion to the area. If any new use increases the occupancy, it will be classified with the corresponding occupancy or use.

### 3.1.10 Group J – Hazardous buildings

These shall include any building or part of a 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, processing which involve highly corrosive, toxic or noxious alkalis, acids or other liquids or chemical producing flame, fumes etc.

Examples include storage and handling of hazardous and highly flammable liquids, LPG, rocket propellants etc, manufacture of artificial flowers, synthetic leather etc.

### 3.1.11 Group K - Heritage Buildings, Archaeological Monuments and Monasteries

These shall include all heritage buildings, archaeological monuments and monasteries. Examples include the Dzongs and the monasteries irrespective of their usage as educational institutions, as office establishments or for any other purpose like religious gatherings.

3.1.12 Any buildings not covered by annex B or 3.1.8 shall be classified in the group which most nearly resembles its existing or proposed use.

3.1.13 Where change in the occupancy of any building places it in a different group or in a different sub-division of the same group, such building shall be made to comply with the requirements of the code for the new group or its sub-division

3.1.14 Where the new occupancy of a building is less hazardous, based on life and fire risk, than its existing occupancy, it shall not be necessary to conform to the requirements of the code for the new group or its sub-division.

3.1.15 A certificate of occupancy shall be necessary, as required in the Development control regulation and the Bhutan Building Rules or its subsequent revisions before any change is effected in the character of occupancy of any building.

## **3.2 Types of construction:**

### 3.2.1 General

The design of any building and type of materials used in its construction are important factors in making the building resistant to complete burn out and spreading fire, smoke, fumes which 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 hours against a specified test load expressed in kcal /m<sup>2</sup> and against a certain intensity of fire.

For the purpose of the code, the types of construction according to fire resistance shall be classified into four categories as given below:

- |                        |   |                                 |
|------------------------|---|---------------------------------|
| a. Type 1 Construction | - | Fire Proof Construction         |
| b. Type 2 Construction | - | Incombustible Construction      |
| c. Type 3 Construction | - | Exterior Protected Construction |
| d. Type 4 Construction | - | Wooden Construction             |

Types of construction given are Type 1 highest in fire resistance and Types 2, 3 and 4 are lower in resistance in ascending numbers.

The fire resistance ratings of various types of construction for structural and non-structural members shall be as given in table 1.

For buildings 15m in height or above, non-combustible materials should be used for construction and the internal walls of staircase enclosures should be of brickwork or reinforced concrete or any other material of construction with minimum 2 h rating. The walls for the chimney shall be of type 1 or type 2 constructions depending on whether the gas temperature is above 200°C or less.

3.2.2 It is required that an element/component shall have the requisite fire resistance rating when tested with relevant standards. Tables 2 to 18 provide available data regarding fire resistance ratings of various building components such as walls, columns and floors. Fire damage assessment, post fire structural safety assessment of various structural elements of the building and adequacy of repairs can be done by the fire resistance ratings mentioned in tables 2 to 18.

### 3.2.3 Steel Construction

Load bearing steel beams and columns of buildings having covered area of 500 m<sup>2</sup> and above shall 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 (table 14 and 15)

**Table 1: Fire resistance ratings of structural and non- structural elements (in hours) (Clause 3.2.1)**

Sl.	Structural element	Type of Construction				
		Type 1	Type 2	Type 3	Type 4	
(1)	(2)	(3)	(4)	(5)	(6)	
A	Exterior Walls					
	a. Fire Separation less than 3.7m	a. bearing	4	2	2	1
		b. Non- bearing	2	1½	1	1
	b. Fire Separation of 3.7m or more but less than 9m	a. bearing	4	2	2	1
		b. Non-bearing	1½	1	1	1
	Fire Separation of 9m or more	a. Bearing	4	2	2	1
b. Non- bearing		1	1	1	1	
B	Fire Resisting Walls	4	2	2	2	
C	Fire Separation Assemblies ( like fire check doors)	4	2	2	2	
D	Fire enclosures of exit ways, elevator and hoist ways	2	2	2	2	
E	Shafts other than exit ways, elevator and hoist ways	2	2	2	2	
F	Exit way access corridors	1	1	1	1	
G	Vertical separation tenant spaces	1	1	1	1	
H	a. Dwelling unit separation	1	1	1	1	
	b. Non Load Bearing partitions	At least half an hour				
I	Interior bearing walls, bearing partitions, columns, girders, trusses ( other than roof trusses) and framing	a. supporting more than 1 floor	4	2	2	2
		b. supporting 1 floor only	3	1½	1	1
		c. supporting a roof only	3	1½	1	1
J	Structural members support walls	3	1½	1	1	
K	Floor construction including walls	3	1½	1	1	
L	Roof Construction	a. 5m or less in height to lowest member	2	1½	1	1
		b. > 5 m but < 6.7 m in height to lowest member	1	1	1	1
		c. 6.7 m or more in height to lowest member	0	0	0	0

**Table 2 Masonry Walls: Solid (Required to resist fire from one side at a time)**  
(Clause 3.2. 2)

Nature of construction and materials	Minimum thickness (mm) excluding any finish for fire resistance (hours) of									
	Load Bearing					Non-Load Bearing				
	1	1½	2	3	4	1	1½	2	3	4
1	2	3	4	5	6	7	8	9	10	11
Reinforced <sup>1</sup> Cement Concrete	120	140	160	200	240					
	(25) <sup>2</sup>	(25) <sup>2</sup>	(25) <sup>2</sup>	(25) <sup>2</sup>	(25) <sup>2</sup>					
Unreinforced cement concrete	150	175	-	-	-					
No – fines concrete with										
a. 13mm cement/sand or gypsum/sand	-	-	-	-	-	150	150	150	150	150
b. 13mm light weight aggregate gypsum plaster	-	-	-	-	-	150	150	150	150	150
Bricks of clay										
a. Without finish	90	100	100	170	170	75	90	100	170	170
b. 13mm light weight aggregate gypsum plaster	90	90	90	100	100	75	90	90	90	100
Bricks of sand lime										
a. without finish	90	100	100	190	190	75	90	100	170	170
b. 13mm light weight aggregate gypsum plaster	90	90	90	100	100	75	90	90	90	100
Blocks of concrete										
a. Without finish	90	100	100	-	-	75	90	100	140	150
b. 13mm light weight aggregate gypsum plaster	90	90	90	100	100	75	75	75	90	100
c. With 13mm cement/sand or gypsum/sand						75	90	90	100	140
Blocks of light weight concrete										
a. Without finish	90	100	100	140	150	75	75	75	125	140
b. 13mm light weight aggregate gypsum plaster	90	90	90	100	100	50	63	75	75	75
c. With 13mm cement/sand or gypsum/sand	-	-	-	-	-	75	75	75	90	100
Blocks of aerated concrete										
a. Without finish	90	100	100	140	180	50	63	63	75	100
b. 13mm 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 3 Masonry Walls: Hollow (Required to resist fire from one side at a time)**  
(Clause 3.2. 2)

Nature of construction and materials	Minimum thickness (mm) excluding any finish for fire resistance (hours) of										
	Load Bearing					Non-Load Bearing					
	1	1½	2	3	4	½	1	1½	2	3	4
1	2	3	4	5	6	7	8	9	10	11	12
Bricks of clay											
a. Without finish	170	170	170	200	200	75	75	90	100	170	170
b. 13mm light weight aggregate gypsum plaster	100	100	170	170	170	75	75	90	90	90	100
Blocks of concrete											
a. Without finish						90	125	125	140	140	150
b. 13mm light weight aggregate gypsum plaster						75	90	90	100	125	125
c. With 13mm cement/sand or gypsum/sand	190	200	200	-	-	90	125	125	140	140	150
Blocks of light weight concrete											
a. Without finish	100	100	100	-	-	75	90	90	100	140	150
b. 13mm light weight aggregate gypsum plaster	-	-	--	-	-	63	63	63	75	90	100
c. With 13mm cement/sand or gypsum/sand	-	-	-	-	-	75	75	75	100	140	140

**Table 4 Framed Construction, Load Bearing (Required to resist fire from one side at a time)**  
(Clause 3.2. 2)

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 1 h
1	2
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 5 Framed Construction, Non Load Bearing (Required to resist fire from one side at a time)**  
(Clause 3.2.2)

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			
		½ h	1 h	1½ h	2 h
1	2	3	4	5	6
A. Dry Lining with materials fixed direct to studs ( without plaster finish)					
1. One layer of plasterboard with taped and filled joints	Timber or steel	12.7			
2. Two layers of plasterboard with joints segregated, joints in outer layer taped and filled – total thickness for each face	Timber or steel	19	25		
3. One layer of asbestos insulating board with transverse joints backed by fillers or asbestos insulating board not less than 9mm thick, or by timber	Timber or steel	9	12		
4. One layer of wood wool slabs	Timber	25			
5. One layer of chip board or of plywood	Timber or steel	18			
B. Lining with materials fixed direct to studs with plaster finish					
Plasterboard of thickness	Timber or steel	9.5			
a. with not less than 5mm gypsum plaster finish			12.7		
b. with not less than 13mm gypsum plaster finish					
C. Wet Finish					
Metal Lath and plaster; thickness of plaster					
a. sanded gypsum plaster	Timber or steel	13			
b. lightweight aggregate gypsum plaster	Timber		13	19	25
	Steel		13		

**Table 6 Framed External Walls Load Bearing (Required to resist fire from one side at a time)**  
(Clause 3.2.2)

Nature of Construction and Materials	Minimum Thickness (mm) of protection for a fire resistance of 1 h
1	2
Timber studs at centres not exceeding 600 mm with internal linings of :	25
i. Plasterboard layers with joints in outer layer taped and filled – total thickness of plaster board	

**Table 7 Framed External Walls Load Bearing Required to resist fire only from inside the building  
(A) (Clause 3.2. 2)**

Nature of construction and materials	Minimum thickness(mm) of protection for a fire resistance					
	½h	1h	1½h	2 h	3 h	4 h
Steel Frame with an external cladding of non-combustible sheets (excluding sheet steel), with a steel supporting framework and internal lining of :						
Metal lath and plaster, thickness of plaster:						
Sanded gypsum plaster ( metal lathing grade)	13	13				
Light weight aggregate gypsum plaster	10	13	15	15	15	19
Two layers of plasterboard with joints staggered joints in outer layer taped and filled – total thickness	21	32				
Plasterboard of thickness						
With not less than 5 mm gypsum plaster finish	12.7					
With not less than 13 mm gypsum plaster finish	9.5					
With not less than 10 mm lightweight aggregate gypsum plaster	9.5					
One layer of wood/wool slabs without finish		50				
One layer of compressed straw building slabs:						
Without finish	50					
With not less than 5 mm gypsum plaster finish		50				
Aerated concrete blocks	50	50	63	63	75	100
Bricks of clay						
Without finish	75	75	90	90	100	100
With not less than 13 mm lightweight aggregate gypsum plaster			75	75	90	90

**Table 8 Framed External Walls Load Bearing Required to resist fire only from inside the building  
(B) (Clause 3.2.2)**

Nature of construction and materials	Minimum thickness(mm) of protection to provide sufficient insulation to achieve a modified fire resistance of up to 4 h
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 :	
Metal lath and plaster, thickness of plaster:	
Sanded gypsum plaster ( metal lathing grade)	13
Light weight aggregate gypsum plaster	10
One layer of plasterboard with joints taped and filled	12.7
Plasterboard of thickness with not less than 5 mm gypsum plaster finish	9.5
One layer of wood/wool slabs without finish	25
One layer of compressed straw building slabs:	50
One layer of chipboard or of plywood	18
Aerated concrete blocks	50
Bricks of clay	75
Any internal decorative lining with a cavity fill independently supported or retained in position of mineral fibre insulating material ( excluding glass) at a density of 48kg/m <sup>3</sup>	50

**Table 9 Framed Walls Non- Load Bearing Required to resist fire only from inside the building (C)  
(Clause 3.2.2)**

Nature of construction and materials	Minimum thickness(mm) of protection for fire resistance of 1½ h
Timber Frame with an external cladding of weather boarding or external plywood, 9.5mm with an internal lining of :	
Plasterboard not less than 9.5 mm thick, finished with:	
Gypsum plaster	13
Lightweight aggregate gypsum plaster	10
Plasterboard not less than 12.7 mm thick, finished with :	
Gypsum plaster	10
Lightweight aggregate gypsum plaster	10

**Table 10 Reinforced Concrete Columns** (Clause 3.2.2)

Nature of construction and materials		Minimum dimension(mm) excluding any finish for a fire resistance of					
		½h	1h	1½h	2 h	3 h	4 h
Fully Exposed	Width	150	200	250	300	400	450
	Cover	40	40	40	40	40	40
50 percent Exposed	Width	125	160	200	200	300	350
	Cover	40	40	40	40	40	40
One face exposed	Thickness	100	120	140	160	200	240
	Cover	40	40	40	40	40	40

**Table 11 Concrete Beams** (Clause 3.2.2)

Nature of construction and materials		Minimum dimension(mm) excluding any finish for a fire resistance of					
		½h	1h	1½h	2 h	3 h	4 h
Reinforced Concrete ( simply supported)	Width	200	200	200	200	240	280
	Cover	20	20	20	40	60 <sup>1</sup>	70 <sup>1</sup>
Reinforced concrete ( continuous)	Width	200	200	200	200	240	280
	Cover	20	20	20	30	40	50 <sup>1</sup>
Pre-stressed concrete ( simply Supported)	Width	100	120	150	200	240	280
	Cover	25	40	55	70	80	90
Pre-stressed concrete ( continuous)	Width	80	100	120	150	200	240
	Cover	20	30	40	55	70	80

<sup>1</sup>Require attention to the additional measures necessary to reduce the risk of spalling

**Table 12 Concrete Floors** (Clause 3.2.2)

Nature of construction and materials		Minimum dimension(mm) excluding any finish for a fire resistance of					
		½h	1h	1½h	2 h	3 h	4 h
Reinforced Concrete ( simply supported)	Width	75	95	110	125	150	170
	Cover	20	20	25	35	45 <sup>1</sup>	55 <sup>1</sup>
Reinforced concrete ( continuous)	Width	75	95	110	125	150	170
	Cover	20	20	20	25	35	45 <sup>1</sup>

<sup>1</sup>Require attention to the additional measures necessary to reduce the risk of spalling

**Table 13 Concrete Floors Ribbed Open Soffit (Clause 3.2.2)**

Nature of construction and materials		Minimum dimension(mm) excluding any finish for a fire resistance of					
		½h	1h	1½h	2 h	3 h	4 h
Reinforced Concrete ( simply supported)	Thickness of floor	75	95	110	125	150	170
	Rib Width	125	125	125	125	150	175
	Cover	20	20	35	45	55	65
Reinforced concrete ( continuous)	Thickness	75	95	110	125	150	170
	Width	125	125	125	125	150	175
	Cover	20	20	20	35	45	55

**Table 14 Encased Steel Columns, 203mm x 203mm  
(Protection applied on four sides)  
(Clause 3.2.2 and 3.2.3)**

Nature of construction and materials		Minimum dimension(mm) excluding any finish for a fire resistance of				
		1h	1½h	2 h	3 h	4 h
A. Hollow Protection ( without an air cavity over the flanges)						
1. <sup>1</sup> Metal Lathing with trowelled lightweight aggregate gypsum plaster		13	15	20	32	
2. Plasterboard with 1.6mm wire binding at 100 mm pitch, finished with lightweight aggregate gypsum plaster not less than the thickness specified						
a. 9.5 mm plaster board		10	15	10	13	20
b. 19 mm plasterboard						
3. Asbestos insulating boards, thickness of board:						
a. Single thickness of board, with 6 mm cover fillets at transverse joints			19	25		
b. Two layers of total thickness					38	50
4. Solid bricks of clay, composition or sand lime, reinforced in every horizontal joint, un-plastered		50	50	50	75	100
5. Aerated concrete blocks		60	60	60		
6. Solid blocks of lightweight concrete hollow protection ( with an air cavity over the flanges)		50	50	50	60	75
C. Solid protections						
1. Concrete, not leaner than 1:2:4 mix ( un-plastered):						
a. Concrete, not assumed to be load bearing, reinforced <sup>2</sup>		25	25	25	50	75
b. Concrete assumed to be load bearing		50	50	50	75	75
2. Lightweight concrete, not leaner than 1:2:4 mix ( un-plastered): concrete not assumed to be load bearing, reinforced <sup>2</sup>		25	25	25	40	60

<sup>1</sup>So fixed or designed, as to allow full penetration for mechanical bond

<sup>2</sup>Reinforcement shall consist of steel binding wire not less than 2.3 mm in thickness, or a steel mesh weighing not less than 0.5kg/m<sup>2</sup>. In concrete protection, the spacing of that reinforcement shall not exceed 200mm in any direction.

**Table 15 Encased Steel Beams, 406mm x176mm (Protection applied on three sides)**  
(Clause 3.2.2 and 3.2.3 )

Nature of construction and materials	Minimum dimension(mm) excluding any finish for a fire resistance of					
	½h	1h	1½h	2 h	3 h	4 h
A. Hollow Protection ( without an air cavity beneath the lower flange)						
1. <sup>1</sup> Metal Lathing with trowelled lightweight aggregate gypsum plaster	13	13	15	20	25	
2. Plasterboard with 1.6mm wire binding <sup>2</sup> at 100 mm pitch, finished with lightweight aggregate gypsum plaster not less than the thickness specified						
a. 9.5 mm plaster board	10	10	15			
b. 19 mm plasterboard	10	10		13	20	
3. Asbestos insulating boards, thickness of board:						
a. Single thickness of board, with 6 mm cover fillets at transverse joints			19	25		
b. Two layers of total thickness					38	50
C. Solid protections						
1. Concrete, not leaner than 1:2:4 mix ( un-plastered):						
a. Concrete, not assumed to be load bearing, reinforced <sup>3</sup>	25	25	25	25	50	75
b. Concrete assumed to be load bearing	50	50	50	50	75	75
2. Lightweight concrete <sup>4</sup> , not leaner than 1:2:4 mix ( un-plastered): concrete not assumed to be load bearing, reinforced	25	25	25	25	40	60

<sup>1</sup>So fixed or designed, as to allow full penetration for mechanical bond

<sup>2</sup>Where binding wire 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

<sup>3</sup>Reinforcement shall consist of steel binding wire not less than 2.3 mm in thickness, or a steel mesh weighing not less than 0.5kg/m<sup>2</sup>.In concrete protection, the spacing of that reinforcement shall not exceed 200mm in any direction.

<sup>4</sup>Concrete not assumed to be load bearing, reinforced

**Table 16 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 3.2.2)**

Nature of construction and Materials/Steel or timber frame at centres not exceeding 600 mm facings on both sides of	Minimum Thickness (mm) of protection for a fire resistance		
	½ h	1 h	2 h
37 mm ( minimum) timber joists with a ceiling of :			
1. Timber lathing and plaster, plaster of thickness	15		
2. Metal Lathing and plaster, thickness of plaster			
a. Sanded gypsum plaster ( metal lathing grade)	15		
b. Lightweight aggregate gypsum plaster	13	13	25
3. One layer of plasterboard with taped and filled joints	12.7		
4. Two layers of plasterboard, with joints staggered, joints in outer layer taped and filled total thickness	19	31	
5. One layer of plasterboard not less than 9.5mm thick, finished with:			
a. Gypsum plaster	5		
b. Sanded gypsum plaster	13		
c. Lightweight aggregate gypsum plaster	13		
6. One layer of plasterboard not less than 12.7mm thick, finished with			
a. Gypsum plaster	5		
b. Lightweight aggregate gypsum plaster	10		

**Table 17 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 3.2.2)**

Nature of construction and Materials/Steel or timber frame at centres not exceeding 600 mm facings on both sides of	Minimum Thickness (mm) of protection for a fire resistance		
	½ h	1 h	2 h
37 mm ( minimum) timber joists with a ceiling of :			
1. Timber lathing and plaster, plaster of thickness	15		
2. Metal Lathing and plaster, thickness of plaster for:			
a. Sanded gypsum plaster ( metal lathing grade)	15		
b. Lightweight aggregate gypsum plaster	13	13	25
3. One layer of plasterboard with taped and filled joints	12.7		
4. Two layers of plasterboard, with joints staggered, joints in outer layer taped and filled total thickness	22	31	
5. One layer of plasterboard not less than 9.5mm thick, finished with:			
a. Gypsum plaster	5		
b. Sanded gypsum plaster	15		
c. Lightweight aggregate gypsum plaster	13		
6. One layer of plasterboard not less than 12.7mm thick, finished with			
a. Gypsum plaster	5		
b. Lightweight aggregate gypsum plaster	10		

**Table 18 Timber Floors- Any structurally Suitable Flooring of Timber or Lignocelluloses Boards**  
(Clause 3.2.2)

Nature of construction and Materials/Steel or timber frame at centres not exceeding 600 mm facings on both sides of	Minimum Thickness (mm) of protection for a fire resistance	
	½ h	1 h
37 mm ( minimum) timber joists with a ceiling of :		
1. Timber lathing and plaster, plaster of thickness	15	
2. Metal Lathing and plaster, thickness of plaster		
a. Sanded gypsum plaster ( metal lathing grade)	15	
b. Lightweight aggregate gypsum plaster	13	19
3. One layer of plasterboard with taped and filled joints	12.7	
4. Two layers of plasterboard, with joints staggered, joints in outer layer taped and filled total thickness	25	
5. Two layers of plasterboard, each not less than 9.5 mm thick, joints between boards staggered and outer layer finished with gypsum plaster	5	
6. One layer of plasterboard not less than 9.5mm thick, finished with:		
a. Sanded gypsum plaster	13	
b. Lightweight aggregate gypsum plaster	15	
7. One layer of plasterboard not less than 12.7mm thick, finished with		
a. Sanded Gypsum plaster	15	12
b. Lightweight aggregate gypsum plaster	13	

### 3.3 Requirements of Type of Construction based on individual occupancies

3.3.1 Depending on the occupancy of a building, the building shall conform to the types of construction as specified in table 19 below:

**Table 19 – Construction types for different occupancies**

Occupancies	Types of construction allowed
Group A – Residential buildings Group B – Educational buildings Group C – Institutional Group D – Assembly Group – E 1 – offices, banks, professional establishments and police stations Group F – Mercantile buildings	Type 1, Type 2, Type 3 and Type 4
Group E – 2 laboratories, research establishments, libraries and test houses Group E – 3 Computer Installations Group E – 4 Telephone Exchanges Group E – 5 Broadcasting stations and TV stations Group G – 1 buildings used for low hazard industries Group G – 2 buildings used for moderate hazard industries	Type 1, Type 2 and Type 3
Group G- 3 Buildings used for high hazard industries Group H – Storage buildings Group J – Hazardous Buildings	Type 1 or Type 2
Group K -	Construction specification to be decided by the Ministry of Home and Cultural Affairs.

### 3.3.2 Temporary buildings or structures :

3.3.2.1 Temporary buildings shall be permitted only as the case may be, 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.

3.3.2.2 Such temporary buildings and structures shall be removed on the expiry of the period specified in the permit.

3.3.2.3 Adequate fire precautionary measures in the construction of temporary structures shall be taken in accordance with IS 8758: 1993 – Recommendations for fire precautionary measures in the construction of temporary structures and PANDALS.

### 3.3.3 Restrictions on existing buildings

The existing buildings shall be required to comply with requirements of fire protection of this code. If these buildings are altered, or in the opinion of the authority, such building constitutes a hazard to the safety of the adjacent property or the occupants of the building itself or is an unsafe building. In the event of alteration, it shall also be necessary to obtain permission of the authority for such alteration consistent with the fire hazard.

Alterations/modifications/renovations shall be so as to ensure conformity with all the safety requirements of the new building. Such alterations shall not in anyway bring down the level of fire and life safety below that which existed earlier. Any addition or alterations or constructions of cubicles or partitioning for floor area exceeding 500 m<sup>2</sup> for all high rise buildings shall be with the approval of the local fire authority.

## 3.4 General Requirements of All Individual Occupancies

### 3.4.1 General

All buildings shall 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.

### 3.4.2 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, the Authority may grant exemptions from the Code.

### 3.4.3 Maximum Height

Every building shall be restricted in its height above the ground level and the number of storeys as per the zoning regulations in the relevant Development Control Regulations, the Bhutan Building Rules or any existing rules and regulations.

### 3.4.4 Open Spaces

The open spaces around or inside a building shall conform to the requirements of Development Control Regulations, the Bhutan Building Rules or any existing rules and regulations.

For high rise buildings, the following additional provisions of means of access to the building shall be ensured

- a. The width of the main street on which the building abuts shall not be less than 12 m and one end of this street shall join another street not less than 12 m in width;
- b. The road shall not terminate in a dead end; except in the case of residential building, up to a height of 30 m.
- c. The compulsory open spaces around the building shall not be used for parking; and
- d. Adequate passageway and clearances required for fire fighting vehicles to enter the premises shall be provided at the main entrance; the width of such entrance shall be not less than 4.5 m. If an arch or covered gate is constructed, it shall have a clear head-room of not less than 5 m.

### 3.4.5 Mixed Occupancy

When any building is used for more than one type of occupancy, then in so far as fire safety is concerned, it shall conform to the requirements for the occupancies of higher hazard. Unless the high hazard area is separated by separating walls of 4 h rating, the occupancies shall not be treated individually.

### 3.4.6 Openings in Separating Walls and Floors

At the time of designing openings in separating walls and floors, particular attention shall be paid to all such factors as will limit fire spread through these openings and maintain fire rating of the structural member.

3.4.6.1 For Types 1 to 3 construction, a doorway or opening in a separating wall on any floor shall be limited to 5.6 m<sup>2</sup> in area with a maximum height/width of 2.75 m. Every wall opening shall be protected with fire-resisting doors having fire rating of not less than 2 h. All openings in the floors shall be protected by vertical enclosures extending above and below such openings, the walls of such enclosures having a fire resistance of not less than 2 h and all openings therein being protected with a fire-resisting assembly as specified in 3.4.7.

3.4.6.2 For Type 4 construction, openings in the separating walls or floors shall be fitted with 2 h fire-resisting assemblies.

3.4.6.3 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, shall be protected by enclosure in the form of ducts/shafts having a fire resistance not less than 2 h. The inspection door for electrical shafts/ducts shall be not less than 2 h and for other services shafts/ducts, the same shall have fire resistance not less than 1 h. Medium and low voltage wiring running in shafts/ducts, shall either be armoured type or run through metal conduits. Further, the space between the conduits pipes and the walls/ slabs shall be filled in by a filler material having fire resistance rating of not less than 1 h.

#### 3.4.6.4 Vertical opening

Every vertical opening between the floors of a building shall 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 shall be ensured to provide a clear height of 2.1 m the passage/escape path of the occupants.
- b. Limitation of damage to the building and its contents.

#### 3.4.7 Fire Stop or Enclosure of Openings

Where openings are permitted, they shall not exceed three-fourths the area of the wall in the case of an external wall and they shall be protected with fire resisting assemblies or enclosures having a fire resistance equal to that of the wall or floor in which these are situated. Such assemblies and enclosures shall also be capable of preventing the spread of smoke or fumes through the openings so as to facilitate the safe evacuation of building in case of a fire

#### 3.4.8 Electrical Installations

For requirements regarding electrical installations from the point of view of fire safety, reference may be made to “Electrical Installations: BTS -010- 2003”

#### 3.4.9 Air-conditioning and Ventilation

Air-conditioning and ventilation requirements of different rooms or areas in any occupancy shall be as given in “Lighting and Ventilation: BTS -012-2003” and “Air Conditioning and Heating : BTS – 012-2003” respectively.

#### 3.4.10 Smoke Venting

3.4.10.1 Smoke venting facilities for safe use of exits in windowless buildings, underground structures, large area factories, hotels and assembly buildings (including cinema halls) shall be automatic in action with manual controls in addition.

3.4.10.2 Natural draft smoke venting shall utilize roof vents or vents in walls at or near the ceiling level; such vents shall be normally open, or, if closed, shall be designed for automatic opening in case of fire, by release of smoke sensitive devices.

3.4.10.3 Where smoke venting facilities are installed for purposes of exit safety, these shall be adequate to prevent dangerous accumulation of smoke during the period of time necessary to evacuate the area served, using available exit facilities with a margin of safety to allow for unforeseen contingencies. It is recommended that smoke exhaust equipment should have a minimum capacity of 12 air changes per hour. Where mechanical venting is employed, it shall be fire safe.

3.4.10.4 The discharge apertures of all natural draft smoke vents shall be so arranged as to be readily accessible for opening by fire service personnel.

3.4.10.5 Power operated smoke exhausting systems shall be substituted for natural draft -vents only by specific permission of the Authority.

### 3.4.11 Additional Precautions

In addition to the factors covered by 3.4.2 to 3.4.10 there are certain aspects, applicable to particular occupancies only, which may effect the spread of fumes and thus the safe evacuation of the building in case of fire. Some such aspects are:

- a. Interior finish and decoration;
- b. Seating, aisles, railings, turnstiles and revolving doors in places of assembly;
- c. Service equipment and storage facilities in buildings other than storage buildings; and
- d. Hazards on stage, in waiting spaces, projection booths, etc, in theatres and cinemas.

### 3.4.12 Surface Interior Finishes

3.4.12.1 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 shall be such that it shall not generate toxic smoke/fumes.

3.4.12.2 The susceptibility to fire of various types of wall surfaces is determined in terms of the rate of spread of flame. Based on the rate of spread of flame, surfacing material shall be considered as divided into four classes as follows

Class 1	Surfaces of very low flame spread.
Class 2	Surfaces of low flame spread.
Class 3	Surfaces of medium flame spread.
Class 4	Surfaces of rapid flame spread.

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

Class I - May be used in any situation

Class 2 – May be used in any situation, except on walls, façade of building, staircase and corridors

Class 3 – 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 façade of the building

NOTE - Panelling (lining) shall be permitted in a limited area. It shall not be permitted in a vestibule.

3.4.12.4 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 class [see Note under 3.4.12.3] Class 4 materials shall 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 shall be excluded from use under these conditions and shall also not be used for construction of ceiling where the plenum is used for return air in air-conditioned buildings.

3.4.12.5 When frames, walls, partitions or floors are lined with combustible materials, the surfaces on both sides of the materials shall 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 there by.

### 3.4.13 Glazing

3.4.13.1 Building of Types 1 to 4 constructions shall employ one of the two types of glazing described in 3.4.13.2 and 3.4.13.3 except that Type 4 construction may have the alternative of hardwood sashes or frames or both.

3.4.13.2 Wired glass shall comply with the following requirements:

- a. Wired glass - The wired glass shall be of minimum half hour fire resistance rating.
- b. Sashes and frames - The sashes or frames or both shall be entirely of iron or other suitable metal such as stainless steel, securely bolted or keyed into the wall, except in the case of panels in internal doors.
- c. Setting of glass - The panels of glass shall be set in rebates or grooves not less than 6.0 mm in width or depth, with due allowance for expansion, and shall be secured by hard metal fastenings to the sashes or frames independently of any cement or putty used for weather-proofing purposes.

3.4.13.3 Electro-copper glazing shall comply with the following requirements:

- a. Electro-copper glazing - The electro-copper glazing shall be of minimum half hour fire resistance rating.
- b. Sashes and frames - The sashes or frames or both shall be entirely of iron or other hard

metal, securely bolted or keyed into the wall, except when in panels in internal doors.

- c. Fixing of sectional lights - The sectional lights shall be set in rebate or grooves not less than 6.5 mm in width or depth, with due allowance for expansion and shall be secured by hard metal fastenings to the sashes or frames independently of any lead, cement or putty used for weather-proofing purposes.

3.4.13.4 Maximum permissible area shall be 5 m<sup>2</sup> for protection by wired glass or electro-copper glazing.

#### 3.4.13.5 Casement

Hard metal casements, not exceeding 0.8 m<sup>2</sup> fitted with wired glass or electro-copper glazing in accordance with 3.4.13.2 and 3.4.13.3, secured to the frames by hard metal hinges not more than 600 mm apart and by fastening at top, centre and bottom shall be permissible.

#### 3.4.14 Skylights

3.4.14.1 Wired glass for skylights or monitor lights shall comply with the following requirements:

- a. Wired glass for skylights or monitor lights. The wired glass for skylights or monitor lights shall be of minimum half hour fire resistance rating.
- b. Frames and glazing - The frame shall be continuous and divided by bars spaced at not more than 700 mm centres. The frame and bars shall be of iron or other hard metal, and supported on a curb either of metal or of wood covered with sheet metal. The toughened glass shall be secured by head metal fastenings to the frame and bars independently of any lead, cement or putty used for weather-proofing purposes.

## 4. LIFE SAFETY

### 4.1 General

Every building shall be so constructed, equipped, maintained and operated as 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.

### 4.2 General Exit Requirements

4.2.1 An exit maybe a doorway, corridor, passageways to an internal staircase, or external staircase, or to a veranda or terraces, which have access to the street, or roof of the building or refuge area. An exit may include a horizontal exit leading to an adjoining building at the same level.

4.2.2 Lifts and elevators shall not be considered as exits.

4.2.3 Every exit, exit access or exit discharge shall 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 meant for human occupancy shall be provided with exits sufficient to permit safe escape of occupants in case of fire or other emergency.

4.2.5 Every building exit shall comply with the minimum requirements of this part, except those not accessible for general public use.

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

4.2.7 Exits shall be clearly visible and the routes to reach the exit shall be sign posted to guide the population of the floor concerned. Signs shall be illuminated and wired to an independent electrical circuit on an alternative source of supply. The colour of the exit signs shall be green.

Note – This provision doesn't apply to A-2 and A-4 occupancies less than 15m in height

4.2.8 Fire doors with 2 h fire resistance shall be provided at appropriate places along the escape routes 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 and smoke.

4.2.9 All exits shall provide continuous means of egress to the exterior of a building or to an exterior open space leading to a street.

4.2.10 Exits shall be so arranged that they may be reached without passing through another occupied unit.

### 4.3 Occupant load

For determining the exits required, the number of persons within any floor area or the occupant load shall be based on the actual number of occupants, but in no case less than specified in table 20

Table 20: Occupant load (Clause 4.3)

Sl. No.	Group of occupancy	Occupant load, floor area in m <sup>2</sup> per person
1	Residential ( A)	12.5
2	Educational (B)	4
3	Institutional ( C)	15 ( see note 1)
4	Assembly ( D) a) with fixed or loose seats and dance floors b) Without seating facilities including dining rooms	0.6 ( see note 2) 1.5 ( see note 3)
5	Mercantile ( F) a) Street floor and sales basement b) Upper sales floor	3 6
6	Business and industrial ( E& G)	10
7	Storage ( H)	30

8	Hazardous ( J)	10
---	----------------	----

## Notes:

1. Occupant load in dormitory portions of homes for the aged, orphanages, insane asylums etc, where sleeping accommodation is provided, shall be calculated at not less than 7.5m<sup>2</sup> gross floor area/person.
2. The gross floor area shall include, in addition to the main assembly room or space, any occupied connecting room or space in the same storey or in the storeys above or below, where entrance is common to such rooms and spaces and they are available for use by the occupants of the assembly place. No deductions shall be made in the gross area for corridors, closets or other sub-divisions; the area shall include all space serving the particular assembly occupancy.

## 4.3.1 Mezzanine

The occupant load of a mezzanine floor discharging to a floor below shall be added to that floor occupancy and the capacity of the exits shall be designed for the total occupancy.

## 4.4 Capacities of exit

- 4.4.1 The unit of exit width, used to measure the capacity of any exit, shall be 500 mm. A clear width of 250 mm shall be counted as an additional half unit. Clear widths less than 250 mm shall not be counted for exit width.

Note: The total occupants from a particular floor must evacuate within 2½ minutes for type 1 construction, 1½ minutes for type 2 constructions and 1 minute for type 3 construction. Size of the exit door/exit way shall be calculated accordingly keeping in view the travel distance as per table 22.

- 4.4.2 Occupants per unit exit width shall be in accordance with table 21 given below.

## 4.4.3 Horizontal exit allowance

When horizontal exit is provided in buildings of mercantile, storage, industrial, business and assembly occupancies, the capacity per storey per unit width of exit of stairways in table 21 may be increased 50 % and in buildings of Institutional occupancy it may be increased by 100 %.

## 4.5 Arrangement of exits

- 4.5.1 Exits shall be so located that the travel distance on the floor shall not exceed the distance given in the table 22

Table 21: Occupant per unit exit width ( clause 4.4.2)

Sl. No.	Group of occupancy	Number of occupants		
		Stairways	Ramps	Doors
1	Residential	25	50	75
2	Educational	25	50	75
3	Institutional	25	50	75
4	Assembly	40	50	60

5	Business	50	60	75
6	Mercantile	50	60	75
7	Business and industrial	50	60	75
8	Storage	50	60	75
9	Hazardous	25	30	40

- 4.5.2 The travel distance to an exit from the dead end of a corridor shall not exceed half the distance specified in the table 22, except in educational, assembly and institutional occupancies in which case it shall not exceed 6 m.
- 4.5.3 Whenever more than one exit is required for any room space or floor of building, exits shall be placed as remote from each other as possible and shall be arranged to provide direct access in separate directions from any point in the area served.

Table 22: Travel distance for occupancy and type of construction (clauses 4.4.1, 4.5.1 and 4.5.2)

Sl. No.	Group of occupancy	Construction	
		Types 1 and 2 Metres	Types 3 and 4 Metres
1	Residential	30	22.5
2	Educational	30	22.5
3	Institutional	30	22.5
4	Assembly	30	30
5	Business	30	30
6	Mercantile	30	30
7	Industrial	45	<sup>1)</sup>
8	Storage	30	<sup>1)</sup>
9	Hazardous	22.5	<sup>1)</sup>

Notes

- For fully sprinklered building, the travel distance may be increased by 50 percent of the values specified
  - Ramps shall be protected with automatic sprinklered system and shall be counted as one of the means of escape
- <sup>1)</sup>constructions of type 3 and 4 is not permitted

#### 4.6 Number of exits

- 4.6.1 The general requirements of number of exits shall supplement the requirement of different occupancies in 6.1 to 6.9
- 4.6.2 All buildings, which are 15m in height and above, and all buildings used as educational, assembly, institutional, industrial, storage and hazardous occupancies and mixed occupancies with any one of the aforesaid occupancies, having area more than 500m<sup>2</sup> on each floor shall have a minimum of two staircases. They shall be enclosed type, at-least one of them shall be on external walls of buildings and shall open directly to the exterior, interior open space or to an open place of safety. Further, the provision or otherwise of

alternative staircases shall be subject to the requirements of the travel time being complied with.

#### **4.7 Doorways**

- 4.7.1 Every exit doorway shall open into an enclosed stairway, or a horizontal exit of a corridor or passageway providing continuous and protected means of egress.
- 4.7.2 No doorway shall be less than 1000 mm in width except assembly buildings where door width shall not be less than 2000mm. Doorways shall not be less than 2000 mm in height.
- 4.7.3 Exit doorways shall open outwards, that is, away from the room, but shall not obstruct the travel along any exit. No door, when opened, shall reduce the required width of the stairway or landing to less than 900 mm; Overhead or sliding doors shall not be installed.
- 4.7.4 Exit door shall not open immediately upon a flight of stairs, a landing equal to at least the width of the door shall be provided in the stairway at each doorway, the level of landing shall be the same as that of the floor which it serves.
- 4.7.5 Exit doorways shall be openable from the side, which they serve without the use of a key.
- 4.7.6 Mirrors shall not be placed in exit ways or exit doors to avoid confusion regarding the direction of exit.

#### **4.8 Corridors and Passageways**

- 4.8.1 Exit corridors and passageways shall be of width not less than the aggregate required width of exit doorways leading from them in the direction of travel to the exterior.
- 4.8.2 Where stairways discharge through corridors and passageways, the height of the corridors and passageways shall not be less than 2.4 metres.
- 4.8.3 All means of exit including staircases, lifts, lobbies and corridors shall be adequately ventilated

#### **4.9 Internal staircases**

- 4.9.1 Internal stairs shall be constructed of non-combustible materials throughout.
- 4.9.2 Interior staircases shall be constructed as a self-contained unit with an external wall constituting at least on its sides and shall be completely enclosed.
- 4.9.3 A staircase shall not be arranged round a lift shaft unless the latter is totally enclosed by a material of fire resisting rating as that of type of construction itself.
- 4.9.4 Hollow combustible construction shall not be permitted.

- 4.9.5 No gas piping shall be laid in the stairways. Ducting in stairway may be permitted if it is of 1 h fire resistance rating
- 4.9.6 The following minimum width shall be provided for staircases:
- |  |        |
|--|--------|
| a) Residential buildings                   | 1.0 m  |
| b) Residential hotel buildings             | 1.5 m  |
| c) Theatres, auditoriums, cinemas          | 2.0 m. |
| d) Educational buildings up to 30 m height | 2.0 m  |
| e) Hospitals                               | 2.0 m  |
| f) All other buildings                     | 1.5 m. |
- 4.9.7 The minimum width of tread without nosing shall be 250 mm for internal staircase of residential building. This shall be 300 mm for assembly, educational, institutional, business and other buildings. The treads shall be constructed and maintained in a manner to prevent slipping.
- 4.9.8 The maximum height of riser shall be 190 mm for residential buildings and 150 mm for other buildings and the number shall be limited to 15 per flight.
- 4.9.9 Handrails shall be provided at a minimum height of 1000 mm to be measured from the base of the middle of the treads to the top of the handrails.
- 4.9.10 The number of people in between floor landings in staircase shall not be less than the population on each floor for the purpose of design of staircase. The design of staircase shall also take into account the following:
- a. The minimum headroom in a passage under the landing of a staircase and under the staircase shall be 2.2 m.
  - b. For building 15 m in height or more, access to main staircase shall be through a fire/smoke check door of a minimum 2 h fire resistance rating. Fire resistance rating may be reduced to 1 h for residential buildings (except hotels and starred hotels).
  - c. No living space, store or other fire risk shall open directly into the staircase or staircases.
  - d. External exit door of staircase enclosure at ground level shall open directly to the open spaces or through a large lobby, if necessary.
  - e. The main and external staircases shall be continuous from ground floor to the terrace level.
  - f. No electrical shafts/ AC ducts or gas pipes, etc, shall pass through or open in the staircases. Lifts shall not open in staircase
  - g. No combustible material shall be used for decoration/wall panelling in the staircase.
  - h. Beams/columns and other building features shall not reduce the head room/width of the staircase.
  - i. The exit sign with arrow indicating the way to the escape route shall be provided at a suitable height from the floor level on the wall and shall be illuminated by electric light

connected to corridor circuits. All exit way marking signs should be flush with the wall and so designed that no mechanical damage shall occur to them due to moving of furniture or other heavy equipments. Further, all landings of floor shall have floor indicating boards prominently indicating the number of floor. These shall be as per bye-laws, if any bye-laws exist.

The floor indication board shall be placed on the wall immediately facing the flight of stairs and nearest to the landing. It shall be of size not less than 0.5 m x 0.5 m.

- j. Individual floors shall be prominently indicated on the wall facing the staircases.
- k. In case of single staircase it shall terminate at the ground floor level and the access to the basement shall be by a separate staircase. The second staircase may lead to basement levels provided the same is separate at ground level by ventilated lobby with discharge points to two different ends through enclosures.

#### **4.10 External Stairs**

An external staircase is desirable to be provided for high rise buildings. External stairs, when provided shall comply the following:

4.10.1 External stairs shall always be kept in sound operable conditions.

4.10.2 All external stairs shall be directly connected to the ground.

4.10.3 Entrance to the external stairs shall be separate and remote from the internal staircase.

4.10.4 Care shall be taken to ensure that no wall opening or window opens on to or close to an external stairs.

4.10.5 The route to the external stairs shall be free of obstructions at all times.

4.10.6 The external stairs shall be constructed of non-combustible materials, and any doorway leading to it shall have the required fire resistance.

4.10.7 No external staircase, used as a fire escape, shall be inclined at an angle greater than 45° from the horizontal.

4.10.8 External stairs shall have straight flight not less than 1250 mm wide with 250 mm treads and risers not more than 190 mm. The number of risers shall be limited to 15 per flight.

4.10.9 Handrails shall be of a height not less than 1000 mm and not exceeding 1 200 mm. There shall be provisions of balusters with maximum gap of 150 mm.

4.10.10 The use of spiral staircase shall be limited to low occupant load and to a building not exceeding 9 m in height.

A spiral staircase shall be not less than 1500 mm in diameter and shall be designed to give adequate headroom.

4.10.11 Unprotected steel frame staircase will not be accepted as means of escape. However, steel staircase in an enclosed fire rated compartment of 2 h will be accepted as means of escape.

#### **4.11 Horizontal Exits**

4.11.1 The width of horizontal exit shall be same as for the exit doorways.

4.11.2 A horizontal exit shall be equipped with at least one fire/smoke door of minimum 1 h fire resistance, of self-closing type. Further, it is required to have direct connectivity to the fire escape staircase for evacuation.

4.11.3 For buildings more than 24 m in height, refuge area of 15 m<sup>2</sup> or an area equivalent to 0.3 m<sup>2</sup> per person to accommodate the occupants of two consecutive floors, whichever is higher, shall be provided as under:

The refuge area shall be provided on the periphery of the floor or preferably on a cantilever projection and open to air at least on one side protected with suitable railings.

For floors above 24 m and up to 39 m one refuge area on the floor immediately above 24 m.

NOTE - Residential flats in multi-storied building with balcony, need not be provided with refuge area, however flats without balcony shall provide refuge area as given above.

4.11.4 Where there is a difference in level between connected areas for horizontal exits, ramps, not more than 1 in 10m slope shall be provided; steps shall not be used.

4.11.5 Doors in horizontal exits shall be openable at all times from both sides.

#### **4.12 Fire Tower**

Fire towers are the preferred type of escape route for storied buildings and these shall be considered as the safest route for escape. Their number, location and size shall depend on the building concerned, and its associated escape routes.

4.12.1 In high rise buildings with over 8 storeys or 24 m in height, at least one required means of egress shall preferably be a fire tower.

4.12.2 The fire towers shall be constructed of walls with a 2 h fire resistance rating without openings other than the exit doorways, with platforms, landings and balconies having the same fire-resistance rating.

### **4.13 Ramps**

4.13.1 Ramps shall comply with all the applicable requirements for stairways regarding enclosure, capacity and limiting dimensions except where specified in 6.1 to 6.9 for special uses and occupancies.

4.13.2 The slope of a ramp shall not exceed 1 in 10. In certain cases steeper slopes may be permitted but in no case greater than 1 in 8.

4.13.3 For all slopes exceeding 1 in 10 and wherever the use is such as to involve danger of slipping, the ramp shall be surfaced with approved non-slipping material.

### **4.14 Fire Lifts**

4.14.1 Where applicable, fire lifts shall be provided with a minimum capacity for 8 passengers and fully automated with emergency switch on ground level. In general, buildings 15 m in height or above shall be provided with fire lifts.

4.14.2 In case of fire, only fireman shall operate the fire lift. In normal course, it may be used by other persons.

4.14.3 Each fire lift shall be equipped with suitable inter-communication equipment for communicating with the control room on the ground floor of the building.

4.14.4 The number and location of fire lifts in a building shall be decided after taking into consideration various factors like building population, floor area, compartmentation, etc.

### **4.15 Emergency and Escape Lighting**

4.15.1 Emergency lighting shall be powered from a source independent of that supplying the normal lighting. Escape lighting shall be capable of:

- a. Indicating clearly and unambiguously the escape routes,
- b. Providing adequate illumination along such routes to allow safe movement of persons towards and through the exits,
- c. Ensuring that fire alarm call points and fire fighting equipments provided along the escape routes can be readily located.

4.15.2 The horizontal luminance at floor level on the centreline of an escape route shall be not less than 10 lux. In addition, for escape routes up to 2 m wide, 50 percent of the route width shall be lit to a minimum of 5 lux.

4.15.3 The emergency lighting shall be provided to be put on within 1seconds of the failure of the normal lighting supply.

4.15.4 Escape lighting luminaries should be sited to cover the following locations

- a. Near each intersection of corridors
- b. at each exit door;
- c. Near each change of direction in the escape route,
- d. Near each staircase so that each flight of stairs receives direct light
- e. Near any other change of floor level,
- f. Outside each final exit and close to it,
- g. Near each fire alarm call point,
- h. Near fire-fighting equipment, and
- i. To illuminate exit and safety signs as required by the enforcing authority.

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

4.15.5 Emergency lighting systems shall be designed to ensure that a fault or failure in anyone luminary does not further reduce the effectiveness of the system.

4.15.6 The luminaries shall be mounted as low as possible, but at least 2 m above the floor level.

4.15.7 Signs are required at all exits, emergency exits and escape routes.

4.15.8 Emergency lighting luminaries and their fittings shall be of non-flammable type.

4.15.9 It is essential that the wiring and installation of the emergency lighting systems are of high quality so as to ensure their perfect serviceability at all times.

4.15.10 The emergency lighting system shall be capable of continuous operation for a minimum duration of 1.5 hrs - even for the smallest premises.

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

#### **4.16 Illumination of Means of Exit**

Staircase and corridor lights shall conform to the following:

- a. The staircase and corridor lighting shall be on separate circuits and shall be independently connected so that it could be operated by one switch installation on the ground floor easily accessible to fire fighting staff at any time irrespective of the position of the individual control of the light points, if any. It should be of miniature circuit breaker type of switch so as to avoid replacement of fuse in case of crisis;
- b. Staircase and corridor lighting shall also be connected to alternative supply. The alternative source of supply may be provided by battery continuously trickle charged from the electric mains; and
- c. Suitable arrangements shall 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 shall be installed in the service room for terminating the stand-by supply.

## 5 FIRE PROTECTION

### 5.1 Fire Extinguishers/Fixed Fire Installations

5.1.1 All buildings depending upon the occupancy use and height shall be protected by fire extinguishers, wet riser, down-comer, automatic sprinkler, high/medium velocity water spray, foam, gaseous or dry powder system in accordance with the provisions of 5.1.2 to 5.1.9.

5.1.2 These fire extinguishers/fixed installations shall be in accordance with IS 2190: 1992 Code of Practice for Selection, installation and maintenance of portable first aid fire extinguisher (third revision). The typical requirements of fire extinguisher /wet riser/ down-comer installation and capacity of water storage tanks and fire pumps, etc shall be as specified in Table 23. The requirements regarding size of main risers shall be as given in Table 24. The typical arrangements of down-comer and wet riser installations are shown in Fig. 2 and Fig. 3. The wet riser shall be designed for zonal distribution ensuring that unduly high pressures are not developed in risers and hose pipes.

5.1.3 In situations where one occupancy is provided. with all the required fire protection arrangements but due to proximity of unprotected buildings around, causing exposure hazard to the protected building, the protected building walls facing the unprotected building shall be made of the requisite fire resistance rated materials or alternatively provided with water curtain/drencher system which can be actuated, when necessary .

5.1.4 The fire fighting equipment and accessories to be installed in buildings for use in fire fighting shall be in accordance with the accepted standards and shall be maintained periodically so as to ensure their perfect serviceability at all times.

5.1.5 In addition to wet riser or down-comer, first-aid hose reels shall be installed on all the floors of buildings of 15 m in height or more. The first-aid hose reel shall be connected directly to the riser/down-comer main and diameter of the hose reel shall not be less than 19 mm.

### 5.1.6 Static Water Storage Tanks

A satisfactory supply of water for the purpose of fire fighting shall always be available in the form of underground/terrace level static storage tank with capacity specified for each building with arrangements or replenishment by mains of alternative source of supply at the rate of 1 000 l/min for underground static tank. When this is not practicable, the capacity of static storage tank(s) shall be increased proportionately in consultation with the fire division of the Royal Bhutan Police

The static storage water supply required for the above mentioned purpose shall entirely be accessible to the fire engines of the local fire service. Provision of suitable number of manholes shall be made available for inspection, repairs, insertion of suction hose, etc. The covering slab shall be able to

withstand the total vehicular load of 45 T equally divided as a four point load when the slab forms a part of pathway/ driveway.

Table 23 – Minimum requirements for fire fighting Installations  
(Clauses 6.1.2, 6.2.3, 6.3.2, 6.4.3, 6.5.2,6.5.2.1, 6.5.2.2, 6.5.2.3, 6.5.2.4, 6.5.2.5, 6.6.2,6.7.2,6.8.2 and 6.9.2)

Sl. No	Type of Building Occupancy	Type of Installation									Water Supply (in l)		Pump capacity (in l/min)	
		Fire extinguisher	Hose reel	Dry riser (see note 6)	Wet riser	Down Comer	Yard hydrant	Automatic sprinkler system	Manually operated electric fire alarm system	Automatic detection and alarm system	Underground static water storage tank	Terrace tank	Pump near underground static water storage tank (fire pump) with minimum pressure of 3.5kg/cm <sup>2</sup> at terrace level	At the terrace tank level with minimum pressure of 2.0 kg/cm <sup>2</sup> at terrace level
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<b>A</b>	<b>Residential buildings</b>													
a	A-1 less than 15m in height( see note 1)													
i	Upto 15 rooms	R	NR	NR	NR	NR	NR	R ( see note 2 )	NR	NR	NR	5000 ( see note 3)	NR	NR
ii	More than 15 and upto 30 rooms	R	R	NR	NR	NR	NR	R ( see note 2 )	NR	NR	NR	5000 (5000) (see note 4)	NR	450 (450) (see note 4)
iii	More than 30 rooms	R	R	NR	NR	NR	NR	R ( see note 2 )	R ( see note 5 )	NR	NR	10000 (5000) (see note 4)	NR	450 (450) (see note 4)
<b>B</b>	A-2	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
c	A-3 and A-4													
1	Less than 15 m in height	R	R	NR	NR	NR	NR	R (see note 2)	NR	NR	NR	5000 (5000) (see note 4)	NR	450 (450) (see note 4)
2	15 m and above but not exceeding 35 m in height	R	R	NR	NR	R	NR	R (see note 2)	R (see note 7)	NR	NR	25000	NR	900
3	Above 35m but not exceeding 45m in height	R	R	NR	R	NR	NR	R (see notes 2 and 8)	R	NR	75000	5000 (5000) (see note 4)	(see note 19)	NR
d	A -5													
1	Less than 15 in height													
i	Covered area not exceeding 300m <sup>2</sup> on each floor	R	R	NR	NR	NR	NR	R (see note 2)	R	NR	NR	5000 (see note 2)	NR	450 (see note 3)
ii	Covered area exceeding 300m <sup>2</sup> but not more than 1000 m <sup>2</sup> on each floor	R	R	NR	R (see note 5)	NR	NR	R (see note 2)	R	R	10000 for every 5000m <sup>2</sup> covered area subject to a minimum of 50000 (see note 5)	10000 (see note 2)	(see notes 5 and 19)	NR
iii	Covered area exceeding 1000m <sup>2</sup> on each floor	R	R	NR	R (see note 5)	NR	R	R (see note 10)	R	R	100000 (see note 9)	10000 (see note 2)	(see notes 9 and 19)	NR
2	15 m and above but not exceeding 30 m in height	R	R	NR	R	NR	R	R (see note 10)	R	R	150000	20000	(see note 20)	NR
3	Above 30m in height	R	R	NR	R	NR	R	R (see note 10)	R	R	200000	20000	(see note 21)	NR
e	A-6	R	R	NR	R	NR	R	R (see note 10)	R	R	200000	20000	(see note 22)	NR

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<b>B</b>	<b>Educational Buildings</b>													
1	Less than 15 m in height													
i	Ground plus one storey	R	NR	NR	NR	NR	NR	R (see note 2)	NR	NR	NR	5000 (see note 3)	NR	450 (see note 3)
ii	Ground plus two or more storeys	R	R	NR	NR	NR	NR	R (see notes 2)	NR	NR	NR	10000 (5000)(see note 4)	NR	450 (450) (see note 4)
2	15 m and above but not exceeding 30 m in height	R	R	NR	NR	R	NR	R (see notes 2)	R	NR	NR	25000	NR	900
<b>C</b>	<b>Institutional Buildings</b>													
<b>a</b>	<b>C-1</b>													
1	Less than 15 m in height with plot area upto 1000m <sup>2</sup> on each floor													
i	Up to ground plus one storey with no beds	R	R	NR	NR	NR	NR	R (see notes 2)	R	NR	NR	2500 (2500) (see note 4)	NR	NR
ii	Up to ground plus one storey with beds	R	R	NR	NR	R	NR	R (see notes 2)	R	NR	NR	5000 (5000)(see note 4)	NR	450 (450) (see note 4)
iii	Ground plus two or more storeys with no beds	R	R	NR	NR	R	NR	R (see notes 2)	R	R	NR	5000 (5000)(see note 4)	NR	450 (450) (see note 4)
iV	Ground plus two or more storeys with beds	R	R	NR	R	NR	NR	R (see notes 2)	R	R	50000	5000 (5000)(see note 4)	(see note 19)	NR
2	Less than 15 m in height with plot area more than 1000m <sup>2</sup> on each floor	R	R	NR	R	NR	R	R (see notes 2)	R	R	100000	10000	(see note 19)	NR
3	15 m and above but not exceeding 24 m in height	R	R	NR	R	NR	R	R (see notes 11)	R	R	100000	20000	(see note 20)	NR
4	Above 24 m but not exceeding 30 m in height	R	R	NR	R	NR	R	R (see notes 11)	R	R	150000	20000	(see note 21)	NR

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
b	C-2 and C-3													
1	Less than 10 m in height													
i	Upto 300 persons	R	R	NR	NR	NR	NR	R (see note 2)	R	NR	NR	10000 (5000)(see note 4)	NR	450 (900)(see note 4)
ii	More than 300 persons	R	R	NR	NR	R	NR	R (see notes 2 )	R	NR	NR	15000 (5000)(see note 4)	NR	450 ( 900) ( see note 4)
2	10 m and above but not exceeding 15 m in height	R	R	NR	R	NR	R	R (see notes 2 )	R	R	50000	5000 (5000)(see note 4)	(see note 20)	NR
3	15 m and above but not exceeding 24 m in height	R	R	NR	R	NR	R	R (see notes 11)	R	R	75000	10000	(see note 20)	NR
4	24 m and above but not exceeding 30 m in height	R	R	NR	R	NR	R	R(see notes 11)	R	R	100000	20000	(see note 21)	NR
D	Assembly Buildings													
A	D-1 to D-5													
1	Less than 10 m in height													
i	Upto 300 persons	R	R	NR	NR	R	NR	R (see note 2 )	R	NR	NR	10000 (5000)(see note 4)	NR	450 ( 450) ( see note 4)
ii	More than 300 persons	R	R	NR	NR	R	NR	R (see notes 2 )	R	NR	NR	15000 (5000)(see note 4)	NR	900
2	10 m and above but not exceeding 15 m in height	R	R	NR	R	NR	NR	R (see note 2 )	R	R	50000	5000 (5000)(see note 4)	(see note 20)	450 ( 450) ( see note 4)
3	15 m and above but not exceeding 24 m in height	R	R	NR	R	NR	R	R (see notes 11 )	R	R	75000	10000	(see note 20)	NR
4	24 m and above but not exceeding 30 m in height	R	R	NR	R	NR	R	R (see note 10 )	R	R	100000	20000	(see note 21)	NR

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
b	D-6	R	R	NR	R	NR	R	R ( see note 10)	R	R	200000	20000	See note 22	NR
C	D-7 for details see 6.4.8													
E	Business Buildings													
1	Less than 10 m in height	R	R	NR	NR	R	NR	R (see note 2)	R	NR	NR	10000 (5000)(see note 4)	NR	450 ( 450) ( see note 4)
2	10 m and above but not exceeding 15 m in height	R	R	NR	R	NR	NR	R (see note 2)	R	R	50000	5000 (5000)(see note 4)	(see note 20)	450 ( 450) ( see note 4)
3	15 m and above but not exceeding 24 m in height	R	R	NR	R	NR	R	R (see note 11)	R	R	75000	10000	(see note 20)	NR
4	24 m and above but not exceeding 30 m in height	R	R	NR	R	NR	R	R (see note 10)	R	R	100000	20000	(see note 21)	NR
F	Mercantile Buildings													
A	F-1 and F-2 (see note 12)													
1	Less than 15 in height													
I	Ground plus one storey, with total covered area not exceeding 500m <sup>2</sup> on each floor	R	R	NR	NR	R	NR	R (see note 2)	NR	NR	NR	5000 ( 5000) (see note 4)	NR	450 ( 450) (see note 4)
ii	Ground plus one storey, and covered area exceeding 500m <sup>2</sup> on each floor	R	R	NR	NR	R	NR	R (see note 2)	R	NR	NR	25000	NR	900
iii	More than ground plus one storey	R	R	R	NR	R	NR	R (see note 2)	R	NR	NR	5000 ( 5000) (see note 4)	NR	900
2	15 m and above but not exceeding 24 m in height	R	R	NR	R	NR	NR	R (see note 11)	R	R	100000	10000	(see note 20)	NR
3	24 m and above but not exceeding 30 m in height	R	R	NR	R	NR	R	R (see note 10)	R	R	150000	10000	(see note 21)	NR
B	F-3 (see note 13)	R	R	NR	R	NR	R	R (see note 10)	R	R	150000	10000	(see note 21)	NR

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
G	Industrial Buildings ( see note 14)													
A	G-1 (see note 15)													
I	Built up area upto 100m <sup>2</sup>	R	NR	NR	NR	NR	NR	R (see note 2)	NR	NR	NR	5000(see note 3)	NR	450 (see note 3)
ii	Built up area more than 100m <sup>2</sup> and upto 500m <sup>2</sup>	R	R	NR	NR	R	NR	R (see note 2)	NR	NR	NR	5000 (5000)(see note 4)	NR	450
iii	Built up area more than 500m <sup>2</sup>	R	R	NR	R	R (see note 7)	R	R	NR	R	100000	10000	(see note 20)	450
4	24 m and above but not exceeding 30 m in height	R	R	NR	R	NR	R	R (see note 10)	R	R	100000	20000	(see note 21)	NR
B	G-2 (see note 14)													
I	Built up area upto 100m <sup>2</sup>	R	R	NR	NR	NR	NR	R	NR	NR	NR	10000	NR	450
ii	Built up area more than 100m <sup>2</sup> and upto 500m <sup>2</sup>	R	R	NR	NR	NR	NR	R	NR	NR	NR	10000	NR	900
iii	Built up area more than 500 m <sup>2</sup> and upto 1000 m <sup>2</sup>	R	R	NR	R	R ( see note 7)	R	R	R	R	75000	20000	(see note 20)	900
Iv	Built up area more than 1000m <sup>2</sup>	R	R	NR	R	R ( see note 7)	R	R	R	R	100000	20000	(see note 20)	900
C	G-3 (see note 16)													
I	Built up area upto 50m <sup>2</sup>	R	R	NR	NR	NR	NR	R	NR	NR	NR	5000	NR	450
ii	Built up area more than 50m <sup>2</sup> and upto 150m <sup>2</sup>	R	R	NR	NR	NR	NR	R	NR	R	NR	5000	NR	450
iii	Built up area more than 150 m <sup>2</sup> and upto 300 m <sup>2</sup>	R	R	NR	R	NR	NR	R	NR	R	25000	10000	(see note 19)	450
iv	Built up area more than 300 m <sup>2</sup> and upto 500 m <sup>2</sup>	R	R	NR	R	NR	R	R	R	R	50000	20000	(see note 19)	900
Iv	Built up area more than 500m <sup>2</sup>	R	R	NR	R	R ( see note 7)	R	R	R	R	100000	20000	(see note 19)	450
H	Storage Buildings ( see note 17)													
I	Below 15m height and covered area less than 250mm <sup>2</sup>	R	R	NR	NR	NR	NR	R	NR	NR	25000	5000	(see note 19)	450

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Below 15m height and covered area more than 250mm <sup>2</sup>													
i	Ground Floor only	R	R	NR	R	NR	R	R	NR	R	50000	10000	(see note 20)	450
ii	Ground plus one floor	R	R	NR	R	NR	R	R	NR	R	75000	10000	(see note 20)	450
iii	More than ground plus one floor	R	R	NR	R	NR	R	R	NR	R	100000	10000	(see note 20)	450
J	Hazardous Buildings ( see note 17)													
1	Upto 15m in height													
i	Single storey building	R	R	NR	NR	NR	R	R	R	R	Minimum 4h fire fighting requirements	NR	(see note 18)	NR
ii	More than one floor building but not exceeding 15 m	R	R	NR	R	R	R	R	R	R	Minimum 4h fire fighting requirements	50000	(see note 18)	900

R – Required

NR – Not required

Notes :

1. Buildings above 15m in height not to be permitted for occupancies A-1 and A-2
2. Required to be installed in basement if the area of basement exceeds 200m<sup>2</sup>
3. Required to be provided in basement if the area of basement exceeds 200m<sup>2</sup>
4. Additional values in parenthesis shall be added if the basement area exceeds 200m<sup>2</sup>
5. Required to be provided for buildings with more than two storeys ( Ground plus one)
6. As per the requirement of the local authority dry riser may be used in hilly areas, industrial areas or as required
7. Required to be provided for buildings with height above 15m
8. To be installed in basement. If basement provided is used for car parking and area thereof exceeds 750m<sup>2</sup> then the sprinklers shall be fed water from both underground static water storage tank and terrace tank
9. Required to be provided for buildings with more than one storey
10. To be installed in entire building
11. To be installed in all floors at appropriate places and in consultation with the local fire authorities
12. Buildings above 30m in height not to be permitted for group B, group C, group D and Group F occupancies
13. All underground shopping areas should be fully air-conditioned
14. The requirements given in this table for group G industrial buildings are for small scale industry units. For other industries the requirements will have to be worked out on the basis of relevant Indian standards and also in consultation with the local fire brigade
15. Buildings above 18m in height not to be permitted for G-1 and G-2 occupancies
16. Buildings above 15m in height not to be permitted for G-3 occupancy
17. Buildings above 15m in height not to be permitted for Group H and group J occupancies
18. Pump capacity shall be based on the covered area of the building
19. one electric and diesel pump of capacity 1620 l/min and one electric pump of capacity 180l/min ( see figure 4)
20. one electric and diesel pump of capacity 2280 l/min and one electric pump of capacity 180l/min ( see figure 4)
21. Two electric and diesel pump of capacity 2280 l/min and one electric pump of capacity 180l/min ( see figure 5)
22. Two electric and diesel pump of capacity 2850 l/min and one electric pump of capacity 180l/min ( see figure 5)
23. For buildings 45m and above , the entire quantity of water for fire fighting purpose ( as required in respective occupancy), if provided at the terrace level, the main pump sprinkler pump, jockey pump and common pump need not be provided, however one electric fire pump of 900LPM capacity with automatic operation is required to be provided.



Table 24 Size of rising mains/risers (Clause 5.1.2)

Size of mains	Type of Building	Height of building
100 mm as single outlet landing valves	1. Residential Buildings ( A) a) <sup>1</sup> Lodging or rooming houses b) Dormitories c) One or two family private dwellings d) Apartment houses ( flats) e) With shopping area not exceeding 500 mm <sup>2</sup> f) Hotels	15m or above and not exceeding 45 m  Less than 15m 15m or above in height but not exceeding 30 m and area not exceeding 600m <sup>2</sup> per floor
-do-	2. Educational Buildings ( B)	15m or above and not exceeding 30 m
-do-	3. Institutional Buildings ( C) a) For hospitals and sanatorium b) For custodial institutions and mental institutions	15m or above and not exceeding 30 m 15m or above and not exceeding 30 m
-do-	4. Assembly Buildings ( D)	15m or above in height but not exceeding 30 m and area not exceeding 500m <sup>2</sup> per floor ( above 30 m, not to be permitted)
-do-	5. Business Buildings ( E)	15m or above and not exceeding 30 m
-do-	6. Mercantile Buildings ( F)	15m or above and not exceeding 30 m (above 30m, not to be permitted)
-do-	7. Industrial Buildings ( G)	15m or above and not exceeding 18 m
-do-	8. All Buildings classified under 1 ( a) to 1 ( d)	above 45m
-do-	9. All buildings classified under 5 above with shopping area exceeding 500 m <sup>2</sup>	above 15m
-do-	10. All buildings classified under 1 ( e) above	Above 30m and area exceeding 500m <sup>2</sup>
150mm with twin outlet landing valves	11. Hotels	Above 30m
-do-	12. All buildings classified under 2 and 3 above	Above 30 m
-do-	13. All buildings classified under 5 above	Above 30 m
-do-	14. All storage buildings	Above 10 m but not exceeding 15 m
-do-	15. All Hazardous Buildings	Above 10 m but not exceeding 15 m

<sup>1)</sup> Buildings above 15m in height not permitted in high hazard industrial buildings.

The domestic suction tank connected to the static water storage tank shall have an overflow capable of discharging 2250 l/min to a visible drain *point* from *which* by a separate *conduit*, the overflow shall be conveyed to a storm water drain.

a. To prevent stagnation of water in the static water storage tank, the suction tank of the

domestic water supply shall be fed only through an overflow arrangement to maintain the level therein at the minimum specified capacity (see Fig. 6).

- b. The static water storage tank shall be provided with a fire brigade collecting head with 4 number 63 mm diameter (2 number 63 mm diameter for pump with capacity 1400 l/min) instantaneous male inlets arranged in a valve box at a suitable point at street level and connected to the static tank by a suitable fixed pipe not less than 150 mm in diameter to discharge water into the tank when required at the rate of 2250 l/min, if tank is in the basement or not approachable for the fire engines.

### 5.1.7 Automatic Sprinklers

Automatic sprinklers shall be installed in:

- a. Basements used as car parks or storage occupancy, if the area exceeds 200 m<sup>2</sup>;
- b. Multi-level basements, covered upper floors used as car parks, and for housing essential services ancillary to a particular occupancy or for storage occupancy, excluding any area to be used for sub-station, AC. plant and DC set;
- c. Any room or other compartment of a building exceeding 1125 m<sup>2</sup> in area except as in (g) (*see* Note 1), if so advised by local authority;
- d. Departmental stores or shops, if the aggregate covered area exceeds 500 m<sup>2</sup>
- e. All non-domestic floors of mixed occupancy which constitute a hazard and are not provided with staircases independent of the remainder of the buildings;
- f. Go downs and warehouses, as considered necessary;
- g. On all floors of the buildings other than residential and educational buildings, if the height of the building exceeds 15 m (45 m in case of group housing and apartments) (*see* Note
- h. Dressing room, scenery docks, stages and stage basements of theatres;
- i. In hotels, hospitals, industries low and moderate hazard mercantile buildings of height 15 m or above;
- j. In hotels below 15 m, if covered area at each floor is more than 1 000 m<sup>2</sup>;
- k. False ceiling voids exceeding 800 mm in height (*see* Note 2); and
- l. Canteen provided in upper floors of D-1 and D-2 occupancies shall be sprinklered.

#### NOTES

1. It is desirable that all high rise buildings should be fully sprinklered irrespective of their height and occupancy. If there is a real danger of a fire starting on one of the lower un-sprinklered floors gathering momentum, spreading upwards from floor to floor through the un-sprinklered floor as a fully developed fire. In such an event, the sprinklers can be rendered useless or ineffective.
2. Use of false ceiling voids for storage or as return air plenums should be discouraged
3. For areas having very high ceiling height and other special function areas, where automatic sprinklers cannot be provided, appropriate sprinklers/provisions shall be provided in consultation with local fire authorities

### 5.1.8 Automatic high velocity water spray or emulsifying system

Automatic high velocity water spray or emulsifying system shall be provided for protection of indoor oil cooled transformers.

A sub-station or a switch station with oil filled equipment shall not be located in the building. The sub-station structure shall have separate fire resisting walls/surroundings and shall

necessarily be located at the periphery of the floor having separate access from fire escape staircase. The outside walls, ceiling, floor, openings including doors and windows to the sub-station area shall be provided with a fire resisting door of 2h fire rating. Direct access to the transformer room shall be provided, preferably from outside fire escape staircase.

The sub-station area needs to be maintained at negative air-pressures and area in sub-station shall not be used as storage/dump areas.

When housed inside the building, the transformer shall be of dry type and shall be cut off from the other portion of premises by walls/doors/cut-outs having fire resistance rating of 4-hour

#### 5.1.9 Fixed foam installation

Fixed foam generating system shall 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 cover fire risks in storage areas generally. High expansion foams are used for cable tunnels and other confined areas.

#### 5.1.10 Carbon dioxide fire extinguishing system

This system shall be used on premises where water or foam cannot be used for fire extinguishing because of special nature of the contents of the building. For some special risk, carbon dioxide may not be suitable and it may be necessary to provide the BCF (Bromochlorodifluoromethane) – Halon 1211 or BTM (Bromochlorotrifluoromethane) – Halon 1301 or other identified substances.

However, the use of halons shall be discouraged, as halons are ozone depleting substances (ODS) and their use is being phased out throughout the world.

5.1.11 Fire fighting equipment shall be suitably located and clearly marked by luminous signs. This provision doesn't apply to occupancies A-2 and A-4 less than 15 m in height.

## 5.2 Fire detection/Extinguishing system

Fire may not itself provide adequate warning to occupants, therefore automatic fire detecting system and alarm facilities should be provided, to warn the occupants of the existence of fire so that they may escape or to facilitate the orderly conduct of fire exit drills. Guide lines for selection of various types of fire detectors for different occupancies are included in IS: 2189 – code of practice for installation of Automatic fire alarm system, using heat sensitive type fire detectors and IS: 2175 Specifications for heat sensitive fire detectors for use in Automatic electrical fire alarm system.

The requirements of fire detection and alarm systems are also covered for each occupancy and alarm systems are also covered in 6.1 to 6.9; and for high rise buildings (15m or more in height in annex C)

## 6 ADDITIONAL OCCUPANCY- WISE REQUIREMENTS

### 6.1 Requirements of Residential Buildings (Group A)

6.1.1 In addition to the general requirements for the type of construction and occupancy group specified in 3.2 and 3.3, and the exit requirements given in 4, the requirements 6.1.2 to 6.1.4.10 shall be complied with.

#### 6.1.2 Fire Detection/Extinguishing System

The requirements for occupancy sub-divisions A-1 to A-5 as specified in Table 23 and Annex C (for High Rise Buildings) shall apply.

#### 6.1.3 Exit Facilities

The capacity of any open mezzanine or balcony shall be added to the capacity of the floor for the purpose of determining the exit capacity.

6.1.3.1 In addition to requirements specified for occupancy sub-division A-2, the following shall be provided for occupancy sub-division A-1:

Every sleeping room above the street floor shall have access to two separate means of exits, at least one of which shall consist of an enclosed interior stairway, or a fire escape or horizontal exit all so arranged as to provide a safe path of travel to the outside of the building without traversing any corridor or space exposed to an unprotected vertical opening.

6.1.3.2 For occupancy sub-division A-2 of more than two rooms, every occupied room, excluding areas used solely for storage shall have at least two means of exits, at least one of which shall be a door or a stairway providing a means of un-obstructed travel to the outside of the building or street or grade level. No room or space shall be occupied which is accessible only by a ladder, folding stairs or through a trap door.

Further the following provisions shall be made:

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 dis-engaged easily by quick releasing catches, shall be prohibited. All closet door latches shall be such that even children can open the doors from inside. All bathroom door locks or fasteners shall 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.

6.1.3.3 For occupancy sub-division A-3, the following provisions shall apply:

All dormitories shall have exits so arranged that from any sleeping room or open dormitory sleeping area, there shall be access to two separate and distinct exits in different directions with no common path of travel unless the room or space is subject to occupancy by not more than 10 persons and has a door opening directly to the outside of the building at street or grade level, or to an outside stairway in which case one means of exit may be accepted.

6.1.3.4 For occupancy sub-division A-4, the following provisions shall apply:

- a. Every individual living unit covered by occupancy sub-division A-4 shall comply with the requirement for occupancy subdivision A-2 in respect of exits.
- b. Every living unit shall have access to at least two separate exits, which are remote from each other and are reached by travel in different directions, except that a common path of travel may be permitted for the first 6 m (that is a dead end corridor up to 6 m long may be permitted) provided that single exit may be permitted under any of the conditions given under (c).
- c. Any part of building lower than the grade level shall have direct accessibility from outside.
- d. At least half of required exits shall discharge direct to the outside of the buildings; any other exit shall be the same as required for hotels.

6.1.3.5 For occupancy sub-divisions A-5 and A-6, the following provisions shall apply

- a. Not less than two exits, as remote from each other as practicable, shall be accessible from every floor, including basements occupied for hotel purpose, except as a single exit as permitted in (b) below. Exits and ways of access thereto shall be so arranged that they are accessible in at least two different directions from every point in any open area, or from any room door.
- b. Any room or section with an outside door at street or grade level may have such outside door as a single exit, provided no part of the room or area is more than 15 m from the door measured along the natural path of travel.
- c. Provision of panic bars shall be provided in the exits.

6.1.3.5.1 Where stairways or other exits serve two or more upper floors, the same stairway or other exit required to serve any one upper floor may also serve other upper floors, except that no inside open stairway or ramp may serve as a required egress facility from more than one floor.

6.1.3.6 Basement Exits

- a. Basements occupied for hotel purposes shall have exits arranged in accordance with 6.1.3.5.
- b. Basement exits shall be sufficient to provide for the capacity of the basement as determined in accordance with 6.1.1. In no case shall there be less than two independent basement exits.
- c. Basement or sub-basements not open to the public and used only for heating equipment, storage and service operations (other than kitchens, which are considered part of the hotel occupancy) shall have exits appropriate to the actual occupancy, in accordance with other applicable provisions of the Code, or in case of mixed occupancy where there may be doubt as to which other section is applicable, such basements shall have exits determined on the basis of lesser exit capacity.

#### 6.1.4 Additional Precautions

6.1.4.1 Flammable liquids for household purposes shall 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, if any.

6.1.4.2 No stove or combustion heater shall 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.

6.1.4.3 All kitchen exhaust fans, where provided, shall be fixed to an outside wall or to a duct of non-combustible material, which leads directly to the outside. The ducts must not pass through areas having combustible materials.

6.1.4.4 All wiring shall be done in accordance with “Electrical Installations: BTS-010 – 2003” and the Bhutan Electricity Act and its rules and regulations

6.1.4.5 Where television is installed, all outdoor antennae shall be properly grounded and protected from lightning (“Electrical Installations: BTS-010 – 2003”).

6.1.4.6 Doors leading to rooms in which flammable liquids are stored or used shall be as in 4.7. Such assembly shall be self-closing and shall be posted with a sign on each side of the door in 25 mm high block letters stating - 'FIREDOOR - KEEP CLOSED'.

6.1.4.7 Where a boiler room is provided or a central heating plant is installed, which uses solid or liquid fuel, it shall be separated from rest of the building by a separation wall with all openings protected as in 3.4.6 and 3.4.7.

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

6.1.4.9 All rooms or areas of high hazard in additions to those herein before mentioned, shall be segregated or shall be protected as may be directed by the enforcing Authority where, in the opinion of the enforcing Authority, fire, explosion or smoke there from is likely to interfere with safe egress from the building.

## 6.2 Requirements of Educational Buildings

6.2.1 In addition to the general requirements specified in 3.2 and 3.3 for the type of construction and occupancy group and the exit requirements given in 4, the requirements given in 6.2.2 to 6.2.6.3 shall be complied with.

6.2.2 Buildings intended for educational occupancy shall not be used for any hazardous occupancy.

#### 6.2.3 Fire Detection/Extinguishing System

The requirements for occupancy sub-divisions B-1 and B-2 as specified in Table 23 and Annex C (for High Rise Buildings) shall apply.

#### 6.2.4 Exit Facilities

The capacity of any open mezzanine or balcony shall be added to the capacity of the floor for the purpose of determining the exit capacity.

In addition to the provisions in 4, the following shall be provided:

6.2.4.1 Exits, in accordance with 4 shall be so arranged that at least two separate exits are available in every floor area. Exits shall be as remote from each other as practicable and so arranged that there are no pockets or dead ends of appreciable size in which occupants may be trapped.

6.2.4.2 Every room with a capacity of over 45 persons in area shall have at least two doorways.

6.2.4.3 Exterior doors shall be operated by panic bars or some other panic hardware device, 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.

#### 6.2.5 Additional Precautions

6.2.5.1 Storage of volatile flammable liquids shall be prohibited and the handling of such liquids shall be restricted to science laboratories only.

6.2.5.2 Each building shall be provided with an approved outside gas shut-off valve conspicuously marked.

6.2.5.3 All exterior openings in a boiler room or rooms containing 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, shall be protected by a fire assembly as in 3.4.7. Such assemblies shall be fixed, automatic or self-closing. Provisions of 6.1.4.7 shall also apply to this group of occupancy.

#### 6.2.6 Exception and Deviation

6.2.6.1 Gymnasiums, indoor stadiums and similar occupancies may have floors/running tracks of wood, cinder, synthetic or unprotected steel or iron.

6.2.6.2 In gymnasiums and in multi-purpose school rooms having an area not greater than 300 m<sup>2</sup>, 25 mm nominal tight tongue-and-grooved or 20 mm plywood wall covering may be used in the inner side in lieu of fire-resistant plaster.

6.2.6.3 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:

- a. Exterior walls or parts of walls which are less than 900 mm from adjacent property lines shall have no openings therein.
- b. Classrooms may have only one exit not less than 900 mm wide.

### 6.3 Requirements of Institutional Buildings (Group C)

6.3.1 In addition to the general requirements specified in 3.2 and 3.3 for the type of construction and occupancy group and the exit requirements given in 4, the requirements given in 6.3.2 to 6.3.5 shall be complied with.

#### 6.3.2 Fire Detection/Extinguishing System

The requirements for occupancy sub-divisions as specified in Table 23 and Annex C (for High Rise Buildings) shall apply.

#### 6.3.3 Exit Facilities

In addition to the provisions of 4, the following requirements shall be complied with.

6.3.3.1 In buildings or sections occupied by bedridden patients where the floor area is over 280 m<sup>2</sup>, facilities shall be provided to move patients in hospital beds to the other side of a smoke barrier from any part of such building or section not directly served by approved horizontal exits or exits from the first floor (floor 2) of a building to the outside.

6.3.3.2 Not less than two exits of one or more of the following types shall be provided for every floor, including basement, of every building or section:

- a. Doors leading directly outside the building;
- b. Stairways;
- c. Ramps;
- d. Horizontal exits; and
- e. Fire tower.

6.3.3.3 All required exits that serve as egress from hospital or infirmary sections shall be not less than 2 m in clear width including patient bedroom doors to permit transportation of patients on beds, litters, or mattresses. The minimum width of corridors serving patients bedrooms in buildings shall be 2 400 mm.

6.3.3.4 Elevators constitute a desirable supplementary facility, but are not counted as required exits. Patient lifts shall also be provided with enough room for transporting a stretcher trolley.

6.3.3.5 Any area exceeding 500 m<sup>2</sup> shall be divided into compartments by fire resistant walls.

6.3.3.6 Doors in fire resistant walls shall be so installed that these may normally be kept in open position, but will close automatically. Corridor door openings in smoke barriers shall be not less than 2000 mm in width. Provision shall also be made for double swing single/ double leaf type door.

6.3.3.7 Exits and other features for penal and mental institutions, and custodial institutions shall be the same as specified for hospitals, in so far as applicable. Reliable means shall be provided to permit the prompt release of inmates from any locked section in case of fire or other emergency.

6.3.3.8 Wherever any inmates are confined in any locked rooms or spaces, adequate guards or other personnel shall be continuously on duty or immediately available to provide for release of inmates or for such other action as may be indicated in case of fire or other emergency.

6.3.3.9 No building constructed in whole or in part of combustible materials shall be used to confine inmates in cells or sleeping quarters, unless automatic sprinkler protection is provided.

6.3.3.10 All buildings or sections of buildings in penal and mental institutions used for manufacturing, storage or office purposes shall have exits in accordance with the provisions of the Code for those occupancies.

#### 6.3.4 Additional Precautions

6.3.4.1 No combustible material of any kind shall 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.

6.3.4.2 Bare minimum quantities of flammable material such as chloroform, ethyl alcohol, spirit shall be allowed to be stored and handled. The handling of such liquids shall not be permitted by unauthorised persons. Bulk storage of these items, will be governed by relevant rules and safe practices.

#### 6.3.5 Exceptions and Deviations

It is recognized that in institutions or part of buildings housing various types of psychiatric patients, or as penal and mental institutions, it is necessary to maintain locked doors and barred

windows; and to such extent the necessary provision in other sections of the Code requiring the keeping of exits unlocked may be waived. It is also recognized that certain type psychiatric patients are not capable of seeking safety without adequate guidance. In buildings where situation prevails, reliable means for the rapid release of occupants shall be provided, such as remote control of locks, or by keying all locks to keys commonly used by attendants.

#### **6.4 Requirements of Assembly Buildings (Group D)**

6.4.1 In addition to the general requirements specified in 3.2 and 3.3 for type of construction and occupancy group and the exit requirements given in 4, the requirements given in 6.4.2 to 6.4.8.9 shall be complied with.

##### 6.4.2 Mixed Occupancy

Places of assembly in buildings of other occupancy such as ballrooms in hotels, restaurants in stores and assembly rooms in schools, shall be so located, separated or protected as to avoid any undue danger to the occupants of the place of assembly from a fire originating in the other occupancy or smoke there-from.

##### 6.4.3 Fire Detection/Extinguishing System

The requirements for occupancy sub-divisions D- 1 to D-5 as specified in Table 23 and Annex C (for Rise Buildings) shall apply.

NOTE - Canteens shall not be provided in basements. If provided in the upper floors, it shall be sprinklered.

##### 6.4.4 Exit Facilities

6.4.4.1 Every place of assembly, every tier or balcony and every individual room used as a place of assembly shall have exits sufficient to provide for the total capacity thereof as determined in accordance with 4. Door width for assembly buildings shall not be less than 2 000 mm.

- a. Every place of assembly of sub-division D-1 shall have at least four separate exits as remote from each other as practicable.
- b. Every place of assembly of sub-division D-2 shall have at least two separate exits as remote from each other as practicable and if of capacity over 600 at least three exits shall be provided with each exit not less than of 2000 mm width.

6.4.4.2 Clear aisles not less than 1.2 m in width shall be fanned at right angles to the line of seating in such number and manner that no seat shall be more than seven seats away from an aisle. Rows of seats opening onto an aisle at one end only shall have not more than seven seats. Under the conditions, where all these aisles do not directly meet the exit doors, cross-aisles shall 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 shall be required. The width of cross-aisles shall be minimum of 1 m. Steps shall not be placed in aisles to overcome differences in levels, unless the gradient exceeds 1 in 10.

6.4.4.3 The fascia of boxes, balconies and galleries shall have substantial railings not less than 1000 mm high above the floor. The railings at the end of aisles extending to the fascia shall be not less than 1100 mm high for the width of the aisle or 1200 mm high at the foot of steps.

6.4.4.4 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 shall be provided with railings not less than 900 mm high.

6.4.4.5 No turnstiles or other devices to restrict the movement of persons shall be installed in any place of assembly in such a manner as to interfere in any way with the required exit facilities.

6.4.4.6 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 shall not encroach upon the required clear width of exits. Such waiting shall be restricted to areas separated from the required exit ways by substantial permanent partitions or fixed rigid railing not less than 1050 mm high. Exits shall be provided for such waiting spaces on the basis of one person for each 0.3 m<sup>2</sup> of waiting space area. Such exits shall be in addition to the exits specified for the main auditorium area and shall conform in construction and arrangement to the general rules of exits given above.

6.4.4.7 No display or exhibit shall be so installed or operated as to interfere in any way with access to any required exit, or with any required exit sign.

All displays or exhibits of combustible material or construction and all booths and temporary construction in connection therewith shall 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.

6.4.4.8 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 the Code.

6.4.4.9 Exits shall be sufficient for simultaneous occupancy of both the places of assembly and other parts of the building, unless the Authority determines that the conditions are such that simultaneous occupancy will not occur.

6.4.4.10 For any place of assembly under sub-division D-1, at least half the required means of exits shall lead directly outdoors or through exit ways completely separated from exits serving other parts of the building.

6.4.4.11 For detailed information regarding cinema buildings, reference may be made to IS 12456:1988 Code of Practice for fire protection of electronic data processing installations.

#### 6.4.5 Lighting

No open flame lighting devices shall be used in any place of assembly, except in the following cases:

- a. Where necessary for ceremonial purposes, the enforcing Authority may permit open flame lighting under such restrictions as are necessary to avoid danger of ignition of combustible materials or injury to occupants.
- b. 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.
- c. 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.

#### 6.4.6 Additional Precautions

6.4.6.1 The decorations of places of assembly shall be of non-flammable materials. Fabrics and papers used for such purpose shall be treated with an effective flame-retardant material. Stage settings made of combustible materials shall likewise be treated with fire retardant materials of Class I flame spread.

6.4.6.2 Seats in places of public assembly, accommodating more than 300 persons, shall be secured fastened to the floor except as permitted in 6.4.6.3. All seats in balconies and galleries shall 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 shall not be fastened.

6.4.6.3 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 shall be not more than one seat for each 1.4 m<sup>2</sup> of floor area and adequate aisles to reach exits shall be maintained at all times.

6.4.6.3.1 Rows of seats between aisles shall have not more than 14 seats.

6.4.6.3.2 Rows of seats opening on to an aisle at one end only shall have not more than 7 seats.

6.4.6.3.3 Seats without dividing arms shall have their capacity determined by allowing 450 mm per person.

6.4.6.4 The spacing of rows of seats from back-to back shall 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 shall 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.

6.4.6.5 Rooms containing high pressure boilers, refrigerating machinery other than domestic

refrigerator type, large transformers or other service equipments subject to possible explosion shall not be located directly under or adjacent to the required exits. All such rooms shall be effectively cut off from other parts of the building and provided with adequate vents to the outer air.

6.4.6.6 All rooms or areas used for storage of any combustible materials or equipment, or for painting, refinishing, repair or similar purposes shall be effectively cut off from assembly areas or protected with a standard system of automatic sprinklers. They shall be located away from staircases.

6.4.6.7 Every stage equipped with fly galleries, grid irons and rigging for movable theatre type scenery, shall 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 shall be provided with a fire-resisting curtain, capable of withstanding a lateral pressure of  $4 \text{ kN/m}^2$  over the entire area. The curtain shall have an emergency closing device capable of causing the curtain to close without the use of power and when so closed, it shall be reasonably tight against the passage of smoke

6.4.6.8 The stage roof of every theatre using movable scenery or having a motion picture screen of highly combustible construction shall 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.

6.4.6.9 The proscenium wall of every theatre using movable scenery or decorations shall have, exclusive of the proscenium opening, not more than two openings entering the stage, each not to exceed  $2 \text{ m}^2$  and fitted with self-closing fire resistant doors

6.4.6.10 Every place of assembly in which projection of motion pictures by light is made shall have the projection apparatus enclosed in a fire-resisting fixed booth in accordance with IS 4878: 1986 – Bye laws for construction of cinema buildings except that such booth shall not be required where no nitrocellulose motion picture film is used.

6.4.6.11 Automatic smoke vents actuated by smoke detectors shall be installed above the auditorium or theatres, including motion picture houses, with vent area equal to not less than 3 percent of the floor area of the auditorium, including the sum of the floor areas of all balconies, galleries, boxes and tiers. It may be desirable to provide a large number of small vents rather than a small number of large vents

#### 6.4.7 Exception and Deviation

6.4.7.1 Where boilers or central heating plants using liquid or solid fuel are located at grade level, these shall be separated from the remainder of the building by a separating wall with openings protected as in 3.4.6 and 3.4.7

6.4.7.2 Gymnasiums, indoor stadiums and similar occupancies may have floors/running tracks of

wood, cinder, synthetic or un-protected steel or iron.

6.4.7.3 The underside of continuous steel deck grand stands when erected outdoors need not be fire-protected when occupied for public toilets.

## **6.5 Requirements of Business buildings: (Group E)**

6.5.1 In addition to the general requirements specified in 3.2 and 3.3 for type of construction and occupancy group and the exit requirements given in 4, the requirements given in 6.5.2 to 6.5.5 shall be complied with.

6.5.2 Fire detection / extinguishing system:

The requirements for occupancy sub-divisions as specified in Table 23 and Annex C (for] Rise Buildings) shall apply.

6.5.2.1 Occupancy E –1 (Except office building) - Automatic fire alarm system.

6.5.2.2 Occupancy sub division E –2

- a. Laboratory with delicate instruments: Fixed automatic CO<sub>2</sub> fire extinguishing system or automatic fire alarm system.
- b. Solvent storage and/or flammable liquid: Automatic foam installation or automatic CO<sub>2</sub> fire extinguishing system.

6.5.2.3 Occupancy sub division E –3

- a. Area of Computer installations: Automatic fire alarm system and suitable halon alternative fire extinguishing system or any other suitable fire extinguishing installation
- b. Space under false ceiling (Floor): Automatic fire alarm system.
- c. Space above false ceiling (Floor): Automatic fire alarm system
- d. Electrical Switch board: Automatic fire alarm system CO<sub>2</sub> fire extinguishing system

6.5.2.4 Occupancy sub division E –4

Telephone exchanges: Any suitable halon alternative fire extinguishing system and/or automatic sprinkler system as per requirement.

6.5.2.5 Occupancy sub division E –5

Broadcasting stations: Automatic fire alarm system based on smoke detectors and sprinkler system.

6.5.3 Exit facilities:

6.5.3.1 In case of mezzanines or balconies open to the floor below, or other unprotected vertical openings between floors, the population of the mezzanine or other subsidiary floor level shall be

added to that of the main floor for the purpose of determining the required exits, provided, however, that in no case shall the total number of exit units be less than that required if all vertical openings were enclosed.

6.5.3.2 Not less than two exits shall be provided for every floor, including basements occupied for office purposes or uses incidental thereto.

#### 6.5.4 Additional Requirements

6.5.4.1 The handling and use of gasoline, fuel oil and other flammable liquids shall not be permitted, unless such use and handling complies with the appropriate regulations

6.5.4.2 Every boiler room or room containing a central heating plant using solid or liquid fuel shall be separated from the rest of the building by a separating wall. Every boiler room containing a central heating plant, which burns gas as a fuel shall be adequately separated from the rest of the building.

#### 6.5.5 Exception and Deviation

Basements used only for storage, heating, any other service equipment shall conform to the exit requirements of Group H occupancy in all respects.

### **6.6 Requirements of Mercantile Buildings (Group F)**

6.6.1 In addition to the general requirements specified in 3.2 and 3.3 for type of construction and occupancy group and the exit requirements given in 4, the requirements given in 6.6.1.1 to 6.6.5 shall be complied with.

#### 6.6.1.1 Mixed occupancy:

No dwelling unit shall have its sole means of exit through any mercantile occupancy in the same building, except in the case of a single-family unit where the family operates the store.

#### 6.6.2 Fire detection / extinguishing system:

The requirements for occupancy sub-divisions F-1 to F-3as specified in Table 23 and Annex C (for Rise Buildings) shall apply.

#### 6.6.3 Exit facilities:

In addition to the provisions of 4, the following requirements shall be complied with

6.6.3.1 In case of mezzanines or balconies open to the floor below, or other unprotected vertical openings between floors, the population of the mezzanine or other subsidiary floor level shall be added to that of the main floor for the purpose of determining the required exits, provided,

however, that in no case shall the total number of exit units be less than that required if all vertical openings were enclosed.

6.6.3.2 At least two separate exits shall be accessible from every part of every floor, including basements, such exits shall be as remote from each other as practicable and so arranged as to be reached by different paths of travel in different directions, except that a common path of travel may be permitted for the first 15 m from any point.

#### 6.6.4 Additional Requirements

6.6.4.1 Requirements specified in 6.5.4.1 shall be applicable to all Group F occupancies also.

6.6.4.2 Hazardous areas of mercantile occupancies shall be segregated or protected suitably.

6.6.4.3 In self-service stores, no check out stand or associated railings or barriers shall obstruct the exits or required aisles or approaches thereto.

6.6.4.4 Open air mercantile operations, such as open air markets, gasoline filling stations, roadside stands for sale of a farm produce and other out door mercantile operations shall be so arranged and conducted as to maintain free and unobstructed ways of travel at all times to prompt escape from any point of danger in case of fire or other emergency, but no dead ends in which persons might be trapped due to display stands, adjoining buildings, fences, vehicles or other obstructions.

6.6.4.5 If mercantile operations are conducted in roofed over areas, there shall be treated as mercantile buildings, provided canopies over individual small stands to protect merchandise from the weather shall not be constructed to constitute buildings for the purpose of this code.

#### 6.6.5 Exception and Deviation

Any mercantile occupancy, where goods of a highly hazardous nature are pre- dominant, shall be considered under group J occupancy for the purpose of this code.

### **6.7 Requirements of Industrial Buildings (Group G)**

6.7.1 In addition to the general requirements specified in 3.2 and 3.3 for type of construction and occupancy group and the exit requirements given in 4, the requirements given in 6.7.2 to 6.7.5 shall be complied with.

#### 6.7.2 Fire detection / extinguishing system:

The requirements for occupancy sub-divisions G-1 to G-3 as specified in Table 23 and Annex C (for] Rise Buildings) shall apply.

#### 6.7.3 Exit facilities

In addition to the provisions of 4, the following requirements shall be complied with

6.7.3.1 Not less than two exits shall be provided for every floor or section, including basements used for industrial purposes or uses incidental to.

6.7.3.2 Additional Precautions

- a. In any room in which the volatile flammable liquids are used or stored, no device generating a glow or flame capable of igniting flammable vapour shall be installed or used. Such a room shall be provided with a suitably designed exhaust ventilation system. To ensure safety from fire due to short circuit, faulty electrical connection or some similar cause, proper care shall be taken in designing electrical installations in such room. (Refer to electrical code)
- b. The storage, use and handling of gasoline, fuel oil and other flammable liquids shall not be permitted in any group G occupancy unless authority satisfies with the compliance of requisite regulations.
- c. Every boiler room or room below the first floor containing a heating plant shall be adequately separated from the rest of the building.

6.7.3.4 Exceptions and deviations:

- a. Basements used only for storage, heating and other service equipment, and not subject to industrial occupancy, shall have exits in accordance with the requirements of Group H occupancies.
- b. The following exceptions shall apply to special purpose industrial occupancies:
  1. Exits need be provided only for the persons actually employed spaces not subject to human occupancy because of the presence of machinery or equipment from consideration.
  2. 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 there from.
  3. Industrial buildings of low and moderate hazard are permitted up to 18 m only (define low and moderate hazard)
- c. The following exceptions shall apply to high hazard industrial occupancies:
  1. Exits shall be so located that it will not be necessary to travel more than 22.5 m from any point to reach the nearest exit.
  2. From every point in every floor area, there shall be at least two exits accessible in different directions, where floor area are divided in to rooms, there shall be at least two ways of escape from every room, however, small, except toilet rooms, so located that the points of access thereto are out of or suitably shielded from areas of high hazard.
  3. 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.

4. All high hazard industrial occupancies shall 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 utilise exits to escape.
5. Industrial buildings of high hazard are permitted up to 15 m height

## 6.8 Requirements of storage Buildings (Group H)

6.8.1 In addition to the general requirements specified in 3.2 and 3.3 for type of construction and occupancy group and the exit requirements given in 4, the requirements given in 6.8.2 to 6.8.5 shall be complied with.

6.8.2 Fire detection and extinguishing system:

The requirements for occupancy group H as specified in Table 23 and Annex C (for Rise Buildings) shall apply.

Note: Automatic sprinklers are prohibited where water reactive materials are kept. Instead automatic fire alarm system coupled with suitable fire extinguishing systems shall be installed.

6.8.3 Exit facilities:

In addition to the provisions of 4, the following requirements shall also be complied with.

6.8.3.1 Every building or structure used for storage, and every section thereof considered separately, shall have access to at least one exit so arranged and located as to provide a suitable means of escape for any person employed therein and in any room or space exceeding 1400 m<sup>2</sup> gross area, or where more than 10 persons may normally be present, at least two separate means of exit shall be available, as remote from each other as practicable.

6.8.3.2 Every storage area shall have access to at least one means of exit, which can be readily opened. This shall not be subject to locking so long as any persons are inside and shall not depend on power operation.

6.8.3.3 The following special provisions shall apply to parking garages of closed or open type, above or below ground, but not to mechanical parking facilities where automobiles are moved in to and out of storage mechanically which are not normally occupied by persons and thus require no exit facilities. Where repair operations are conducted, the exits shall comply with the requirements of Group G occupancies in addition to compliance with the following.

- a. Where both parking and repair operations are conducted in the same building, the entire building shall comply with the requirements for group G occupancies, unless separation walls effectively separate the parking and repair sections
- b. Every floor of every closed parking garage shall have access to at least two separate means of exit, so arranged that from any point in the garage the paths of travel to the

- two means of exit shall be in different directions, except that a common path of travel may be permitted for the first 15 m from any point.
- c. On the street floor, at least two separate exit doors shall be provided, except that any opening for the passage of automobiles may serve as means of exit, provided no door or shutter is installed thereon. Street floor exits in closed garages shall be so arranged that no point in the area is more than 30 m from the nearest exit, or 45 m in the case of garages protected by automatic sprinklers, distance being measured along the natural path of travel.
  - d. On floors above the street, at least two means of exit shall be provided, one of which shall be an enclosed stairway. The other means of egress may be a second exit of any of the types, or in a ramp type garage with open ramps not subject to closure, the ramp may serve as the second means of exit.
  - e. Upper floor exits in closed garages shall be so arranged that no point in the area shall be more than 30 m from the nearest exit other than ramp on the same floor level, or 45 m in the case of garages protected by automatic sprinklers.
  - f. On floors below the street (either basement or outside underground garages) at least two exits shall be provided, not counting any automobile ramps, except that for garages extending only one floor level below the street, a ramp leading direct to the outside may constitute one required means of exit. In garages below street level, exits shall be so arranged that no part of the area shall be more than 30 m from the nearest stair exit.
  - g. If any gasoline pumps are located within any closed parking garage, exits shall be so located that travel away from the gasoline pump in any direction shall lead to an exit, with no dead ends in which the occupants might be trapped by fire or explosion at any gasoline pump. Such exit shall lead to the outside of the building on the same level, or down stairs, no upward travel shall be permitted unless direct outside exits are available from that floor and any floor below (as in the case of a basement garage where the grade is one storey or more lower at the rear than at the street).

#### 6.8.4 Additional Precautions

Requirements specified in 6.7.3.3 shall apply to Group H occupancies also.

#### 6.8.5 Exceptions and deviations:

Every area used for the storage of hazardous commodities shall have an exit within 22.5 m of any point in the area where persons may be present or 30 m where automatic sprinklers protection is provided.

### 6.9 Requirement of buildings for Hazardous Uses (Group J)

6.9.1 In addition to the general requirements specified in 3.2 and 3.3 for type of construction and occupancy group and the exit requirements given in 4, the requirements given in 6.9.2 to 6.9.5 shall be complied with.

### 6.9.2 Fire detection and extinguishing system:

The requirements for occupancy group J as specified in Table 23 and Annex C (for Rise Buildings) shall apply.

Hazardous buildings shall have combustible vapour detectors / explosion suppression systems / automatic sprinklers, depending on the situation.

### 6.9.3 Exit facilities:

In addition to the provisions of 4 and 6.7.3.4 (c) shall apply to group J occupancies also.

### 6.9.4 Additional Precautions:

The following requirements shall apply to all group J occupancies as applicable.

- a. Each building where gas is employed for any purpose shall be provided with an approved gas shut off valve conspicuously marked.
- b. Each boiler room or room containing a heating plant shall be separated from the rest of the building by a separating wall.
- c. In any room in which the volatile flammable liquids are used or stored, no device generating a spark or glow flame capable of igniting gasoline vapour shall be installed or permitted unless it is enclosed in a flameproof enclosure.
- d. The use, handling, storage and sale of gasoline, fuel oil and other flammable liquids shall not be allowed without permissions of authority to that extent.
- e. All openings in exterior walls except wall vents shall be protected by a fire assembly and they shall be fixed, automatic or self-closing. Wall vents having an area of not less than 100 sq. cm each shall be placed in the exterior walls near the floor line, not more than 180 cm apart horizontally. Each building shall be provided with a power driven fan exhaust system of ventilation, which shall be arranged and operated so as to produce a complete change of air in each room every 3 minutes.
- f. Each machine in dry cleaning establishments which uses flammable liquid shall have an adequate steam line directly connected to it, so arranged as to have the steam automatically released to inside of each machine should an explosion occur in the machine.
- g. Equipment or machinery which generates or emits combustible or explosive dust or fibres shall be provided with an adequate dust collecting and exhaust system, unless the building or portion thereof housing such machinery is provided with an automatic fire extinguishing system.

## 6.10 Requirement of Heritage, archeological monuments and monasteries (Group K)

It is recommended that this class of Buildings have proper fire protection. Their fire protection should be done in based on the guidelines provided by the Department of Culture, Ministry of Home and Cultural Affairs.

## ANNEX A (Clause 3.1.10)

## CALORIFIC VALUES OF COMMON MATERIALS AND TYPICAL VALUES OF FIRE LOAD DENSITY

A-1 The calorific values of some common materials are given in the table 25 for guidance

Table 25 Calorific values of common materials

material	Calorific value ( $10^3\text{kJ/kg}^{-1}$ ) <sup>1)</sup>	Wood Equivalent Kg/Kg	Material	Calorific value ( $10^3\text{kJ/kg}^{-1}$ ) <sup>1)</sup>	Wood Equivalent Kg/Kg
Solid Fuels					
Anthracite	28.6	1.66	Bituminous coal	30.8	2.75
Charcoal	28.4	1.61	Coke( average)	27.5	1.56
Peats	20.9	1.19	Sub-bituminous coal	22.0	1.25
Woods( hard wood and soft wood)				17.6	1.00
Hydrocarbons					
Benzene	39.6	2.25	Butane	47.1	2.68
Ethane	49.1	2.79	Ethylene	47.7	2.71
Fuel oil	41.6	2.36	Gas oil	42.9	2.44
Hexane	44.9	2.55	Methane ( natural gas)	52.8	3.00
Octane	45.3	2.58	Paraffin	39.6-44	2.3-2.5
Pentane	46.0	2.61	Propane	47.3	2.69
Propylene				46.2	2.63
Alcohols					
Ethyl Alcohol	28.4	1.61	Methyl Alcohol	21.1	1.2
Propyl Alcohol	31.9	1.81			
Polymers					
Casein	23.1	1.31	Cellulose	16.5	0.94
Cellulose acetate	17.8	1.01	Polyethylene	48.4	2.75
Polypropylene	48.4	2.75	Polystyrene	41.8	2.38
Polyvinylchloride	20.9	1.19	Polymethylmethacrylate	24.6	1.40
Polyurethane	35.2	2.0	Polyamide ( nylon)	22.0	1.25
Polyester	22.0	1.25			

material	Calorific value ( $10^3\text{kJ/kg}^{-1}$ ) <sup>1)</sup>	Wood Equivalent Kg/Kg	material	Calorific value ( $10^3\text{kJ/kg}^{-1}$ ) <sup>1)</sup>	Wood Equivalent Kg/Kg
Common solids					
Asphalt	38.3	2.13	Bitumen	33.4	1.90
Carbon	32.1	1.83	Carbon(dry)	15.8	0.90
Flax	14,3	0.81	Furs and Skins	18.7	1.06
Hair(animal)	20.9	1.19	Leather	17.6	1.00
Ozokerite( wax)	43.3	2.46	Paper ( average)	15.4	0.88
Paraffin wax	40.9	2.33	Pitch	33.0	1.88
Rubber	37.4	2.13	Straw	13.2	0.75
Tallows	37.6	2.14	Tan bark	20.9	1.19
Tar( bituminous)	35.2	2.00	Wool(raw)	21.6	1.23
Wool ( scoured)				19.6	1.11
Foodstuffs					
Barely	14.1	0.80	Bran	11.0	0.63
Bread	9.9	0.56	Butter	29.5	1.68
Cheese( Cheddar)	18.1	1.03	Cornmeal	14.1	0.80
Flour	14.1	0.80	Margarine	29.5	1.68
Oatmeal	15.8	0.90	Rice	13.9	0.79
Soyabean flour	16.1	0.91	Sugar	15.4	0.88
Whole wheat	14.3	0.81			
Miscellaneous					
Acetone	29.7	1.69	Acetalhyde	25.1	1.43
Formalhyde	17.6	1.00	Hydrogen	134.2	7.63
Magnesium	24.0	1.36			

<sup>1)</sup> 1 kJ is approximately equal to 1 Btu so the figures in the tables are also equivalent to Btu/kg

A-2 Typical values of fire load density for arriving at the classification of occupancy hazard is given in table 26 for guidance

Table 26 Typical values of Fire Load Density

<b>Building type</b>	<b>Fire load density( expressed as wood equivalent) kg/m<sup>2</sup></b>	<b>Building type</b>	<b>Fire load density( expressed as wood equivalent) kg/m<sup>2</sup></b>
Residential ( A-1 and A-2)	25	Residential ( A-3 to A-5)	25
Institutional and educational ( B & C)	25	Assembly ( D)	25-50
Business (E)	25-50	Mercantile ( F)	Upto 250
Industrial ( G)	Upto 150	Storage and hazardous( H&J)	Upto 500

## ANNEX B (Clause 3.1.10 and 3.1.12)

### BROAD CLASSIFICATION OF INDUSTRIAL AND NON-INDUSTRIAL OCCUPANCIES INTO DIFFERENT DEGREE OF HAZARD

#### B-1 LOW HAZARD OCCUPANCIES

Abrasive manufacturing premises  
 Aerated water factories  
 Incense manufacturing premises  
 Analytical and/or Q.C. Laboratories  
 Asbestos steam packing and lagging manufacturers  
 Assembly buildings small (D-4 and D-5)  
 Battery charging and service stations  
 Breweries  
 Brickworks  
 Canning factories  
 Cardamom factories  
 Cement factories and/or asbestos or concrete products manufacturing premises  
 Ceramic factories, crockery, stoneware pipe manufacturing  
 Clay works  
 Clubs  
 Condensed milk factories, milk pasteurising plants and dairies  
 Confectionary manufacturing  
 Dwellings, lodges, dormitories, etc  
 Educational and research institutions  
 .Engineering workshops  
 Fruits and vegetables dehydrating and drying factories  
 Fruits products and condiment factories  
 Go-downs and warehouses (non-combustible goods)  
 Gold thread/gilding factories  
 Gum and/or glue and gelatine manufacturing  
 Mica products manufacturing  
 Office premises  
 Places of worship  
 Pottery works  
 Poultry farms  
 Residential buildings (A-1 to A-4) (except hotels A-5)  
 Sugar candy manufacturing  
 Vermicelli factories  
 Water treatment/filtration plants and water pump houses  
 Zinc/copper factories

#### B-2 MODERATE HAZARD OCCUPANCIES

Airport and other transportation terminal buildings  
 Aluminium factories  
 Assembly buildings (D-1 to D-3)  
 Flour and cereal grinding  
 Bakeries and biscuit factories  
 Book-binders, envelopes and paper bag manufacturing  
 Cable manufacturing  
 Camphor boiling  
 Candle works  
 Carbon paper/typewriter ribbon makers  
 Card board box manufacturing  
 Carpenters, wood wool and furniture makers  
 Carpet and durries factories  
 Chemical manufacturers (using raw materials having F.P > 23°C)  
 Cigar and cigarette factories  
 Coir factories  
 Cold storage premises  
 Computer installations  
 Cork products manufacturing (coir, carpets, rugs and tobacco) (hides and skin presses)  
 Dry cleaning, dyeing and laundries  
 Electric sub-stations/distribution stations  
 Electrical generating stations except under ground  
 Powerhouses  
 Enamelware factories  
 Filler and wax paper manufacturing  
 Flour mills  
 Garment makers  
 Ghee factories (other than vegetable)  
 Go-downs and warehouses (other than non-combustible goods)  
 Grains and seed disintegrating or crushing  
 Hosiery, lace, embroidery and thread  
 Hospitals including 'X' -ray and other diagnostic clinics (institutional buildings)  
 Industrial gas manufacturing (only halogenated hydrocarbons/inert gases)

Man-made yarn/fibre (except acrylic fibre/yarn)	Cinema films and T.V. production studios
Manure and fertilizer works (blending, mixing and granulating only)	Coal, coke and charcoal ball and briquettes making
Mercantile occupancies (departmental stores, shopping complex, etc)	Collieries, steel plants Distilleries
Mineral oil blending and processing	Duplicating/stencil paper making
Museums, archives, record rooms	Foamed plastic and/or converting plants
Oil and leather cloth factories	Go-downs or warehouses (combustible/hazardous goods) (H)
Open storage of flammable liquids (in drums, cans, etc)	Grass, hay, fodder chaff)
Oxygen plants	Hazardous occupancy buildings (J)
Paper and cardboard mills (except raw material yard)	Industrial gas manufacturing (except halogenated Hydrocarbon gases/inert gases)
Plastic goods manufacturing	Industrial units (G-3 occupancies)
Plywood/wood veneering factories	Linoleum factories
Printing press premises	Man-made fibres (only acrylic fibre/yarn making)
Pulverizing and crushing mills	Match factories
Residential apartments, hotels, cafes, restaurants Rice mills	Mattress and pillow makings (foam plastics)
Rope works	Metal or tin printers (if more than 50 percent is engineering, shift to ordinary hazard)
Silk filatures	Oil mills
Soaps and glycerine factories	Oil extraction plants
Spray painting	Oil terminals/depots
Starch factories	Paints\varnish factories
Tea factories (including blending packing of tea)	Paper and cardboard mills (only raw material yard)
Telephone exchanges, garages	Pressing factories
Textile mills	Printing ink making
Woollen mills	Resin, lamp black and turpentine manufacture
<b>B-3 HIGH HAZARD OCCUPANCIES</b>	Tarpaulin and canvas proofing factories
<b>A</b>	Turpentine and resin distilleries
Aircraft hangers	Tyre retreading and resolving factories
Aluminium/magnesium powder plants	Underground shopping complexes (F-3)
Bituminized paper/Hessian cloth/tar felt manufacturing	<b>B</b>
Bulk storage of flammable liquids (tank farm, etc)	Ammonia and urea synthesis plants
Celluloid goods making	Explosive factories
Chemical manufacturers (where raw materials have a F.P. < 23°C)	LPG bottling plants
	Petrochemical plants
	Petroleum refineries

NOTE – in cases of complexes having segregated plants with varying degrees of hazards, the competent authority having jurisdictions shall be consulted to decide the level of protections to be

## ANNEX C

*(Clauses 3.4.9, 5.1.8, 5.2, 6.1.2, 6.2.3, 6.3.2, 6.4.3, 6.5.2, 6.6.2, 6.7.2, 6.8.2 and 6.9.2)*

### FIRE PROTECTION REQUIREMENTS FOR HIGH RISE BUILDINGS 15 m IN HEIGHT OR ABOVE

#### C-O GENERAL

In addition to the general provisions given in this Part, the Authority may insist on suitable protection measures (*see C- 1 to C-11*) in a building 15 m in height or above.

#### C-1 CONSTRUCTION

C - 1.1 All materials of constructions in load bearing elements, stairways and corridors and facades shall be non-combustible.

C - 1.2 The interior finish materials shall not have a flame spreadability rating exceeding Class 1 (*see 3.4.14.2*).

C - 1.3 The internal walls or staircase shall be of brick or reinforced concrete with a minimum of 2 h fire rating.

C - 1.4 The staircase shall be ventilated to the atmosphere at each landing and a vent at the top; the vent openings shall be of 0.5 m<sup>2</sup> in the external wall and the top. If the staircase cannot be ventilated, because of location or other reasons, a positive pressure 50 Pa shall be maintained inside. The mechanism for pressurizing the staircase shall operate automatically with the fire alarm. The roof of the shaft shall be 1 m above the surrounding roof. Glazing or glass bricks if used in staircase, shall have fire resistance rating of minimum 2 h.

#### C - 1.5 Lifts

- a. General requirements of lifts shall be as follows:
- b. Walls of lift enclosures shall have a fire rating of 2 h; lifts shafts shall have a vent at the top of area not less than 0.2 m<sup>2</sup>.
- c. Lift motor room shall be located preferably on top of the shaft and separated from the shaft by the floor of the room.
- d. Landing doors in lift enclosures shall have a fire resistance of not less than 1 h.
- e. The number of lifts in one row for a lift bank shall not exceed 4 and the total number of lifts in the bank (of two rows) shall not exceed 8. A wall of 2 h fire rating shall separate individual shafts in a bank.
- f. Lift car door shall have a fire resistance rating of half an hour.
- g. Collapsible gates shall not be permitted for lifts and shall have solid doors with fire resistance of at least 1 h.
- h. If the lift shaft and lobby is in-the core of the building, a positive pressure between 25 and 30 Pa shall be maintained in the lobby and a positive pressure of 50 Pa shall be

maintained in the lift shaft. The mechanism for pressurization shall act automatically with the fire alarm; it shall be possible to operate this mechanically also.

- i. Exit from the lift lobby, if located in the core of the building, shall be through a self-closing smoke stop door of half an hour fire resistance.
- j. Lifts shall not normally communicate with the basement; if, however, lifts are in communication, the lift lobby of the basements shall be pressurized as in (g), with self-closing door as in (h).
- k. Grounding switch (es), at ground floor level, shall be provided on all the lifts to enable the fire service to ground the lifts.
- l. Telephone or other communication facilities shall be provided in lift cars for building of 30 m in height and above. Communication system for lifts shall be connected to fire control room for the building.
- m. Suitable arrangements such as providing slope in the floor of lift lobby shall be made to prevent water used during fire fighting, etc, at any landing from entering the lift shafts.
- n. A sign shall be posted and maintained on every floor at or near the lift indicating that in case of fire, occupants shall use the stairs unless instructed otherwise. The sign shall also contain a plan for each floor showing the locations of the stairways.

Alternate source of power supply shall be provided for all the lifts through a manually operated changeover switch.

- o) Fire Lifts - Following details shall apply for a fire lift:
  1. To enable fire services personnel to reach the upper floors with the minimum delay, one fire lift per 1,200 m<sup>2</sup> of floor area shall be provided and shall be available for the exclusive use of the firemen in an emergency.
  2. The lift shall have a floor area of not less than 1.4 m<sup>2</sup>. It shall have loading capacity of not less than 545 kg (8 persons lift) with automatic closing doors of minimum 0.8 m width.
  3. The electric supply shall be on a separate service from electric supply mains in a building and the cables run in a route safe from fire, that is, within the lift shaft. Lights and fans in the elevators having wooden panelling or sheet steel construction shall be operated on 24 V supply.
  4. Fire fighting lift should be provided with a ceiling hatch for use in case of emergency, so that when the car gets stuck up, it shall be easily openable.
  5. In case of failure of normal electric supply, it shall automatically trip over to alternate supply. For apartment houses, this changeover of supply could be done through manually operated changeover switch. Alternatively, the lift shall be so wired that in case of power failure, it comes down at the ground level and comes to stand-still with door open.
  6. The operation of a fire lift is by a simple toggle or two-button switch situated in a glass-fronted box adjacent to the lift at the entrance level. When the switch is on, landing call-points will become inoperative and the lift will be on car control only or on a priority control device. When the switch is off, the lift will return to

normal working. This lift can be used by the occupants in normal times.

7. The words 'Fire Lift' shall be conspicuously displayed in fluorescent paint on the lift landing doors at each floor level.
8. The speed of the fire lift shall be such that it can reach the top floor from ground level within 1 min.

## C-1.6 Basements

C-1.6.1 Each basement shall be separately ventilated. Vents with cross-sectional area (aggregate) not less than 2.5 percent of the floor area spread evenly round the perimeter of the basement shall be provided in the form of grills, or breakable stall-board lights or pavement lights or by way of shafts. Alternatively, a system of air inlets shall be provided at basement floor level and smoke outlets at basement ceiling level. Inlets and extracts may be terminated at ground level with stall-board or pavement lights as before, but ducts to convey fresh air to the basement floor level have to be laid. Stall-board and pavement lights should be in positions easily accessible to the fire brigade and clearly marked 'SMOKE OUTLET' or 'AIR INLET' with an indication of area served at or near the opening.

C-1.6.2 The staircase of basements shall be of enclosed type having fire resistance of not less than 2 h and shall be situated at the periphery of the basement to be entered at ground level only from the open air and in such positions that smoke from any fire in the basement shall not obstruct any exit serving the ground and upper stores of the building and shall communicate with basement through a lobby provided with fire resisting self closing doors of 1 h resistance. For travel distance *see* 4.5. If the travel distance exceeds as given in Table 21, additional staircases shall be provided at proper places.

C-1.6.3 In multi-storey basements, intake ducts may serve all basement levels, but each basement levels and basement compartment shall have separate smoke outlet duct or ducts. Ducts so provided shall have the same fire resistance rating as the compartment itself. Fire rating may be taken as the required smoke extraction time for smoke extraction ducts.

C-1.6.4 Mechanical extractors for smoke venting system from lower basement levels shall also be provided. The system shall be of such design as to operate on actuation of heat/smoke sensitive detectors or sprinklers, if installed, and shall have a considerably superior performance compared to the standard units. It shall also have an arrangement to start it manually.

C-1.6.4.1 Mechanical extractors shall have an internal locking arrangement, so that extractors shall continue to operate and supply fans shall stop automatically with the actuation of fire detectors.

C-1.6.4.2 Mechanical extractors shall be designed to permit 30 air changes per hour in case of fire or distress call. However, for normal operation, air changes schedule shall be as given in 3.4.11.

C-1.6.4.3 Mechanical extractors shall have an alternative source of supply.

C-1.6.4.4 Ventilating ducts shall be integrated with the structure and made out of brick masonry or reinforced cement concrete as far as possible and when this duct crosses the transformer area or electrical switchboard, fire dampers shall be provided.

C-1.6.5 Use of basements for kitchens working on gas fuel shall not be permitted, unless air conditioned. The basement shall not be permitted below the ward block of a hospital/nursing home unless it is fully sprinkled.

Building services such as electrical sub-stations, boiler rooms in basements shall comply with the provisions of the Bhutan Electricity Act and the existing rules and regulations.

C-1.6.6 If cut outs are provided from basements to the upper floors or to the atmospheres, all sides cut out openings in the basements shall be protected by sprinkler head at close spacing so as to form a water curtain in the event of a fire.

C - 1.7 Openable windows on external walls shall be fitted with such locks that can be opened by a fireman's axe.

C - 1.8 All floors shall be compartmented with area not exceeding 750 m<sup>2</sup> by a separation wall with 2 h fire rating, for floors with sprinklers the area may be increased by 50 percent. In long building, the fire separation walls shall be at distances not exceeding 40 m. For departmental stores, shopping centres and basements, the area may be reduced to 500 m<sup>2</sup> for compartmentation. Where this is not possible, the spacing of the sprinklers shall be suitably reduced. When reducing the spacing of sprinklers, care should be taken to prevent spray from one sprinkler impeding the performance of an adjacent sprinkler head.

C-1.8.1 It is essential to make provisions for drainage of any such water on all floors to prevent or minimize water damage of the contents. The drain pipes should be provided on the external wall for drainage of water from all floors. On large area floors several such pipes may be necessary which should be spaced 30 m apart. Care shall be taken to ensure that the construction of the drain pipe does not allow spread of fire/smoke from floor to floor.

#### C - 1.9 Service Ducts/Shafts

a) Service ducts and shafts shall be enclosed by walls of 2 h and doors of 1 h, fire rating. All such ducts/shafts shall be properly sealed and fire stopped at all floor levels.

b) A vent opening at the top of the service shaft shall be provided having between one-fourth and one-half of the area of the shaft.

C - 1.10 Refuse chutes shall have opening at least 1 m above roof level or venting purpose and they shall have an enclosure wall of non-combustible material with fire resistance of not less than 2 h. They shall not be located within the staircase enclosure or service shafts, or air-conditioning shafts inspection panel and doors shall be tight fitting with 1 h fire resistance; the chutes should be as far away as possible from exits.

#### C - 1.11 Refuge Area

Provisions contained in 4.12.3 shall apply for all buildings except multi-family dwellings, refuge area of not less than 15 m<sup>2</sup> shall be provided on the external walls.

C - 1.12 Electrical services shall conform to the following:

- a) The electric distribution cables/wiring shall be laid in a separate duct. The duct shall be sealed at every floor with non-combustible materials having the same fire resistance as that of the duct. Low and medium voltage wiring running in shaft and in false ceiling shall run in separate conduits;
- b) Water mains, telephone lines, intercom lines, gas-pipes or any other service line shall not be laid in the duct for electrical cables; use of bus ducts/solid rising mains instead of cables is preferred;
- c) Separate circuits for fire fighting pumps, lifts, staircases and corridor lighting and blowers for pressurizing system shall be provided directly from the main switch gear panel and these circuits shall be laid in separate conduit pipes, so that fire in one circuit will not affect the others. Such circuits shall be protected at origin by an automatic circuit breaker with its no-volt coil removed. Master switches controlling essential service circuits shall be clearly labelled.
- d) The inspection panel doors and any other opening in the shaft shall be provided with air-tight fire doors having fire resistance of not less than 2 h;
- e) Medium and low voltage wiring running in shafts and within false ceiling shall run in metal conduit. Any 230 V wiring for lighting or other services, above false ceiling, shall have 660 V grade insulation. The false ceiling, including all fixtures used for its suspension, shall be of non-combustible material and shall provide adequate fire resistance to the ceiling in order to prevent spread of fire across ceiling.
- f) An independent and well ventilated service room shall be provided on the ground level or first basement with direct access from outside or from the corridor for the purpose of termination of electric supply from the licensees' service and alternative supply cables. The doors provided for the service room shall have fire resistance of not less than 2 h; NOTE - If service room is located at the first basement, it should have automatic fire extinguishing system.
- g) If the licensees agree to provide meters on upper floors, the licensees' cables shall be segregated from consumers' cables by providing a partition in the duct. Meter rooms on upper floors shall not open into stair case enclosures and shall be ventilated directly to open air outside; and
- h) Suitable circuit breakers shall be provided at the appropriate points.

C - 1.13 Illumination of Means of Exit

Staircase and corridor lights shall conform to the following (*see* 4.15 and 4.16 for additional details):

- a) The staircase and corridor lighting shall be on separate circuits and shall be independently connected so as it could be operated by one switch installation on the ground floor easily accessible to fire fighting staff at any time irrespective of the position of the individual control of the light points, if any. It should be of miniature circuit breaker type of switch so as to avoid replacement of fuse in case of crisis;
- b) Staircase and corridor lighting shall also be connected to alternative supply. The alternative source of supply may be provided by battery continuously trickle charged

from the electric mains;

- c) Suitable arrangements shall 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 shall be installed in the service room for terminating the stand-by supply;
- d) Emergency lights shall be provided in the staircase and corridor; and
- e) All wires and other accessories used for emergency light shall have fire retardant property.

C - 1.14 A stand-by electric generator shall be installed to supply power to staircase and corridor lighting circuits, fire lifts, the stand-by fire pump, pressurization fans and blowers, smoke extraction and damper systems in case of failure of normal electric supply. The generator shall be capable of taking starting current of all the machines and circuits stated above simultaneously. If the stand-by pump is driven by diesel engine, the generator supply need not be connected to the stand-by pump. Where parallel HV /LV supply from a separate sub-station is provided with appropriate transformer for emergency, the provision of generator may be waived in consultation with the Authority.

C - 1.15 Transformers shall conform to the following:

- a) A sub-station or a switch-station with oil filled equipment shall not be located in the building. The sub-station structure shall have separate fire resisting walls/surroundings and shall necessarily be located at the periphery of the floor having separate access from fire escape stair case. The outside walls, ceiling, floor, openings including doors and windows to the sub-station area shall be provided with a fire resisting door of 2 h fire rating. Direct access to the transformer room shall be provided, preferably from outside fire escape staircase.
- b) The sub-station area needs to be maintained at negative air pressures and area in sub-station shall not be used as storage/dump areas.
- c) When housed inside the building, the transformer shall be of dry type and shall be cut off from the other portion of premises by walls/doors/cut-out having fire resistance rating of 4 h.

C - 1.16 Air-conditioning shall conform to the following:

- a) Escape routes like staircases, common corridors, lift lobbies, etc, shall not be used as return air passage.
- b) The ducting shall be constructed of substantial gauge metal in accordance with IS 9583 : 1981 – emergency lighting
- c) Wherever the ducts pass through fire walls or floors, the opening around the ducts shall be sealed with materials having fire resistance rating of the compartment.
- d) Where duct crosses a compartment which is fire rated, the ducts shall be fire rated for same fire rating. Further depending on services passing around the duct work, which may get affected in case of fire temperature rising, the ducts shall be insulated.
- e) As far as possible, metallic ducts shall be used even for the return air instead of space above the false ceiling
- f) Where plenum is used for return air passage, ceiling and its fixtures shall be of non-combustible material.
- g) The materials used for insulating the duct system (inside or outside) shall be of non-

combustible materials. Glass wool shall not be wrapped or secured by any material of combustible nature.

h) Area more than 750 m<sup>2</sup> on individual floor shall be segregated by a fire wall and automatic fire dampers for isolation shall be provided [see (j)]. .

i) Air ducts serving main floor areas, corridors, etc, shall not pass through the staircase enclosure.

j) The air-handling units shall be separate for each floor and air ducts for every floor shall be separated and in no way inter-connected with the ducting of any other floor.

k) If the air-handling unit serves more than one floor, the recommendations given above shall be complied with in addition to the conditions given below:

1) Proper arrangements by way of automatic fire dampers working on smoke detector/ or fusible link for isolating all ducting at every floor from the main riser shall be made.

2) When the automatic fire alarm operates, the respective air-handling units of the air - conditioning system shall automatically be switched off.

l) The vertical shaft for treated fresh air shall be of masonry construction.

m) The air filters of the air-handling units shall be of non-combustible materials.

n) The air-handling unit room shall not be used for storage of any combustible materials.

o) Inspection panels shall be provided in the main trunking to facilitate the cleaning of ducts of accumulated dust and to obtain access for maintenance of fire dampers.

p) No combustible material shall be fixed nearer than 150 mm to any duct unless such duct is properly enclosed and protected with non-combustible material (glass wool or spun glass with neoprene facing enclosed and wrapped with aluminium sheeting) at least 3.2 mm thick and which would not readily conduct heat.

t) Fire Dampers

1. These shall be located in conditioned air ducts and return air ducts/passages at the following points:

i) At the fire separation wall.

ii) Where ducts/passages enter the central vertical shaft.

iii) Where the ducts pass through floors.

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

2. The dampers shall operate automatically and shall simultaneously switch off the air-handling fans. Manual operation facilities shall also be provided.

NOTE - For blowers, where extraction system and duct accumulators are used, dampers shall be provided.

3. Fire/smoke dampers (for smoke extraction shafts) for buildings more than 24 m in height.

For apartment houses in non-ventilated lobbies/ corridors operated by fusible link/smoke detectors and with manual control.

For other buildings on operation of smoke detection system and with manual control.

4. Automatic fire dampers shall be so arranged as to close by gravity in the direction

of air movement and to remain tightly closed on operation of a fusible link/smoke detector.

## **C-2 PROVISION OF FIRST-AID FIRE FIGHTING APPLIANCES**

The first-aid fire fighting equipment shall be provided on all floors, including basements, lift rooms, etc, in accordance IS 884 : 1985 – Specification for first aid hose reel for fire fighting and IS 15517 : 2004 code of practice for inspection and maintenance of fire extinguishing systems in consultation with the Authority.

## **C-3 FIRE ALARM SYSTEM**

C-3.1 All buildings with heights of 15 m or above shall be equipped with manually operated electrical fire alarm system and automatic fire alarm system. However, apartment buildings between 15 m and 30 m in height may be exempted from the installation of automatic fire alarm system provided the local fire brigade is suitably equipped for dealing with fire in a building of 15 m in height or above and in the opinion of the Authority, such building does not constitute a hazard to the safety of the adjacent property or occupants of the building itself.

C-3.1.1 Manually operated electrical fire alarm system shall be installed in a building with one or more call boxes located at each floor.

C-3.1.2 The installation of call boxes in hostels and such other places where these are likely to be misused shall as far as possible be avoided. Location of call boxes in dwelling units shall preferably be inside the building.

## **C-4 LIGHTNING PROTECTION OF BUILDINGS**

The lightning protection for buildings shall be provided as given in BTS 010-2003 - Electrical Installations'.

## **C-5 FIRE CONTROL ROOM**

For all buildings 15 m in height or above and apartment buildings with a height of 30 m and above, there shall be a control room on the entrance floor of the building with communication system (suitable public address system) to all floors and facilities for receiving the message from different floors. Details of all floor plans along with the details of fire fighting equipment and installations shall be maintained in the fire control room. The fire control room shall also have facilities to detect the fire on any floor through indicator boards connection; fire detection and alarm. Systems on all floors. The fire staff in charge of the fire control room shall be responsible for the maintenance of the various services and fire fighting equipment and installations in co-ordination with security, electrical and civil staff of the building.

## **C-6 FIRE OFFICER FOR HOTELS, BUSINESS AND MERCANTILE BUILDINGS WITH HEIGHT MORE THAN 30 m**

C-6.1 A qualified Fire Officer with experience of not less than 3 years shall be appointed who

will be available on the premises.

C-6.2 The Fire Officer shall:

- a. Maintain the fire fighting equipment in good working condition at all times,
- b. Prepare fire orders and fire operational plans and get them promulgated,
- c. impart regular training to the occupants of the buildings in the use of fire fighting equipments provided on the premises and keep them informed about the fire emergency evacuation plan,
- d. Keep proper liaison with city Fire Brigade, and e) ensure that all fire precautionary measures are observed at the times.

NOTE - Competent authority having jurisdiction may insist on compliance of the above rules in case of buildings having very large areas even if the height is less than 30 m.

#### C-7 HOUSE KEEPING

To eliminate fire hazards, good house keeping, both inside and outside the building, shall be strictly maintained by the occupants and/or the owner of the building.

#### C-8 FIRE DRILLS AND FIRE ORDERS

Fire notices/orders shall be prepared to fulfil the requirements of fire fighting and evacuation from the buildings in the event of fire and other emergency. The occupants shall be made thoroughly conversant with their actions in the event of emergency, by displaying fire notices at vantage points and also through regular training. Such notices should be displayed prominently in broad lettering.

#### C-9 COMPARTMENTATION

The building shall be suitably compartmentalized so that fire/smoke remains confined to the area where fire incident has occurred and does not spread to the remaining part of the building.

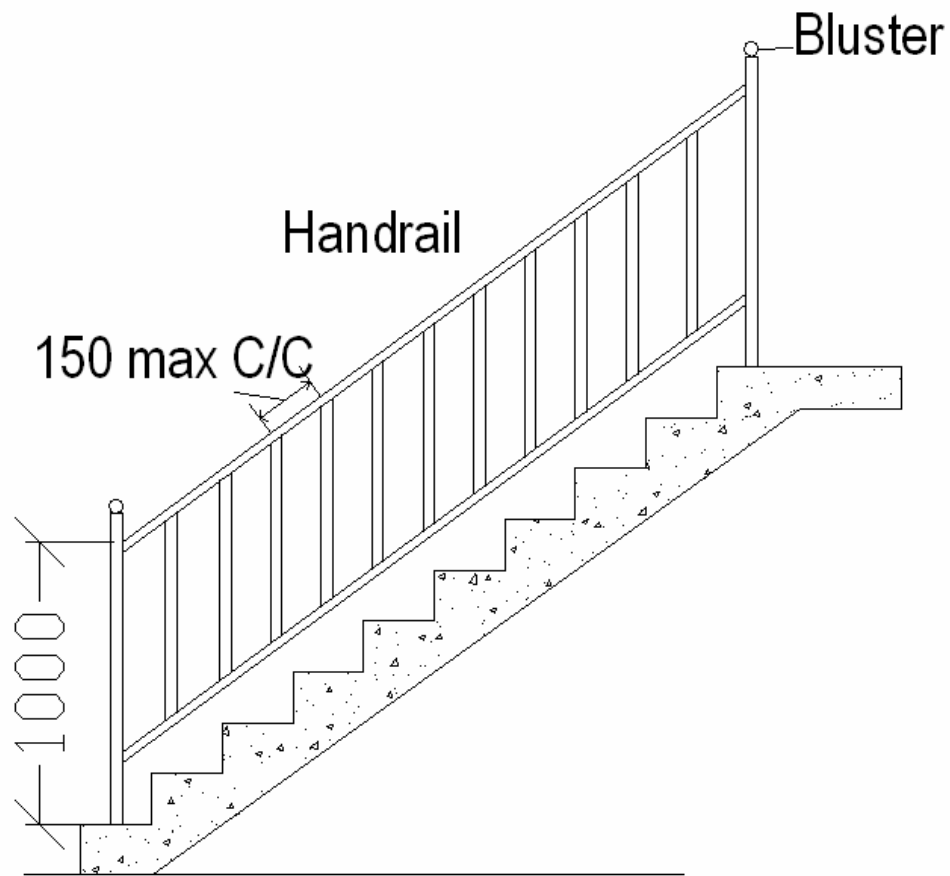
#### C-10 HELIPAD

For high rise buildings above 60 m in height, provision for helipad should be made.

#### C-11 MATERIALS FOR INTERIOR DECORATION/FURNISHING

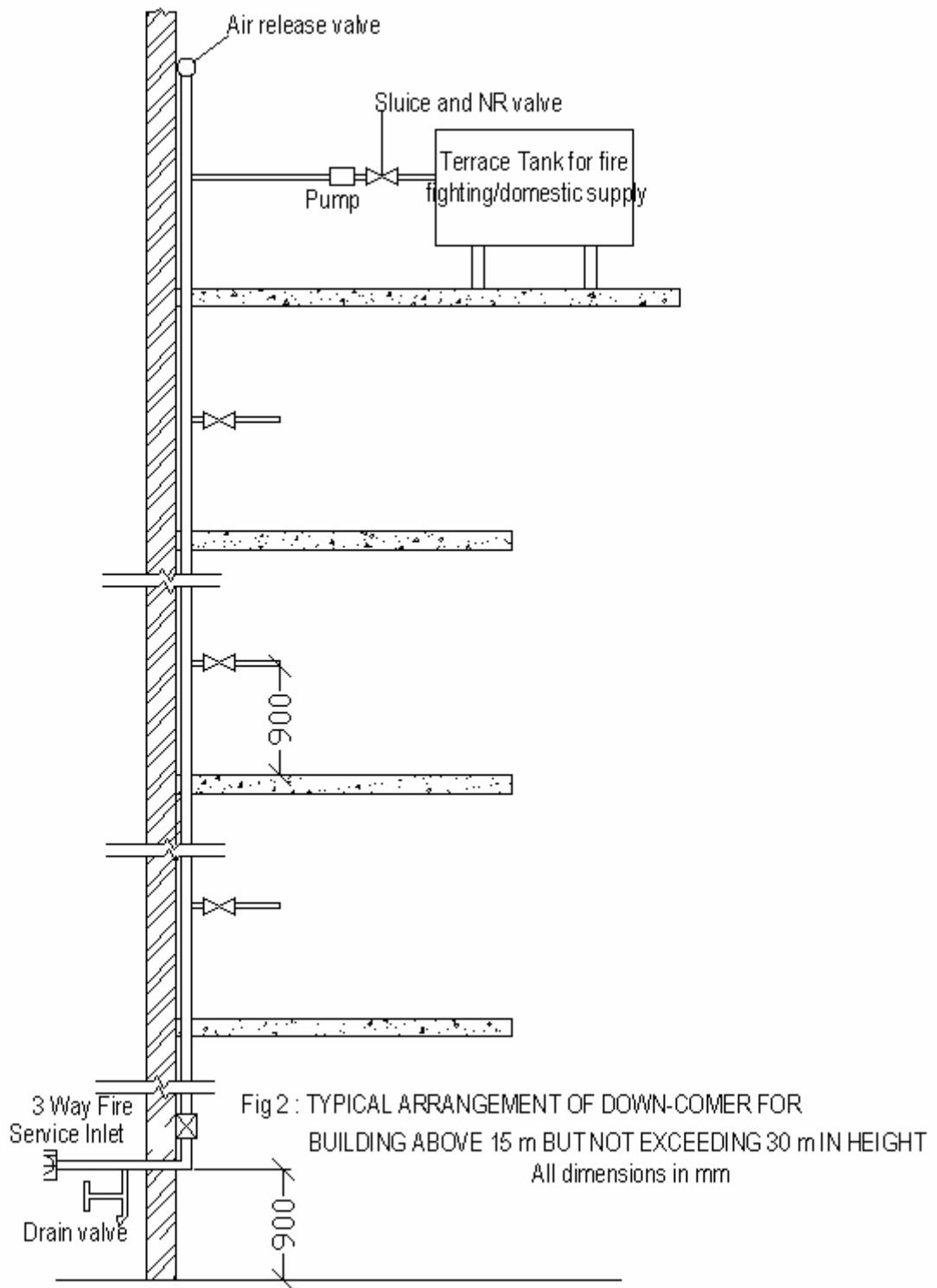
The use of materials which are combustible in nature and may spread toxic fume/gases should not be used for interior decoration/furnishing, etc.

ANNEX D – FIGURES



All Dimensions in mm

Fig 1 - TYPICAL DETAIL FOR HANDRAIL/BLUSTERS OF A STAIRCASE



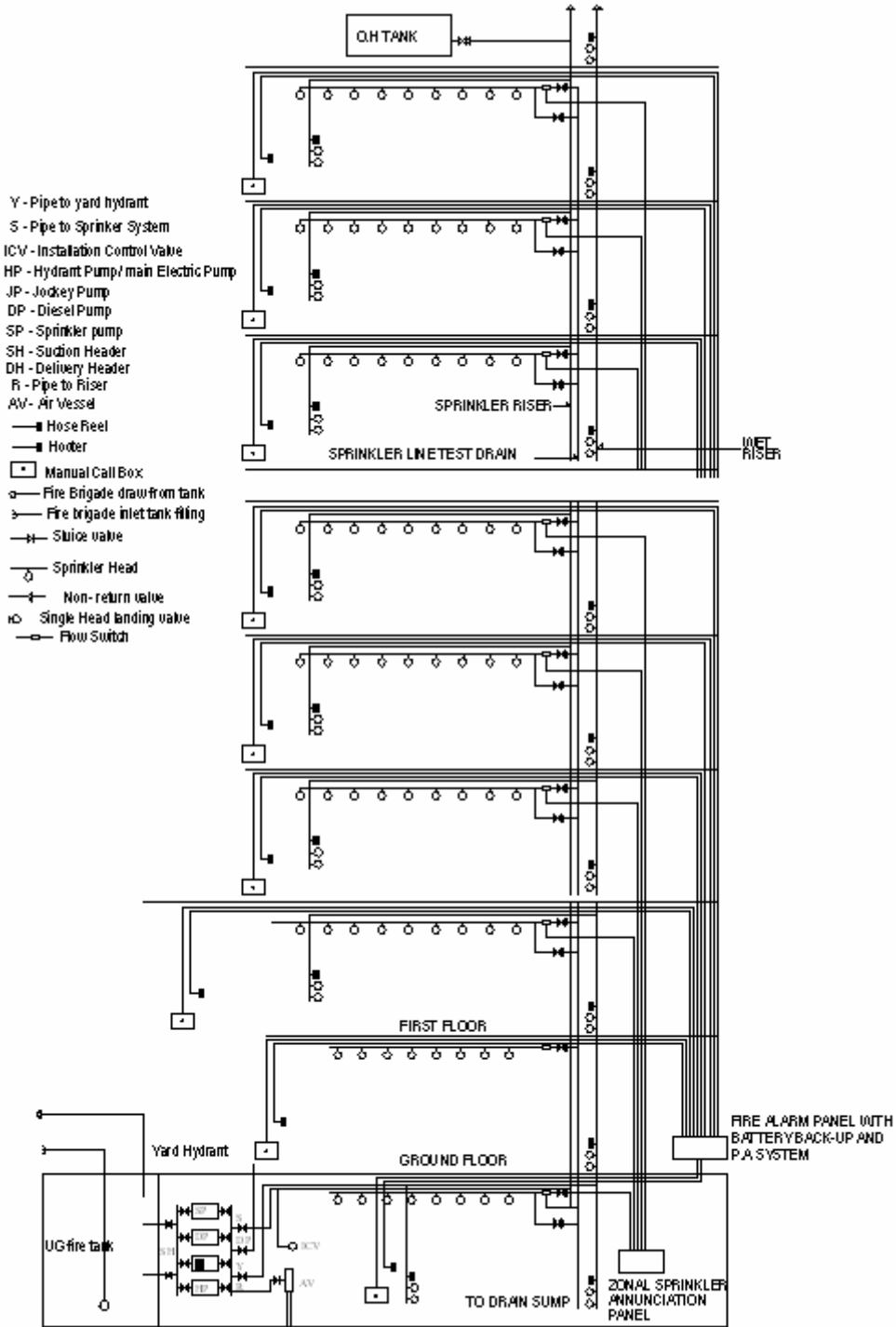


Fig 5 - TYPICAL ARRANGEMENT OF WET RISER AND TOTAL SPRINKLER SYSTEM OF BUILDING OTHER THAN APARTMENT EXCEEDING 30 m IN HEIGHT

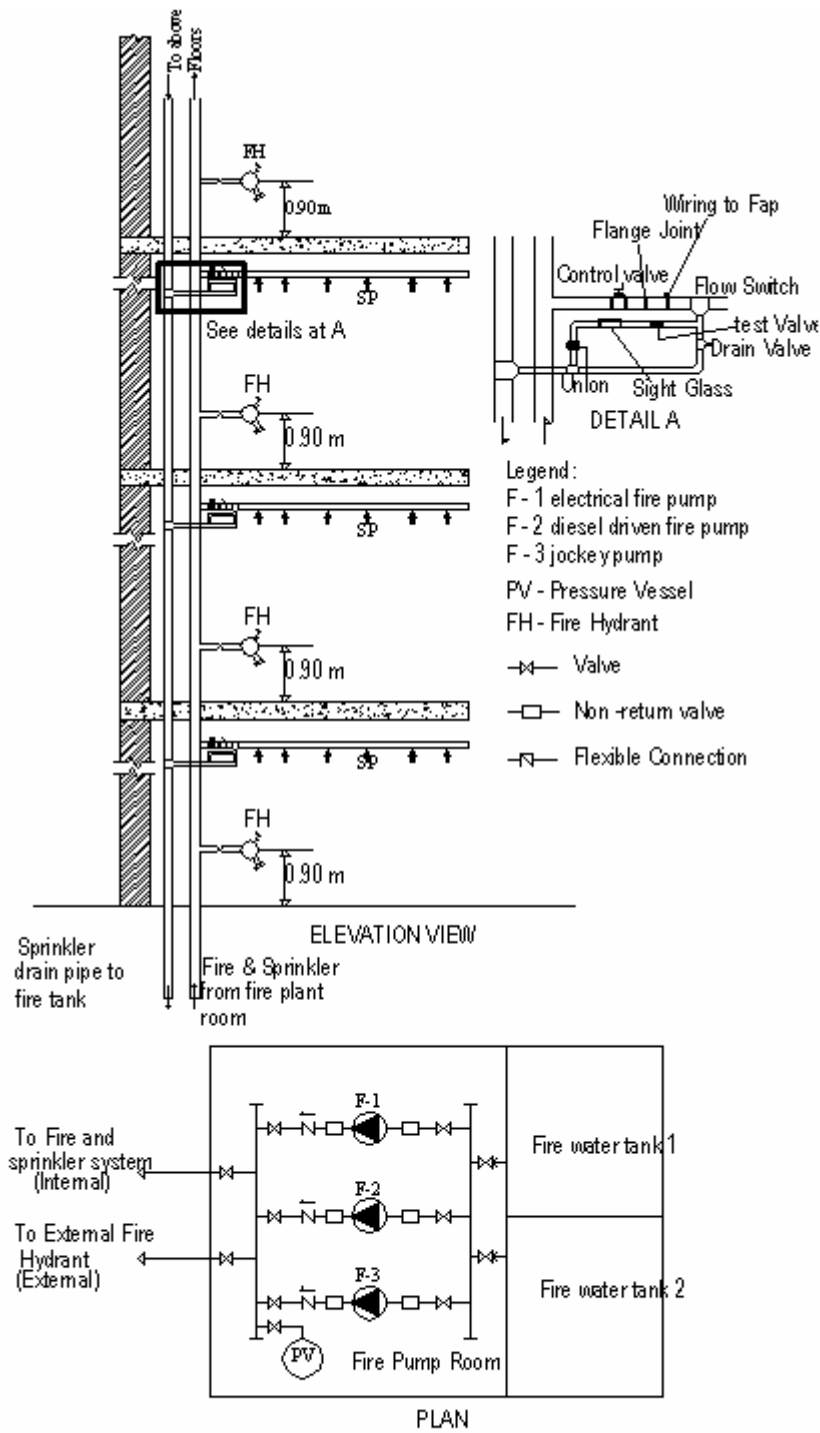


Fig 4 - TYPICAL SYSTEM OF PUMPING WITH ONE ELECTRIC AND ONE DIESEL PUMP

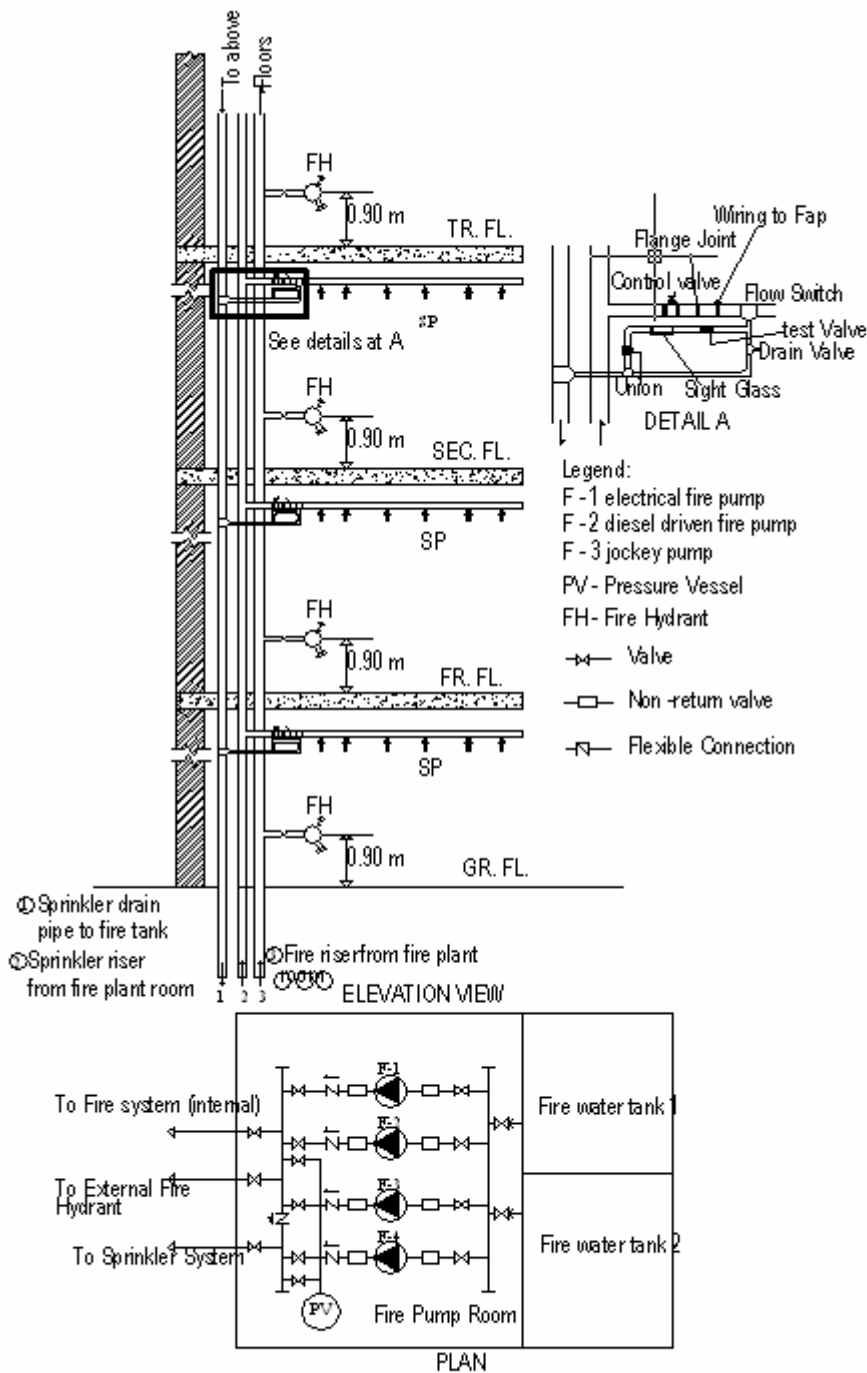


Fig 5 - TYPICAL SYSTEM OF PUMPING WITH TWO ELECTRIC AND ONE DIESEL PUMP

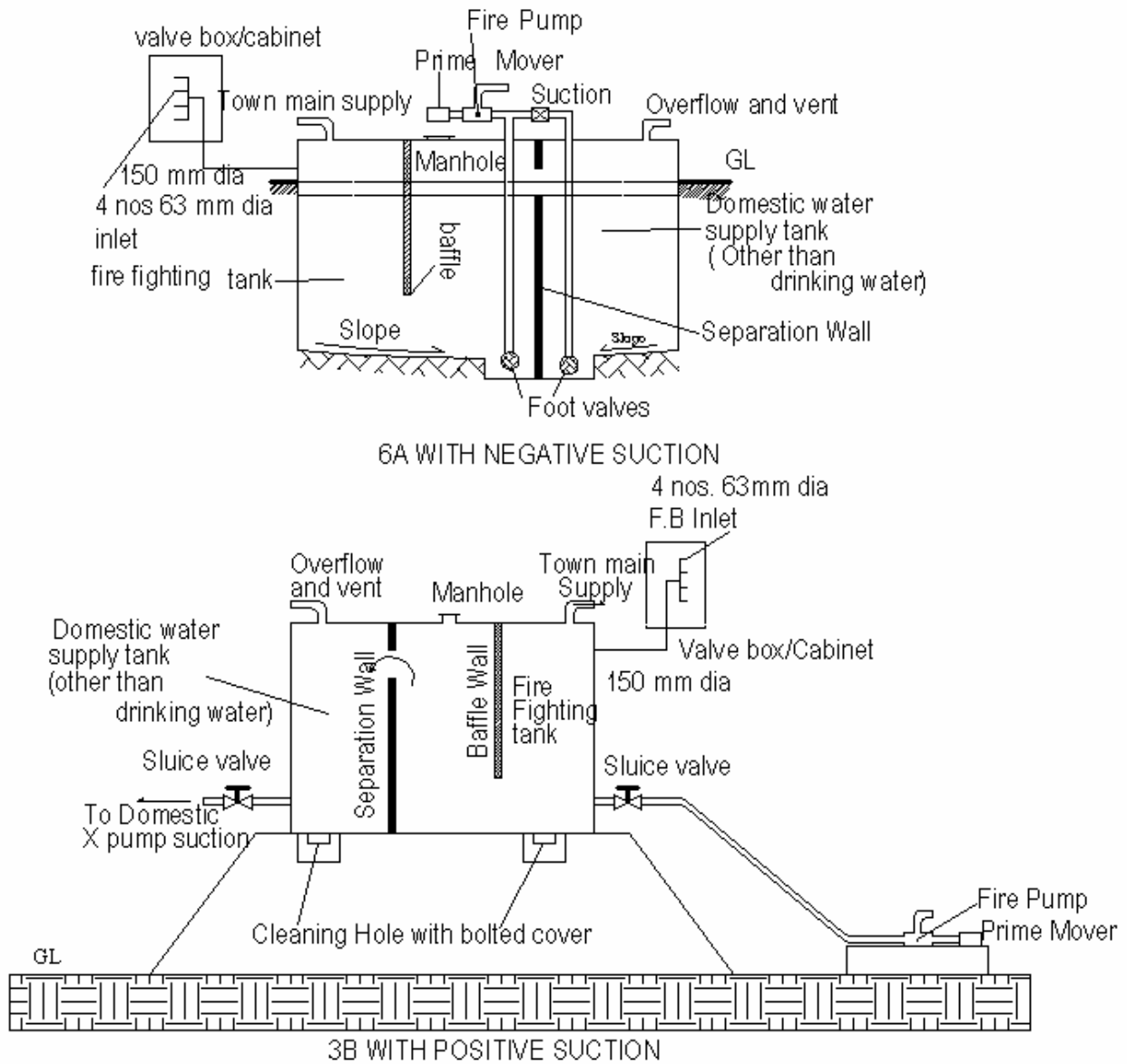


Fig. 6 TYPICAL ARRANGEMENT FOR PROVIDING COMBINED FIRE FIGHTING AND DOMESTIC WATER STORAGE