Handbook Series on Fire Safety

Hazardous Buildings

A basic guide for Fire Prevention, Life Safety & Fire Protection requirements for the Hazardous Buildings

GUJARAT INSTITUTE OF DISASTER MANAGEMENT
BUILDING RESILIENCE

Directorate of State Fire Prevention Services,
Government of Gujarat

Handbook Series on Fire Safety

Hazardous Buildings

A basic guide for Fire Prevention, Life Safety & Fire Protection requirements for the Hazardous Buildings

GUJARAT INSTITUTE OF DISASTER MANAGEMENT
BUILDING RESILIENCE

सत्यमेव जयते
Directorate of State Fire Prevention Services, Government of Gujarat

GUJARAT INSTITUTE OF DISASTER MANAGEMENT
BUILDING RESILIENCE

Handbook Series on Fire Safety

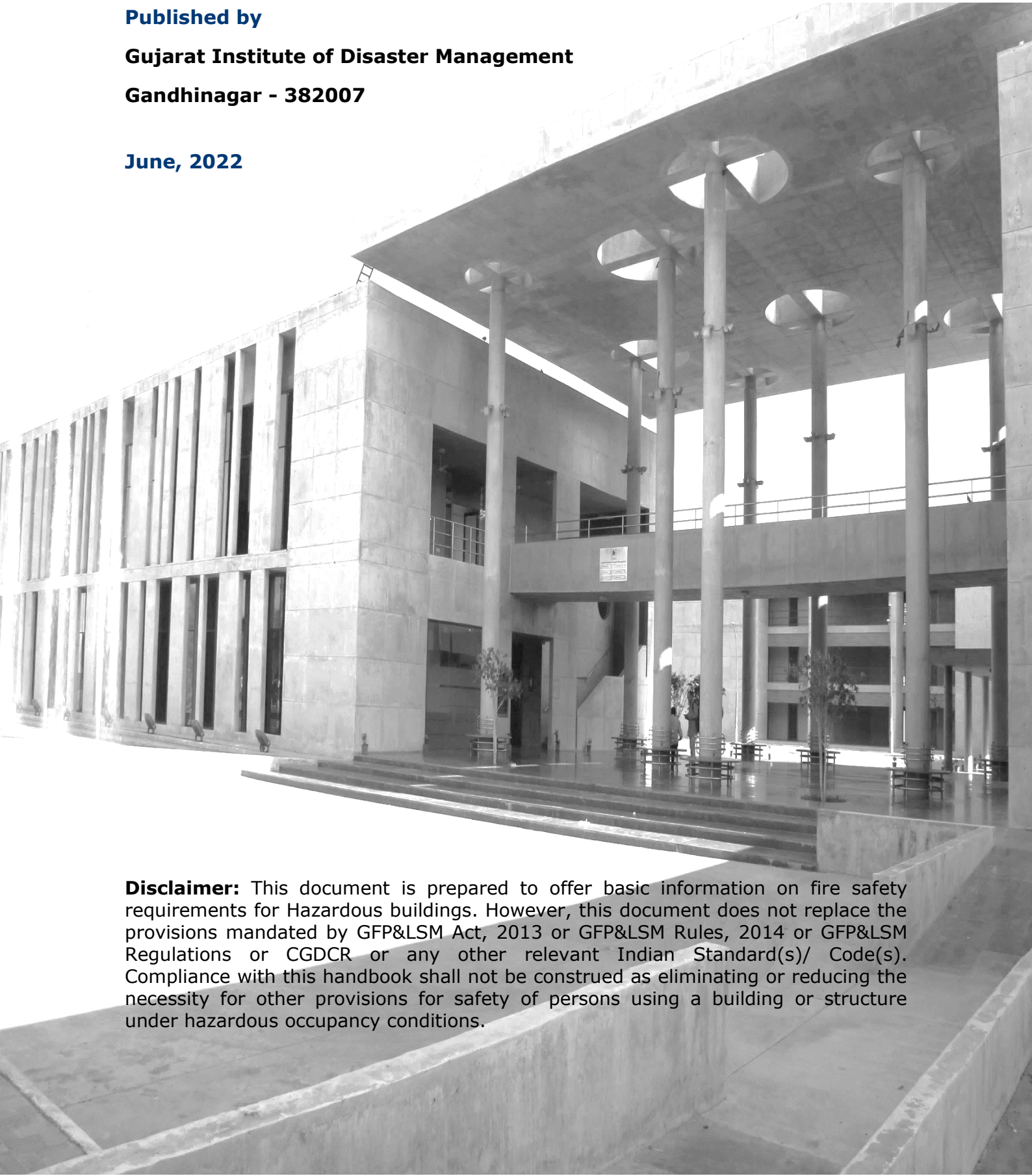
Hazardous Buildings: A basic guide for Fire Prevention, Life Safety & Fire Protection requirements for the Hazardous Buildings

Published by

Gujarat Institute of Disaster Management

Gandhinagar - 382007

June, 2022



Disclaimer: This document is prepared to offer basic information on fire safety requirements for Hazardous buildings. However, this document does not replace the provisions mandated by GFP&LSM Act, 2013 or GFP&LSM Rules, 2014 or GFP&LSM Regulations or CGDCR or any other relevant Indian Standard(s)/ Code(s). Compliance with this handbook shall not be construed as eliminating or reducing the necessity for other provisions for safety of persons using a building or structure under hazardous occupancy conditions.

Message

Fires in hazardous occupancies can be catastrophic in absence of suitable fire prevention, life safety and fire protections measures. The number and placement of life safety measures in hazardous buildings are based on the number of people that can be expected to reasonably occupy a building. The hazardous buildings contain flammable, combustible and explosive materials stored in huge quantities which make fire fighting a major challenge. Therefore, it is important to incorporate the fire prevention, life safety and fire protection measures in the building to minimise fire risk and build resilience.

The objective of preparing the document is to enhance the knowledge of all the stakeholders directly related to hazardous buildings and engineers / architects on the basic fire safety measures to be implemented in hazardous buildings/ premises. The document is divided in two parts i.e. Part A and Part B. Part A of the document focuses on basic understanding on fire safety concepts. Part B of the document consists of Fire Prevention, Life Safety and Fire Protection measures that engineers / architects need to consider in hazardous buildings/ premises.

I am happy to acknowledge the support and cooperation extended by Mr. Snehanshu Choudhari for his contribution in drafting and Mr Paresh Vyas, Fire Advisor, Government of Gujarat, Mr K K Bishnoi, Director, State Fire Prevention Services and Mr. Abhay Purandare, for patiently reading the various drafts, and offering constructive criticism, guidance and suggestions.

Finally, the efforts made by GIDM team especially, Mr. Nisarg Dave, Mr. Piyush Ramteke, Mr. Himalay Kotadiya and Ms. Shilpa Boricha for coming up with this handbook are highly appreciated. I hope this handbook will benefit the all stakeholders immensely. Further, I am sure concerted efforts in this direction would help in building and creating a culture of fire prevention, life safety and fire protection which in turn would lead to a resilient society and nation.

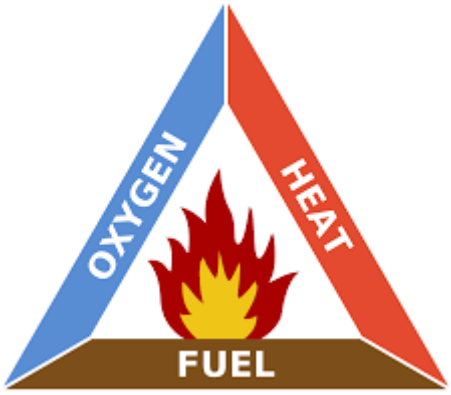
(P K Taneja)
Director General, GIDM

June, 2022
Gandhinagar

PART – A

How Fire Starts?

The three things, a fire needs to start are heat, fuel and oxygen. These three elements work together to start a fire. Fuel is the first element in the fire triangle. The fire will need a fuel source in order to continue to burn. The fuels readily available in hazardous building premises are flammable liquid chemicals and gases, combustible solids, electrical equipments etc. Heat is the second essential element that a fire needs. A fire can't even start or spread unless there's a significant amount of heat involved. That's why in majority of fires water is applied to cool the fire source. Commonly available heat sources in the hazardous building are welding, cutting, grinding activities, hot surfaces etc. Finally, the third thing that is needed is oxygen. Oxygen is in the air all around us. So all the three things when they come together they cause fire.



Fire Triangle

If we need all of these things for a fire to burn, how do you put a fire out? You only need to take away one of these three things, and the fire will go out.

What are the types of fire?

According to IS15683: 2018, there are five classes of fires, namely:

- **Class A fire**: Fires involving solid combustible materials of organic nature such as paper, plastics, rubber etc.
- **Class B fire:** Fires involving flammable liquids e.g. diesel, petrol, naphtha etc.

- **Class C fire:** Fires involving flammable gases under pressure including liquefied gases e.g. LPG, PNG[1] etc.
- **Class D fire:** Fires involving combustible metals, such as magnesium, aluminium, zinc, sodium, potassium, etc,
- **Class F fire:** Fires involving cooking oils and fats. The characteristic of these fires is that the boiling point of these liquids is quite high (> 200 C) and as the heated oil reaches these temperatures, water cannot be applied as it will convert to steam and cause the burning oil to splash out and increase the fire.

Different types of fire extinguishers are designed to fight above classes of fire. The four most common types of fire extinguishers are: dry chemical type, foam type, water type, CO_2 (carbon dioxide) type. The following figure provides information regarding the type of fire and which fire extinguisher to be used. Fire Extinguishers should be installed in line with IS 15683 requirements.

Type (Fire Type / Extinguisher Type)	Class A Organic Materials (e.g Paper & Coal)	Class B Flammable Liquids (e.g Petrol & Paint)	Class C Flammable Gases (e.g Butane & Methane)	Class D Combustible Metals (e.g Lithium & Magnesium)	Electrical Electrical Equipment (e.g Computers & Servers)	Class F Cooking Oils (e.g Olive Oil & Fat)
Water	✓	✗	✗	✗	✗	✗
Foam	✓	✓	✗	✗	✗	✗
Dry Powder	✓	✓	✓	✓	✓	✗
CO2	✗	✓	✗	✗	✓	✗
Wet Chemical	✓	✗	✗	✗	✗	✓

Types of Fire and Suitable Fire Extinguishers

[1] Piped Natural Gas – Used in kitchens as an alternative to LPG.

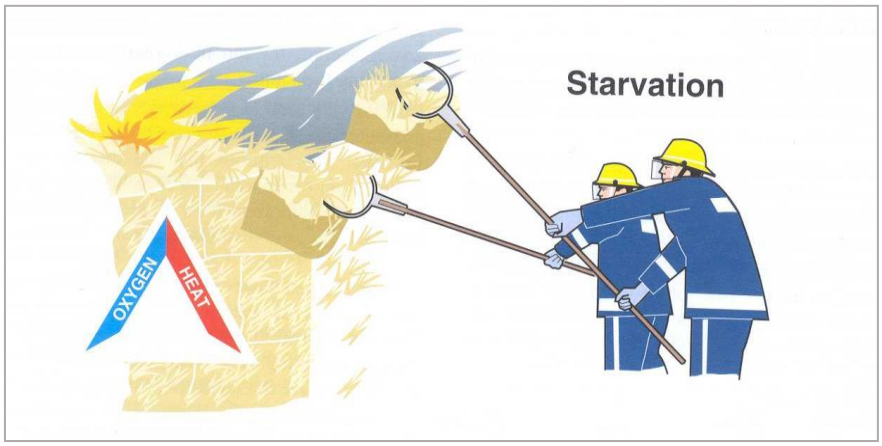
The principles of fire extinguishment consist of one of the following three elements:

1. Starvation: Starvation is achieved in three ways:

i. By removing potential fuel from neighbourhood of fire. e.g. Draining out fuel from burning tank, counter burning in forest fire, etc.

ii. By removing the fire from the mass of combustible material for instance, pulling apart burning haystack.

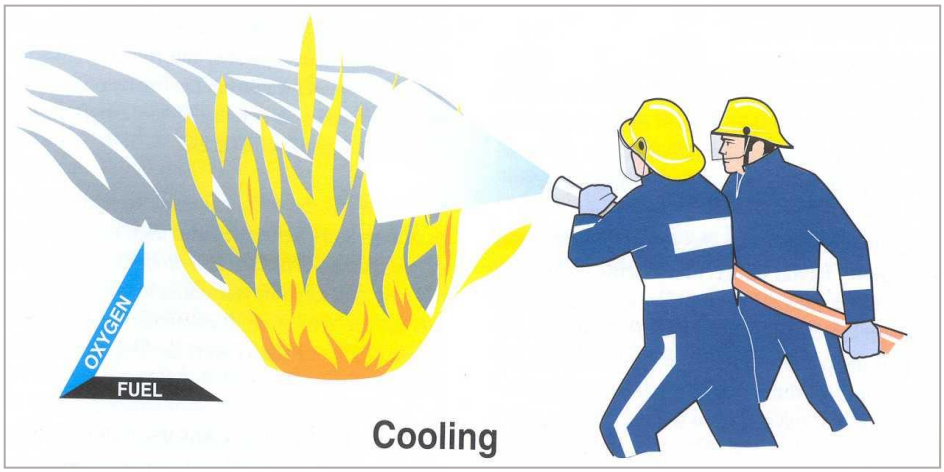
iii. By dividing burning material into smaller fires which may be left to burn out or which can be extinguished more easily.



2. Smothering: In this method, oxygen is excluded in the surrounding atmosphere, thereby leading to fire extinguishment. Smothering can be achieved by using sand, blanketing, or by the use of dry chemical extinguishers.

3. Cooling: The most commonly used firefighting medium is water. Water, cools the burning material thereby achieving fire extinguishment. When it is applied to a fire, the extinguishing medium, water itself undergoes changes as it absorbs heat from the fire: (i) Its temperature will rise, (ii) It may evaporate (boil)

Further, smothering effect of the steam produced during boiling process plays important part in fire extinguishment.



Where do Fires occur in Hazardous buildings?

Hazardous buildings have multiple fire and explosion hazards. The most common causes of fires are as under;

- The hazardous building have storage of flammable and combustible material like petrol, diesel, naphtha etc. which can easily catch fire. These materials are easily ignitable and burn rapidly.
- Numerous mechanical equipments like pumps, compressors, agitators etc. are used in hazardous use building. Failure of the parts of mechanical equipments lead to fire and explosion.
- Numerous maintenance and fabrication activities are undertaken in hazardous buildings like welding, cutting, grinding etc. When above activities are conducted without precautionary measures, then there are chances of fire and explosions.
- Faulty electrical wiring or frayed wires could cause electrical short circuits in hazardous use building. Typically, in modern constructions, these wires are concealed and many times it becomes difficult to track the right source of the fire.

How to safeguard Hazardous buildings from fires and human loss?

- Fire drills should be conducted periodically in hazardous building. Fire drills help the occupants to understand their roles and responsibilities during a fire scenario.
- Egress routes form a primary route of escape during a fire scenario. Fire exits should be inspected on regular basis. It should be ensured that stairways, doors, egress routes are unblocked and working properly.
- Regular training for building occupants should be conducted on fire drills. Occupants should be trained on how to respond to a fire alarm during a fire drill.
- The firefighting equipment should be readily available during a fire emergency. The location of the firefighting equipment should be identified and the building occupants should be aware of the location of the fire protection equipments, manual call points, smoke detectors.
- An assembly point should be designated outside the building. All the occupants in the building should be aware of the location of assembly point and the path to reach the assembly point.
- Firefighting system, fire alarm system are the means of extinguishing the fire and alerting the occupants. Same should be regularly inspected, maintained and tested.
- Cooking activity should be performed in kitchen only. No other place should be designated as cooking area.
- Combustible and flammable material of any kind should be stored in their designated places. If any temporary storage facility has been allocated, then it should be audited to meet the relevant code and standard requirements.
- Smoking should not be allowed inside hazardous building, the cigarette buds can easily ignite the combustible and flammable material inside the buildings.
- Electrical points and electrical equipments inside the building should be serviced

periodically. Un-serviced electrical points may lead to short circuit and fire.

- ELCB and MCB should be used for electrical wirings and electrical connections. ELCB and MCB trip in event of high load conditions, hence they prevent the overheating and fire in an electrical apparatus.
- Wherever sprinkler systems are provided in line with the requirements of codes and standards, same should be serviced periodically.
- Any work which is undertaken inside the building should be done with proper precaution and permission from the authorities. Work permit system should be implemented in the building premises.
- Hazardous buildings should always have a proper functioning fire alarm system. The fire alarm system should be designed in line with the requirements mentioned in the legislation / standards.
- In any room in which volatile flammable substances are used or stored, no device generating a spark, or glow flame capable of igniting flammable vapour shall be installed or permitted unless it is enclosed in a flameproof enclosure.
- The use, handling, storage and sale of gasoline, fuel oil and other flammable liquids should not be permitted in hazardous buildings unless such use, handling, storage and sale is in accordance with appropriate legislation in force.
- All personnel working in the building premises should have received adequate training before being assigned their duty.
- Regular third party audit should be conducted for the buildings. This helps to understand the areas of improvement in the current systems / practices adopted by other hazardous buildings.
- While designing the fire prevention, fire protection and life safety system it should be ensured that same meets the relevant legislative requirements.
- Ensure Fire Safety Certificate (FSC) is obtained for the building from the local fire authorities, if required.

What to do in case of fire in your premises?

- If you can extinguish the fire then extinguish it completely

- If you cannot extinguish the fire then run to a place of safety and alert the nearest fire station by dialling 101.

- If your clothes are on fire then,
  - Stop – Wherever you are.
  - Drop – Drop on the ground
  - Roll – Cover your face and roll over and over or back and forth till the flames are put off.

- Once the fire is out remember to cool the burned skin with water and get medical attention.

- While escaping from a fire scene in a building, close the doors behind you.

- If closed doors and handles are warm, don't open such doors. (Figure 8 Do not open doors which are warm to touch)

- Once you are outside go to a meeting place or assembly point.

PART – B

Background:

Part B of the document provides the basic information to the developer/ architects / engineers/ designers on what measures to be adopted during construction of the hazardous buildings. The hazardous buildings presents unique fire safety challenges especially as different chemicals are handled, man and woman are working in same premises, different age group people are working in premises, which needs to be focused at the very onset of construction / design of the hazardous buildings. This part is divided into three sub-parts i.e. Fire Prevention, Life Safety and Fire Protection measures which need to be taken/installed in the building premises. Further reading on requirements of NBC 2016, Gujarat Fire Prevention and Life Safety Measures Act, Rules & Regulations, General Development Control Regulations (GDCR) & different IS standards is necessary, since this handbook provides only an overview of the fire safety requirements.

Hazardous occupancy classification:

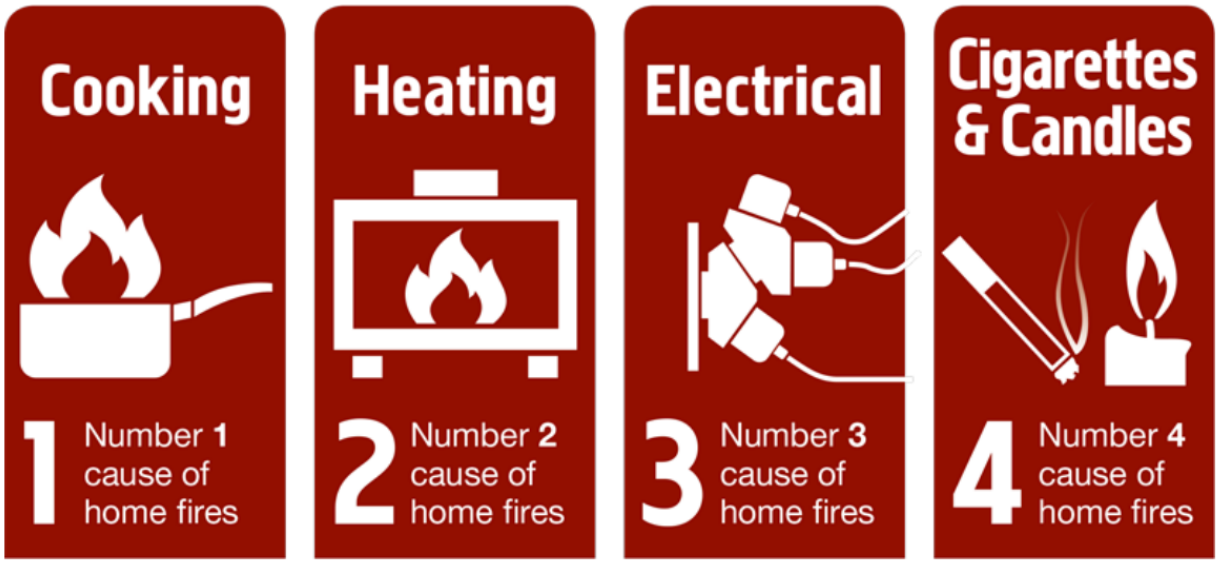
Hazardous occupancies are classified as Group J in National Building Code 2016. These shall include any building or part thereof which is used for the storage, handling, manufacture or processing of highly combustible or explosive materials or products which are liable to bum with extreme rapidity and/or which may produce poisonous fumes or explosions for storage, handling, manufacturing or processing which involve highly corrosive, toxic or noxious alkalis, acids or other liquids or chemicals producing flame, fumes and explosive, poisonous, irritant or corrosive gases; and for the storage, handling or processing of any material producing explosive mixtures of dust which result in the division of matter into fine particles subject to spontaneous ignition. Examples of buildings in this class are those buildings which are used for:

a) Storage, under pressure of more than 0.1 N/mm^2 and in quantities exceeding 70 m^3, of acetylene, hydrogen, illuminating and natural gases, ammonia, chlorine, phosgene, sulphur dioxide, carbon dioxide, methyloxide and all gases subject to explosion, fume or toxic hazard, cryogenic gases, etc;
b) Storage and handling of hazardous and highly flammable liquids, liquefiable gases like LPG, rocket propellants, etc;

c) Storage and handling of hazardous and highly flammable or explosive materials (other than liquids); and
d) Manufacture of artificial flowers, synthetic leather, ammunition, explosives and fire works.

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

In case of mixed occupancy[2], i.e. residential occupancy in an hazardous occupancy etc. fire protection of the entire occupancy / building should be governed by most restrictive provision of the entire code. The provision of the life safety should however apply to individual occupancy.



[2] Buildings having more than one type of occupancy like – Hazardous, residential etc.

Chapter 1: Fire Prevention Measures

The hazardous buildings should be designed and constructed in such a way that, in the event of fire, its stability, integrity and load bearing capacity will be maintained for a reasonable period. The design of the hazardous buildings and the types of material used in its construction are important factors in making the building resistant to a complete burn-out and in preventing the rapid spread of fire, smoke or fumes which may contribute to the loss of lives and property. For further details on fire prevention systems / measures section 3, section 6.9 & Annexure E of NBC 2016(Part IV) should be referred.

Non-combustible material should be used for construction of the hazardous building, and internal walls of staircase enclosure should be of brick work or reinforced concrete or any material having a fire resistant rating of 120 minute. Load bearing members and non-load bearing members must be constructed to a fire resistant rating as detailed in table 1 of NBC 2016(Part IV), Section 3 of NBC 2016(Part IV) and Gujarat Fire Prevention and Life Safety Measures Regulations.

Fire Resistant Walls and Floors:

The fire resistance of an element of construction (such as wall / floor etc.) is a measure of its ability to withstand the effects of fire in one or more ways i.e. its ability to resist collapse, resist penetration from fire / smoke, resist heat transfer during a fire. Fire resistance of a constructional element is defined in minutes or hours e.g. 120 minute or 1 hour. The fire resistance property of an element of construction influences the life safety and property protection requirements.

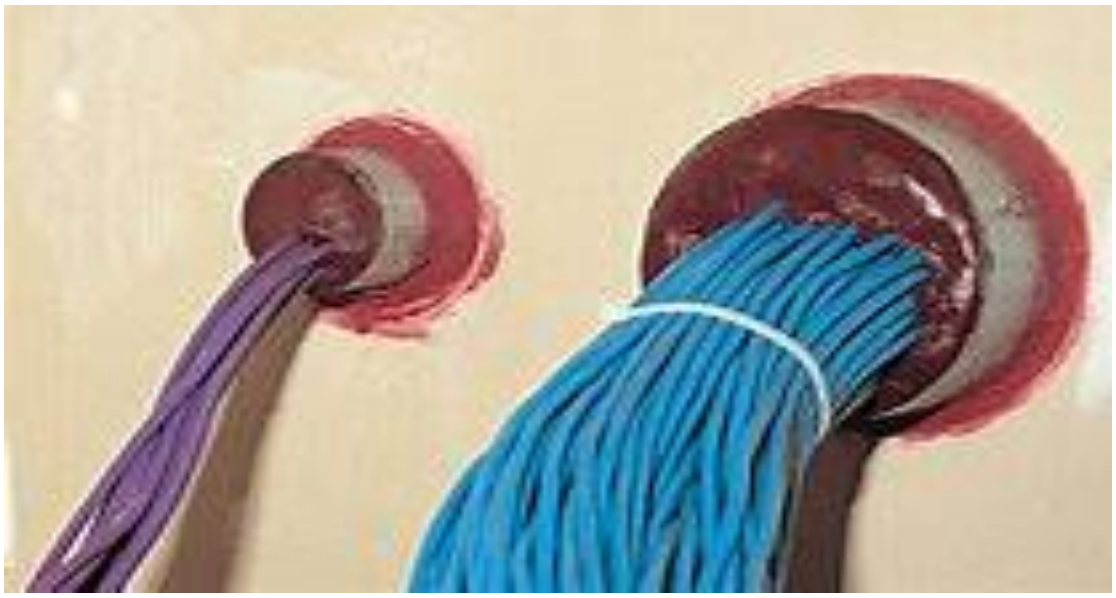
In hazardous buildings, the openings in the fire resistant walls and floors should be sealed to prevent spread of fire / smoke from one area to another. For Type 1[3] to 3 constructions, a doorway or opening in a fire resistant wall on any floor should be limited to 5.6 m^2 in area with a maximum height/width of 2.75 meter. Every wall opening should be protected with fire-resisting doors, having the fire rating of not less than 120 minute. The openings in the floors must be protected by vertical enclosures extending above and below such openings, such enclosures having a fire resistance of not less than 120 minute and all openings therein being protected with a fire-resisting assembly.

[3] For type of construction of the building, refer Table 1 in NBC 2016 (Part IV)

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

In hazardous buildings, openings in walls or floors which are provided for passage of cables, electrical wirings etc. must be protected by enclosure in the form of ducts / shafts with fire resistance rating of 120 minute. Each boiler room or room containing a heating plant shall be separated from the rest of the building by a separating wall.

The space between the electrical cables / conduits and walls / slabs must be filled with a fire stop material with fire resistant rating of 120 minute.



Fire stop material

All vertical openings in the hazardous buildings should be suitably enclosed / protected. This should be required to prevent spread of smoke from floor to floor to allow the occupants to evacuate safely.

All openings in exterior walls except wall vents should be protected by a fire stop assembly and they shall be fixed, automatic or self-closing. Wall vents having an area of not less than 100 cm^2 each should be placed in the exterior walls near the floor line, not more than 1800 millimeter apart horizontally. Each building should be provided with a power driven fan exhaust system of ventilation which should be arranged and operated so as to produce a complete change of air in each room every 3 minute.

Electrical Installation:

The electrical cables forming circuits should be with flame retardant property. The damage to electrical cable should be limited by the use of sufficiently robust cables, careful selection of cable routes and/or by the provision of physical protection in areas where cables may be susceptible to damage. Methods of cable support should generally be non-combustible and such that circuit integrity will not be reduced below that afforded by the cable.

Electrical cables / wiring should be laid in separate shaft. Electrical cables must not run in shafts containing water mains, gas pipes, telephone lines, intercom lines or similar building service. The shaft should be sealed on every floor with fire stop material with same fire resistant rating as that of a floor.

Medium and low voltage wiring running in shafts, and within false ceiling must run in metal conduit. Any 230 V wiring for lighting or other services, above false ceiling, should have 660 V grade insulation.

Electric meters should not be located below the staircase or along the exit route. Electric meters room should be adequately ventilated & easily accessible.

The electrical installation provided in the hazardous buildings should be compliant to the Regulation No. 5A and 30 of the Central Electricity Authority (Measures relating to Safety and Electric Supply) Amendment Regulations, 2015.

Emergency power (i.e. power supply when main electrical power is not working) should be provided to the following equipment / systems:

- Fire water pumps.
- Pressurization and smoke venting; including its ancillary systems such as dampers and actuators.
- Fireman's lifts.
- Exit signage lighting.
- Emergency lighting.
- Fire alarm system.
- Public address (PA) system (relating to emergency voice evacuation and annunciation).
- Magnetic door hold open devices.
- Lighting in fire command centre and security room

Power supply to the above systems must be through the normal power and emergency power with changeover facility. The power supply to the panel / distribution board of the above systems must be through fire proof enclosures or circuit integrity cables or through alternate route in the adjoining fire compartment to ensure supply of power is reliable to the above systems and equipment's.

Substation in buildings should not be used for storage of material or material for other utility purposes other than those required for the functioning of the substation. Adequate ventilation must be ensured in substation. Independent AC / ventilation must be provided for MV(Medium voltage) panel room located on the ground level or first basement. The MV panel room must be provided with fire resistance of not less than 120 minute.

In hazardous buildings, the substation / switch station with oil filled equipment should be located at least 7 meter away from the adjoining buildings. All oil filled transformers exceeding 10 MVA capacity must be protected with high velocity water spray system or nitrogen injection system. Transformer located inside the buildings should be of dry type.

Diesel generator (DG) set must not be installed on ground floor / first basement of the hazardous building. The DG set if installed indoor, proper ventilation and exhaust should be planned. The DG set rooms should have 120 minute fire resistance rating. For detailed information regarding fire safety requirements for hazardous petroleum products, reference may be made to The Petroleum Act, 1934 and the Rules framed there under.

Lightning protection of the hazardous building should be ensured by routing of down conductors (insulated or uninsulated) through electrical shafts. For further details, see Part 8 "Building Services, Section 2 Electrical and Allied Installation" of the NBC 2016 and Central Electricity Authority (Measures relating to Safety and Electric Supply) Amendment Regulations, 2015.

Escape Lighting and Exit Signage:

In the hazardous buildings, exit access, exits and exit discharge should be properly identified and continuously illuminated. Emergency lighting should be provided from an independent source i.e. from different source supplying normal

lighting. The horizontal luminance at the floor level on the escape route must be not less than 10 lumens / m^2. Required illumination should be arranged such that failure of any single luminary will not leave any area in darkness. The emergency lighting should be provided to be put on within 5 second of the failure of the normal lighting supply. Also, emergency lighting should be able to maintain the required illumination level for a period of not less than 90 minutes in the event of failure of the normal lighting even for smaller premises. The emergency lighting system should be well maintained and periodically inspected and tested to ensure perfect serviceability.

In hazardous buildings, exit access corridors / paths must be provided with exit signage. The exit signs should be located such that no point in exit access is more than 30 meter of viewing distance. The exit sign indicating the direction should be installed in all changes of direction. Exit signs should be illuminated and wired to an independent electrical circuit on an alternative source of supply. All exit way marking signs should be so installed that no mechanical damage should occur to them due to moving of furniture or other heavy equipment. Further, all landings of floor should have floor indicating boards prominently indicating the number of the floor. The sizes and colours of the exit signs should be in accordance with IS 9457, IS 12349, IS 12407. The colour of the exit signs should be green.

Exit signage

Air Conditioning, Ventilation and Smoke Control:

In hazardous buildings, where mechanical ventilation is provided it should be ensured that, the system of mechanical ventilation should be designed to ensure that, in a fire, the ductwork does not assist in transferring fire, smoke and fumes through the building and put at risk the protected means of escape. Any exhaust points should be sited so as not to further jeopardize the building, i.e., away from exits, combustible building material or roofing materials and openings into the building.

In hazardous buildings, where Air handling unit (AHU) is provided it should be ensured that separate Air handling unit (AHU) should be provided for each floor so as to avoid the hazards arising from spread of fire and smoke through the air conditioning ducts. The air ducts should be separate from each AHU to its floor and in no way should interconnect with the duct of any other floor. Equipment or machinery which generates or emits combustible or explosive dust or fibres shall be provided with an adequate dust collecting and exhaust system.

In hazardous buildings, shafts or ducts, if penetrating multiple floors, must be of masonry construction with fire damper in connecting ductwork or should have fire rated ductwork with fire dampers at floor crossing. Alternatively, the duct and equipment may be installed in room having walls, doors and fire damper in duct exiting/entering the room of 120 minute fire resistance rating. The air filters of the air handling units should be made of non-combustible materials.

In hazardous buildings, air ducts serving main floor areas, corridors, etc, should not pass through the exits/exit passageway/ exit enclosure. Wherever the ducts pass through fire walls or floors, the opening around the ducts should be sealed with material having the fire resistant rating of the compartment. The materials used for insulating the duct system (inside or outside) should be of non-combustible type. Any such insulating material should not be combustible in nature.

Fire or Fire/smoke dampers[4] should be provided in supply air ducts, fresh air and return air ducts/ passages. The damper should be so installed to provide complete integrity of the compartment with all passive fire protection sealing.

4 A device installed in ducts and air transfer openings of an air distribution or smoke control system designed to close automatically upon detection of heat / smoke.

Damper should be accessible to maintain, test and also replace, if so required. There should also be provision for manual operation of the dampers.

The dampers should be located in supply air ducts, fresh air and return air duct / passages at the following points:

1. At the fire separation wall[5]
2. Where ducts / passages enter the vertical shaft.
3. Where the ducts pass through floors and
4. At the inlet of the supply air duct and the return air duct of each compartment on every floor.

Glazing:

Nowadays, glass façade is used in many buildings for aesthetic purpose and sleek look features. In addition to the aesthetic purposes, the glass façade in the building also provides unique fire safety challenges like breaking of the glass during fire, falling of the broken glass on fire fighters etc. Certain fire safety features should be followed while installing glass façade in the buildings.

The distance between building structure and glass facade must not be more than 300 millimeter. To restrict spread of fire, there must be an automatic water curtain system on each floor. The glass façade must not have any coating of combustible materials like plastic, and must be designed to resist fire for atleast 120 minutes. The glazing used for the facade should be of toughened (tempered) safety glass as per IS 2553. No glass façade should be permitted at the external face of the staircase. Every floor must have a two-way opening measuring 1.5meter ×1.5meter in the wall, as access points for rescue workers. They must properly labelled as "Emergency Exit".

Surface Interior Finish:

Interior finishes in the hazardous buildings have been a leading factor in flame spread. Interior finishes are considered to consist of those materials or

[5] A fire resistant rated wall having fire protected openings, which restrict the spread of fire and extends continuously from the foundation to the roof (and through the roof at least 1 meter above the roof in case of combustible roof), with sufficient structural stability under fire conditions to allow collapse of construction on one side or either side without collapse of the wall

combination of materials that form the exposed interior surfaces of walls and ceilings in a building.

In buildings the use of combustible surface finishes on walls, ceilings and curtains used inside rooms, affects the safety of the occupants. Such finishes tend to spread the fire and add intensity to the fire. It also produces toxic fumes and leads to property damage. It is essential that the finishing material used in the building should be such as to limit the spread of fire and should not generate toxic fumes / smokes.

Fire Command Centre (FCC):

In hazardous buildings, the fire command centre should be located on the entrance floor, having direct access. The fire command centre should have main fire alarm panel with communication system (and public address system).

The fire command centre should be constructed of 120 minute fire resistant rated walls and with fire doors and should be provided with emergency lighting. Interior finish used in fire command centre should not be combustible. Details of floor plans along with the details of fire fighting equipment and installations should be maintained in fire command centre.

We should not tolerate losing life of innocent people that could have been prevented by taking simple measures at the time of building construction.

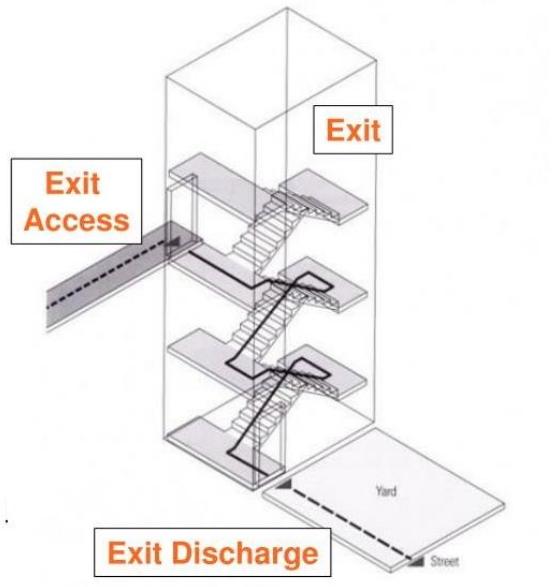
Chapter 2: Life Safety Measures

Life safety measures are made up of elements that are designed to protect occupants and visitors in the building during a fire situation. There are many components that make up life safety systems in a building. Having an integrated and fully functioning life safety system can improve the safety in the hazardous building. Life safety can be termed as strategies / methods to protect occupants in buildings based on building construction, protection, and occupancy features that minimize the effects of fire and related hazards.

The life safety measures in an hazardous building mainly consist of means of egress requirements, compartmentation, smoke control systems, Gas supply systems, fire detection and alarm system, Fire drills, fire orders, lifts. For further details on life safety systems it is advised to read section 4 & 6.9.1, Annexure E in NBC 2016 (Part IV), Gujarat Fire Prevention and Life Safety Measures Regulations.

Means of Egress Requirements:

In a hazardous building the means of egress comprises of exit access, exits and exit discharge. These components play a major role for a safe evacuation of the occupants and visitors in the building premises. All three components i.e. exit access, exit and exit discharge must be maintained obstruction free and in working condition. Now let us look into the details of the egress components and important features highlighted in NBC 2016(Part IV).

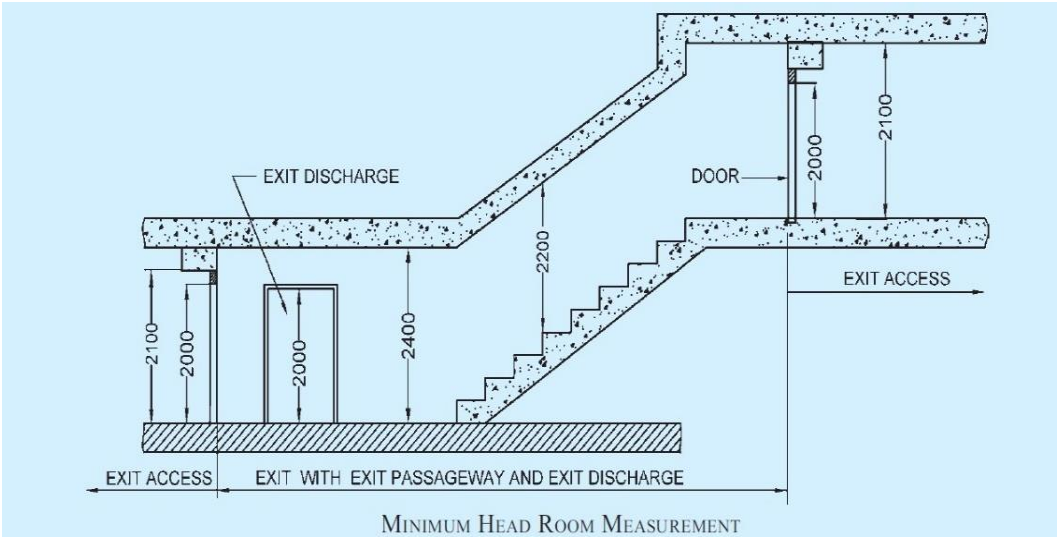


Means of Egress, Exit, Exit Discharge

Exit access is defined as the portion of the means of egress that leads from an occupied portion to an exit. Exits are components like doorways, staircases etc. which is between the exit access and exit discharge or public way. Exits are separated by fire resistant rated construction and opening protectives to provide a protected path of egress travel. Exit components include exterior exit doorways, exit passageways, exterior exit stairways, exterior exit ramps etc. Exit discharge is defined as component of a means of egress between the termination of exit and public way.

In hazardous buildings, from every point in every floor area, there should be at least two exits accessible in different directions; where floor areas are divided into rooms, there should be at least two ways of escape from every room, however small rooms, except toilet rooms, so located that the points of access there to are out of or suitably shielded from areas of high hazard.

Every exit, exit passageway and exit discharge must be maintained obstruction free, to aid free movement of the occupants and visitors during an emergency.

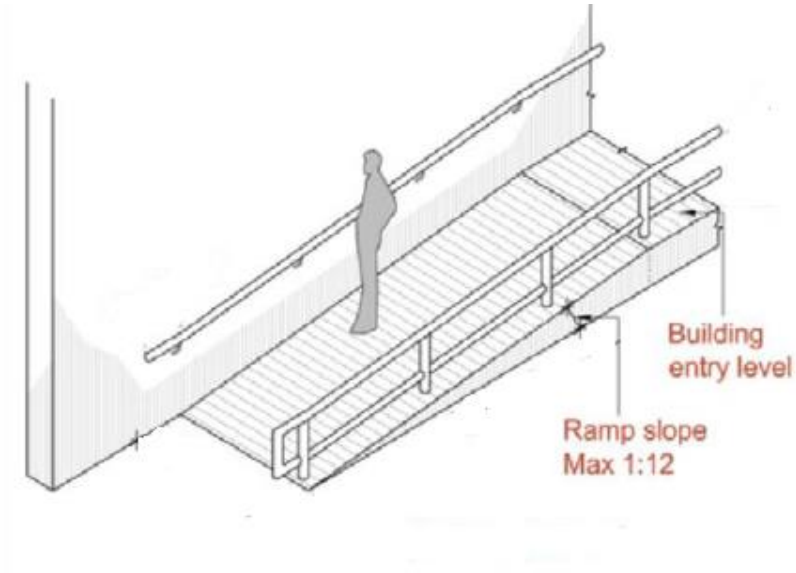


Exit Height

All the exit and exit passageways to exit discharge must have a clear ceiling height of at least 2.4 meter. However, the height of exit door should be at least 2.0 meter.

In buildings, the capacity of the means of egress need not be reduced along the path of egress travel until arrival to the exit discharge.

Wherever changes in elevation are envisaged for more than 300 millimeter, ramps with handrails must be provided. Floor finish of ramps should contrast the adjacent finish material. Penetrations such as fire protection piping, ducts for pressurization and for life safety systems should only be allowed in exits, with adequate passive fire protection.



Ramp Slope

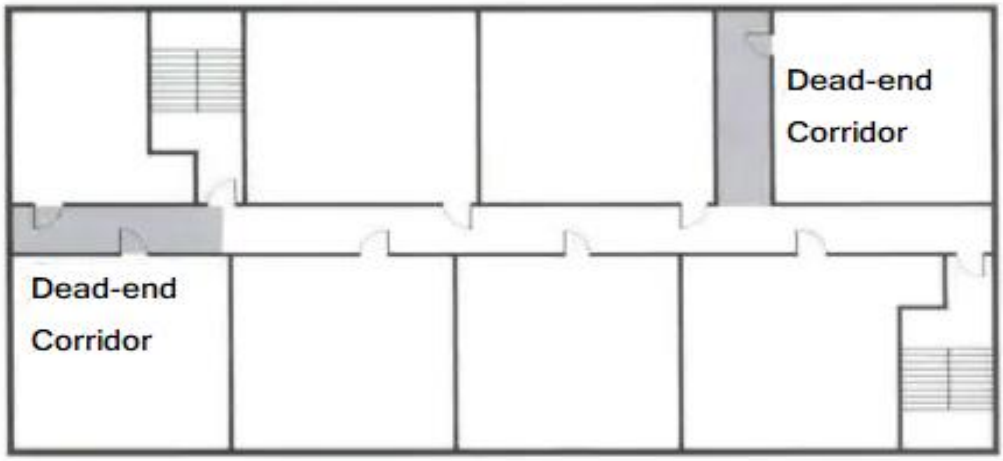
Walking surface along the exit access must meet the following requirements:

1. Levelled and slip resistant surface.
2. Slope should not exceed 1 in 20, unless ramp is provided.
3. Slope perpendicular to the direction of travel should not exceed 1 in 48.

In hazardous buildings, the number of escape routes and exits to be provided will depend on the occupant load[6](i.e. number of people) in the room or storey and the limits on travel distance to the nearest exit as mentioned in NBC 2016(Part IV).

For hazardous building, requiring more than one staircase, it must be ensured that, every part of each storey will have access to more than one staircase. This does not prevent areas from having a dead end condition provided that the alternative stair is accessible in case the first one is not usable. Though dead end corridors are not desirable, however maximum distance to a dead end should not exceed 15 meter.

[6]The total number of people that might occupy a building or space at any point of time.



Dead End

Travel distance to the nearest exit should be limited to the NBC 2016 (Part IV) requirements. There are benefits to limit the travel distance like -

- Limited travel time; safety may be reached without serious exposure to smoke;
- Limited size and complexity of enclosure;
- Provision of sufficient alternative escape capacity within a reasonable distance. Increased likelihood that an exit is visible, and remains so during a fire;
- Reduced likelihood that a fire can occur unseen, or grow large before detection/alarm; and
- Reduced likelihood of a fire between occupant and exit.

The maximum travel distance from any point within the building to a final exit should not exceed the limits mentioned in NBC 2016 (Part IV). If the travel distance limits are exceeded, then one more exit provision should be made.

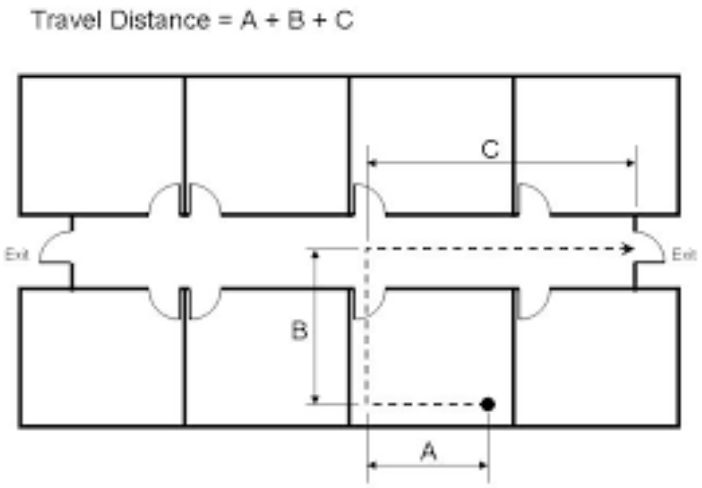
	Maximum Travel Distance (meter)	
	Type 1 / Type 2	Type 3 / Type 4
Hazardous building	22.5	This construction type is not permitted

The occupant load factor mentioned in NBC 2016 (Part IV) should be used as the basis for arriving at the occupant load of a floor / room in the hazardous building. When the number of occupants likely to use a room or storey is not

known, the capacity should be calculated on the basis of the appropriate floor area & occupant load factors as per NBC 2016.

Note:

- *For sprinklered building, the travel distance may be increased by 50 percent of the value specified.*
- *Ramps should not be counted as an exit in case of basement below the first basement in car parking.*



Travel Distance

The number of occupants (occupant load) arrived from table 3 of NBC 2016 (Part IV) is the number of persons during the normal level of occupancy in a room or storey. If the number of occupants are anticipated to exceed, then the exit design should consider the increased occupant load.The width of escape routes and exits depends on the number of persons needing to use them. The aggregate width of all the escape routes should be not less than that required to accommodate the maximum numbers of people likely to use them. Where the maximum number of people likely to use the escape route and exit is not known, the appropriate capacity should be calculated on the basis of the occupant load factor mentioned in NBC 2016 (Part IV).

Example:

The width of the escape route should be calculated based on the capacity factors for stairways i.e. 18 millimeter / person and for level components / ramps i.e. 10 millimeter / person.

Example an exit doorway with 1000 millimeter clear width will have an exit capacity for 1000 / 10 occupants that is 100 persons.

Example:

As per NBC 2016 (Part IV), the occupant load factor for a room in hazardous building is 10m^2/person. Assume the area of the room is 180 m^2.

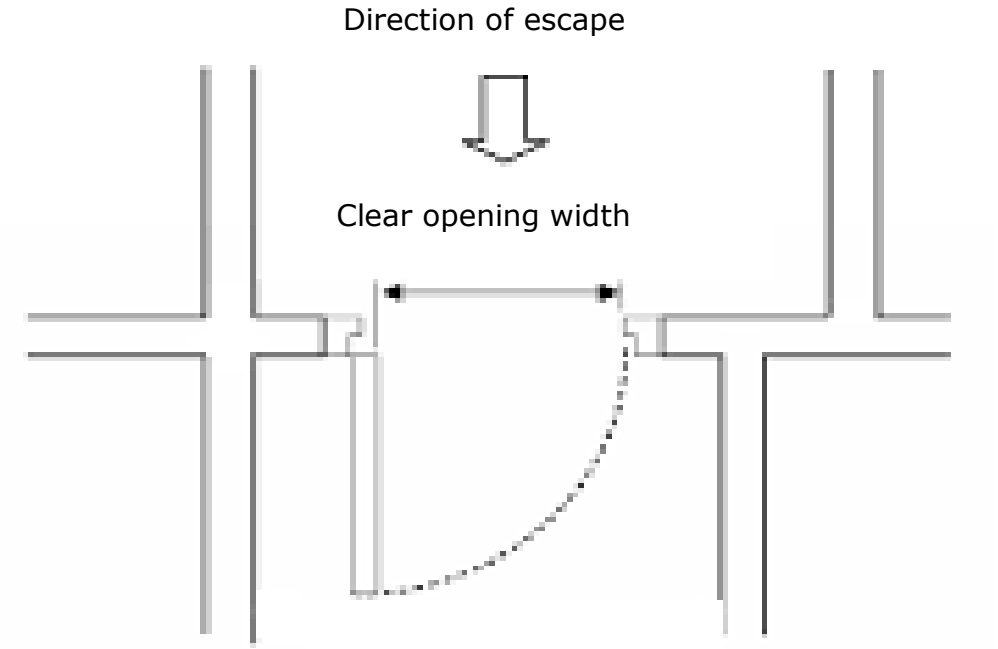
The occupant load for the room will be 180 / 10 = 18 persons. Hence the exit requirements will be based on 18 persons, subject to minimum requirement stated.

If it is anticipated that the number of occupants in the room is 25 instead of 18, then the exit requirements will be based on 25 persons.

Exit components:

Doorways

Exit doorways in hazardous building must open into an enclosed stairway or horizontal exit of a corridor or passageway, and should always be operable from direction of egress.



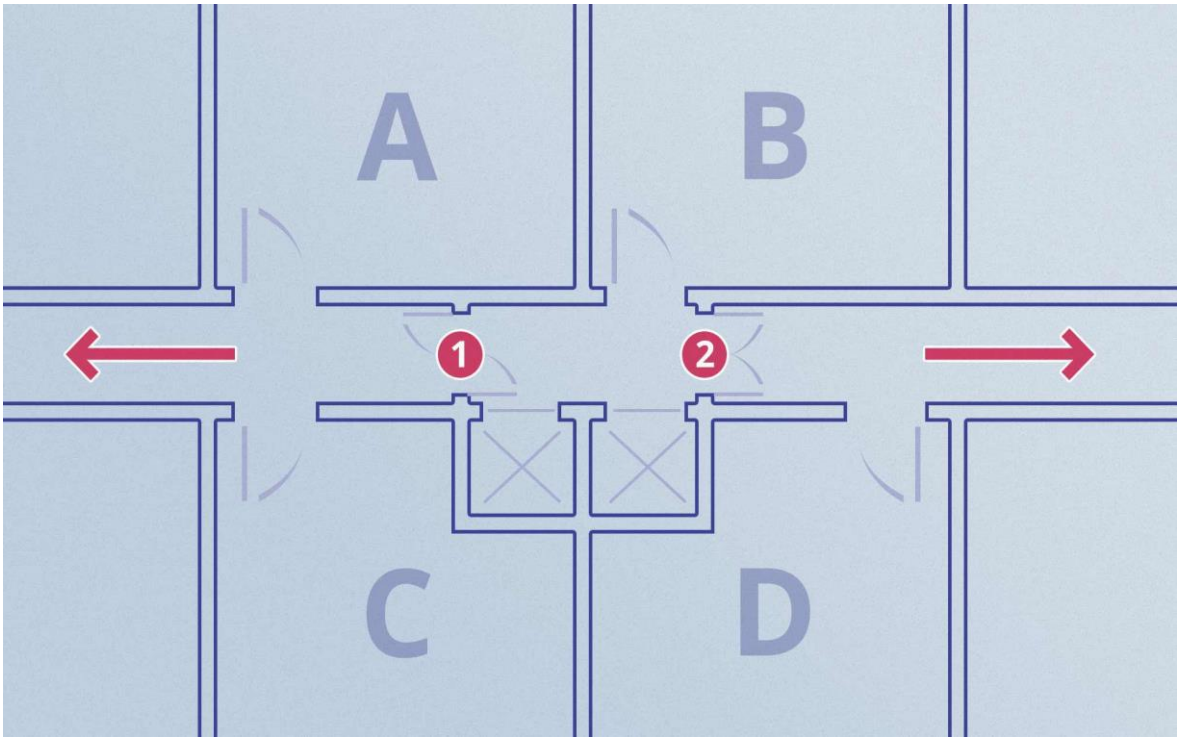
Doorway Opening

In hazardous buildings, minimum height and width of exit doorway should be 2 meter and 1 meter.

In hazardous building, the activation of the building automatic sprinkler system or fire detection system should automatically unlock the access control system. Any loss of power must unlock the access control system. A manual release device must be provided near the access control doorways with signage "Push to Exit".

Corridor and Passageways of Means of Egress:

For hazardous building, width of the corridor must be not less than the aggregate width of exit doorway leading from them. Wherever there is central corridor, which is part of exit access, the doors of rooms must open inwards.

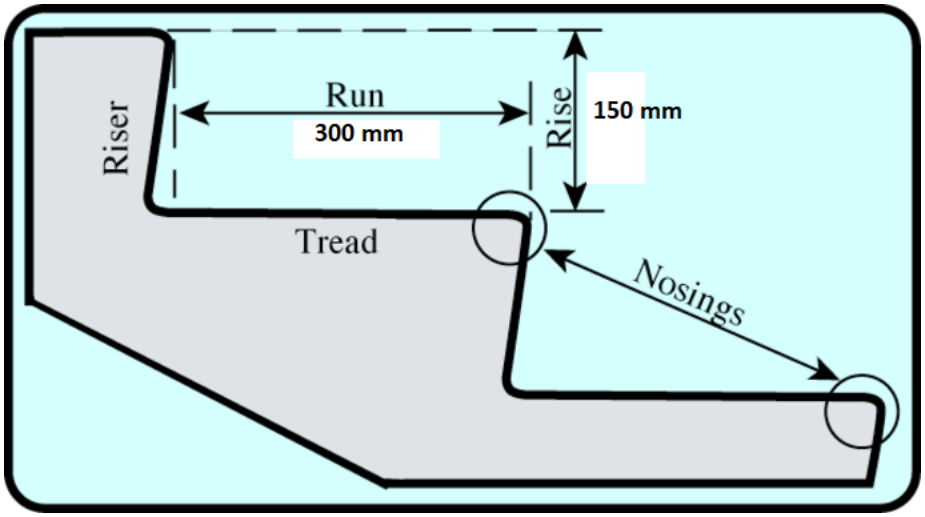


Doorway Opening in Corridor

Staircase:

In hazardous buildings, the flights and landings of every escape stair should be constructed of non-combustible material.

Dimensional constraints on the design of stairs are kept, to meet requirements for safety while using staircase. The preferred rise for each step should be not more than 150 millimeter, and the tread 300 millimeter and there should be between maximum 12 riser per flight.



Riser and Tread of Staircase

Internal staircase[7] inside the hazardous building must be constructed of fire resistant material with minimum 120 minute fire resistant rating.

Internal staircase should not be arranged around a lift. Lift must not open inside a staircase. No electrical shaft / AC ducts / gas pipelines should pass through the staircase.

For internal staircase, handrail must not project more than 90 millimeter. The Floor indication board should be pasted inside the internal staircase, with a minimum size of 300 millimeter X 200 millimeter.

Staircase Indication Board

All external staircase[8] must be connected to the ground. External staircases must be constructed of non-combustible material and staircase must be kept in usable conditions. The external staircase must not be blocked / obstructed under any condition.

External staircase must have a flight of not less than 1500 millimeter wide.

[7] It is a staircase which is inside the premises of the building, and leads to inside of the building.
[8] It is a staircase which is open to outdoor and leads directly to the exterior of the building.

External Staircase

Ramps:

Ramps are sloped surfaces inside / outside of the hazardous building to aid access to vertical levels. These are specifically made for physically challenged people with mobility issues and for wheelchair movement.

In hazardous buildings, ramp width should not decrease along the direction of travel and slope should not exceed 1 in 12 inch. The ramp surface should be slip resistant and water accumulation should be minimised. The ramps must have

landing located at the top and bottom and at the doors opening onto the ramp. The ramps should be provided with handrails on both sides. For further guidance on ramps refer Part 3 "Development Control Rules and General Building Requirements" of NBC 2016.

Smoke Control Systems:

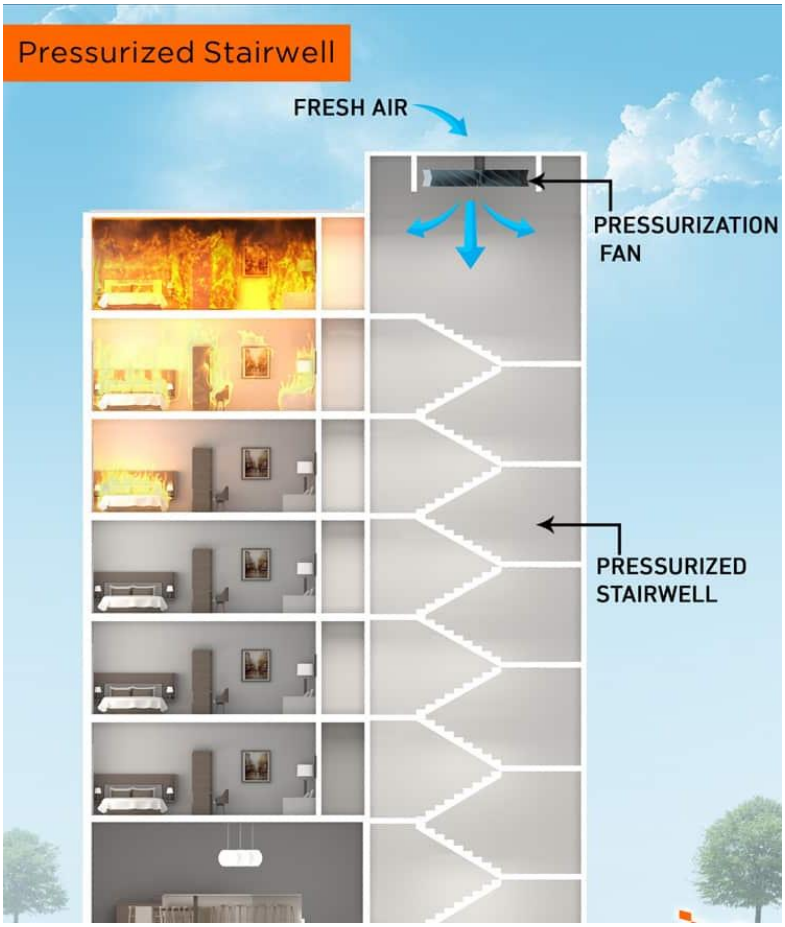
Smoke control in hazardous building play a very vital role in ensuring the life safety of the occupants in air tight buildings. The purpose of smoke control is to reduce the build-up of smoke within an enclosed space in order to provide the occupants of building sufficient time to escape to a safer area in the building or outside the building. Smoke control systems are also designed to reduce the rate of growth of the smoke in a fire affected zone such that height of smoke layer does not impair the movement of occupants from hazardous area.

In hazardous building, one of the means to achieve smoke control is through pressurization. Pressurization is adopted by protecting the exits from ingress of smoke, especially in high rise building. In pressurization air is injected into the staircase, lobbies etc, to raise the pressure slightly above the pressure in adjacent parts of the building.

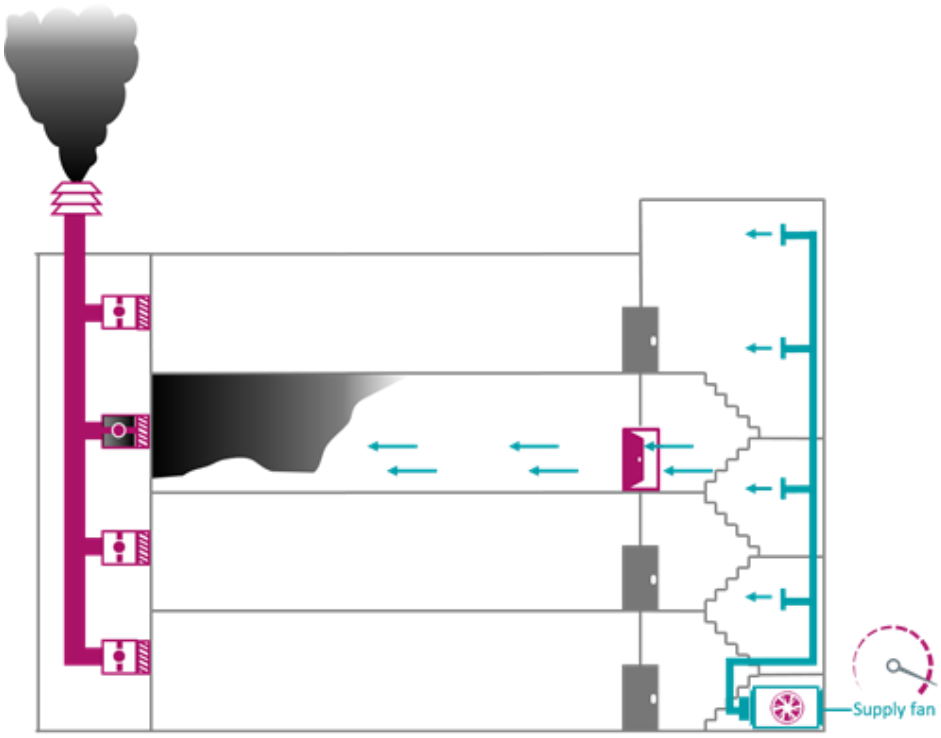
The pressurization system is initiated by the fire alarm panel. Once a fire alarm panel receives a signal from detection system or manual signal regarding a fire in any premises, the pressurization system is actuated to ensure escape of the occupants. Pressurization system is not required for a naturally ventilated corridor with openable windows.

In hazardous buildings, the other method for smoke control is the exhausting of the smoke as it gets accumulated in a layer in the exit pathway, atria etc. In this method of smoke control, the design for rate of smoke extraction must be equal to the rate of smoke generation. The air intake ducts should be located 5 meter away from the smoke exhaust ducts. Smoke exhaust system must ensure atleast 12 air changes per hour in the area affected by fire / smoke.

For further guidance on smoke control systems refer Part 8 "Building Services, Air Conditioning, Heating and Mechanical Ventilation" of NBC 2016.



Staircase Pressurization System

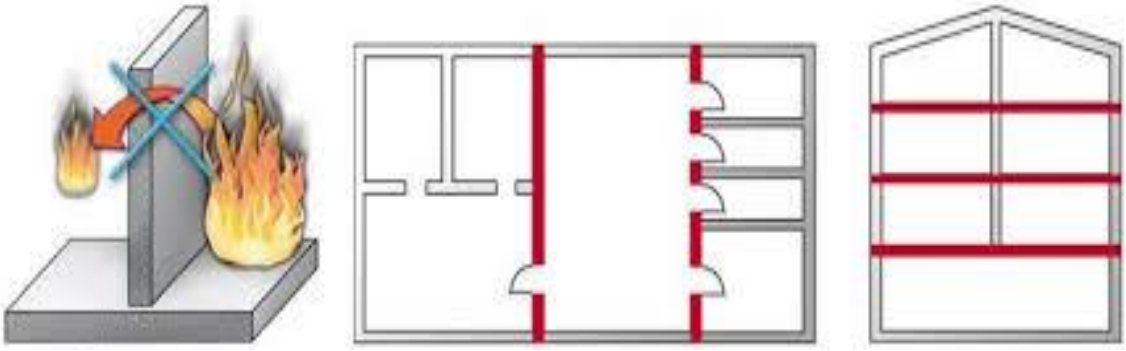


Smoke Exhaust System

Compartmentation:

In hazardous buildings, compartmentation is an important component of the fire safety design as it aims to divide large spaces into smaller and manageable fire compartments. Fire compartmentation is used to create a safe, protected means of escape for the building occupants in the event of a fire. Generally, these fire compartments are separated from each other by compartment walls and compartment floors made of a fire-resisting construction which acts as a barrier to the spread of fire and smoke for a specific period of time.

All floors should be compartmented with area of each compartment equal to 750 m^2. The compartmentation should be achieved by a fire barrier wall of 120 minute fire rating.



Fire Compartment in Building

Gas Supply:

In hazardous buildings, gas pipelines are installed to supply natural gas to the kitchens and process usages. The gas pipelines should always run in separate shafts in the building premises. The gas pipeline shafts should run on external walls and away from staircases. The pipeline length should be as short as possible.

Each building where gas is employed for any purpose shall be provided with an approved outside gas shut-off valve conspicuously marked.

Gas lines should not be installed through any electrical shaft, escape route, refuge area / refuge floor. Gas meters should be housed in a suitably constructed metal cupboard located in a well ventilated space.

For further guidance on gas pipeline installation refer Part 9 "Plumbing services, section 4 gas supply" of NBC 2016.

Fire Detection and Alarm System:

The purpose of fire detection and alarm system in building is to provide early warning and intimation regarding fire situation to the occupants of the building. The fire detection and alarm system consist of smoke detectors, heat detectors, manual alarm call points, visual and audible warning system, fire alarm panels etc.

Hazardous buildings should have vapour / flame / ember / spark detectors and explosion suppression systems depending on the type of fire hazard involved.

The fire detection and alarm system in building should be programmed with fire alarm panel to operate smoke control systems, hold up of the fire doors, visual and audible warning systems etc. All components of the fire alarm and detection system must be maintained and ensured in healthy working condition.

In buildings provided with automatic fire alarm system, following must be monitored:

- Water level in tanks
- Hydrant and sprinkler pressures of respective zones as provided
- Pump "ON/OFF" status
- All isolation valves, wherever provided with supervisory switch

For further guidance on smoke control systems refer Part 12 "Asset and Facility Management" of NBC 2016 & IS 2189.

Smoke detector

Manual Call Point

Fire Safety Executive, Fire Drills and Fire Orders:

In hazardous buildings, a fire safety executive with experience not less than 3 years, may be appointed. The fire safety executive should be responsible for following:

- Maintain the fire fighting equipment in building in good working condition.
- Prepare fire orders and fire operational plans and promulgated.
- Impart training to the occupants for use of fire fighting equipment and keep them informed about fire emergency evacuation plan.
- Keep liaison with the fire brigade.
- Ensure that all fire precautionary measures are observed at all times.

Fire orders / fire notices should be prepared to fulfil the requirements of fire fighting and evacuation from the building in event of fire and other emergency. The occupants should be made thoroughly conversant with their action in the event of emergency by displaying fire notices at the vantage points and also through regular training. For guidelines for fire drills and evacuation procedures for hazardous buildings qualifying as high rise buildings refer annexure D of NBC 2016 (Part IV).

The rates of death and disability caused by fire hazard are alarming. Let's unite and pledge to follow Fire Safety Standards and show our society that we care.

Chapter 3: Fire Protection Measures

Hazardous buildings must have proper fire protection system[9] in place for occupants of the building to be protected in event of fire emergency. Depending on the height and number of occupants, NBC 2016 (Part IV) details the necessary fire protection measures required for hazardous buildings. For further details on fire protection systems, it is advised to read section 5, section 6.9.2, in NBC 2016 (Part IV), Annexure E in NBC 2016 (Part IV), IS 15325, IS 15105, IS 13039, Gujarat Fire Prevention and Life Safety Measures Regulations.

The fire protection measures to be considered for the hazardous buildings may include the following:

Fire Extinguishers:

Fire extinguishers are the first line of defence against a fire. Fire extinguishers should be installed throughout the building premises. Fire extinguishers should be mounted at a convenient height. The fire extinguishers should be suitable to the fire hazard anticipated in the area, e.g. near an electrical apparatus CO_2 type fire extinguisher should be installed, in DCP type fire extinguisher should be installed in buildings. Further details on selection, installation and maintenance of fire extinguisher IS 2190 should be referred.

Fire Extinguishers

[9] A system of fire protection which comes into action once there is a fire. This system consists of actions to control the effects of fire.

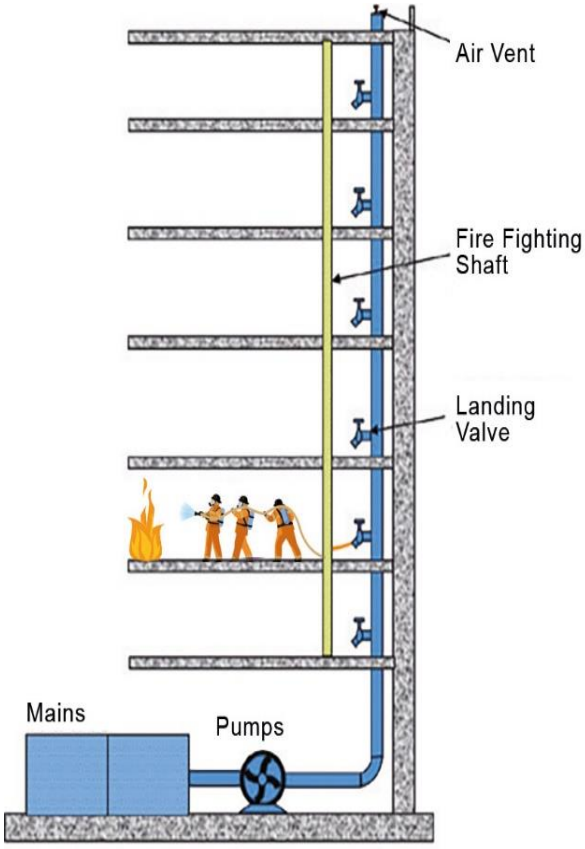
First Aid Hose Reel:

The first aid hose reel should be installed on the downcomers / wet risers installed in the hazardous building. The first aid hose reels are the first line of defence for incipient stage fires. Minimum diameter of the hose reel should not be less than 19 mm.

Fire Aid Hose Reel

Wet Risers:

An arrangement of fire fighting in the hazardous building by means of vertical fire water line with diameter not less than 100 millimeter and fire hydrant valves on each floor / landing. Wet risers are permanently charged with water. The wet risers are fed with fire water pumps. The pressure available at the hydrant points should be between 3.5 to 7 bar. Fire hose should be connected to the hydrant landing valves to supply water at the site of fire. Trained personnel should handle the fire hose connected to the wet risers.



Wet Riser

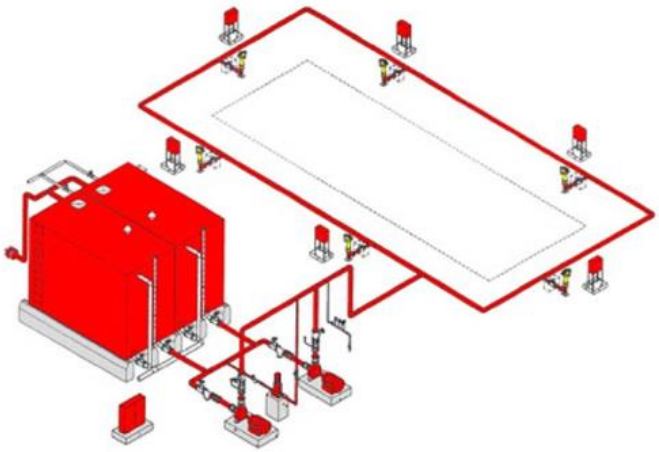
Downcomer:

An arrangement of firefighting within the hazardous building by means of down-comer pipe connected to terrace tank through terrace pump, gate valve and non-return valve and having mains not less than 100 millimeter 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. The pressure available at the hydrant points should be between 3.5 to 7 bar. Trained personnel should handle the fire hose connected to the wet risers.

Downcomer

Yard Hydrant:

Yard hydrant is a network of fire hydrant installed in the premises outside the hazardous building. The yard hydrant network is fed through fire water pumps. The pressure in the yard hydrants should not exceed 7 bar. Fire hose should be connected to the yard hydrants to supply fire water to the fire area. Trained personnel should handle the fire hose connected to the yard hydrants.



Yard hydrant picture

Automatic Sprinkler System:

One of the most important part of fire protection is a fire sprinkler system. A properly designed and functional fire sprinkler system can prevent fire from spreading to different parts of building, help in ensuring life safety and reduce property damage. Automatic sprinklers should be installed in all areas except in substation and DG set area. Pressure in sprinkler system should not exceed 12

bar. The Sprinkler system flow switches must be monitored from fire alarm panel. Provision should be made to ensure water from sprinkler do not enter the lift and electrical rooms. Sprinkler system control valve must be installed in fire pump room.

Automatic Sprinkler System

Manual Operated Electronic Fire Alarm Systemphoto (MOEFA):

MOEFA systems include the manual call points, talk back system and public address systems installed in the hazardous buildings. The purpose of the MOEFA systems is to provide early warning to the occupants.

Automatic Detection and Alarm System:

This system comprises of components to automatically detect fire, heat, smoke in the hazardous building. The automatic detection and alarm system should be kept operational 24 X 7. It is essential that fire detection and warning systems are properly designed, installed and maintained. Alarm systems should be standardised across a building.

Underground Static Fire Water Storage Tank:

Water for fire fighting purpose should be stored in the fire water storage tanks. The fire water tanks should be filled to the complete capacity and maintained on 24 x 7 basis. Water should be stored in two or more interconnected compartments of equal size to facilitate cleaning and maintenance. The static

water storage must be easily accessible to the fire engines. The underground fire water storage tank must not be more than 7 meter deep from the level of fire draw of connection. The covering slab of the storage tank should be able to withstand 45 ton (or as applicable) vehicular load. The static water storage should be provided with fire brigade collecting head and a fire brigade tank filling connection.

Terrace Tank over respective towers:

Water for fire fighting may be stored in overhead terrace tanks located on hazardous buildings. The fire water tanks should be filled to the complete capacity and maintained on 24 x 7 basis. Water should be stored in two or more interconnected compartments of equal size to facilitate cleaning and maintenance.

Fire Water Pumps:

It is preferable to install the fire water pumps at ground level. The fire water pump house should be accessible from ground level. The fire water pumps should not be installed in second basement. The fire water pumps should be kept operational at all times. The fire water pump house should be separated by fire wall all around and doors should be protected by fire doors (120 minute) rating. The pump house should be well ventilated and care should be taken to prevent water stagnation. The fire water pump house should not have negative suction arrangement and submersible pumps should not be used. Fire water pump house should be sufficiently large to accommodate all pumps and supporting accessories. Exhaust of the diesel engine should be insulated and routed to a safe location at ground level.

High Velocity Water Spray System:

Automatic high velocity water spray system should be installed on transformers in line with requirements of IS 15325.

Following requirements relating to the fire protection features should be considered for Hazardous Building, based on NBC 2016 (Part IV) Table 7:

Sr. No.	Hazardous Building (Note 4)	Type of Installation								Water Supply (Litre)		Pump Capacity (litre/ minute)	
		Fire Extingui-Sher	First Aid Hose Reel	Wet Riser	Down Comer	Yard Hydrant	Automatic Sprinkler System	Manually Operated Electronic Fire Alarm System (Note 1)	Automatic Detection System (Note 2)	Under-ground storage tank per set of pumps	Terrace tank over respective tower	Pump near underground storage tank (minimum 3.5 bar pressure at remotest point)	Pump at terrace tank with minimum pressure of 3.5 bar
a)	Up to 15 meter in height												
	i. Single Storey building	R	R	R	NR	R	R	R	R	Minimum 240 minute of fire fighting requirement	NR	(Note 3)	NR
	ii. More than one floor Building but not exceeding 15m	R	R	R	R	R	R	R	R	Minimum 240 minute of fire fighting requirement	50000	(Note 3)	900

R = Required
NR = Not Required

Notes:

1. MOEFA must also include talk back system and public address system for hazardous buildings in all buildings above 15 meter height. Also same to be installed in car parking area greater than 300 m^2 and multi-level car parking area.
2. Automatic detection and alarm system is not required to be provided in car parking area. Such detection system should however be required in other areas of car parking such as electrical rooms, cabins and other areas.
3. Pump capacity to be based on covered area of the building.
4. Maximum height of the hazardous building must be in accordance with Gujarat Fire Prevention and Life Safety Measures Regulations.

Fire Safety Inspection Checklist for Hazardous Buildings:

Sr. No.	Item	Yes	No	NA	Remarks
Exits					
1	Are all exits free from obstructions or impediments?				
2	Are all exits unlocked and can be readily open in direction of travel?				
3	Can all egress doors open fully?				
4	Are exits signs in place, visible and illuminated?				
5	Are the shafts and electrical cable openings in the floors / walls sealed with fire stop material?				
6	Is there any combustible material storage in exit, exit corridors and in areas other than designated storage rooms?				
Electrical Safety					
7	Is the electrical cable and wiring having a fire retardant property?				
8	Are all electrical system maintained and there are no loose or open wirings?				
9	Are ELCB / RCCB / GFCI / MCB / electrical points present in the electrical system maintained and tested?				
10	Is the installed electrical load in the building as per the sanctioned load?				
11	Are air conditioner and ventilators present in the building maintained?				
Fire Fighting Systems					
12	Are all emergency lights in auto starting mode.				
13	Are all emergency power systems tested and inspected on regular basis?				
14	Are the fire extinguishers installed as				

Sr. No.	Item	Yes	No	NA	Remarks
	per the anticipated fire hazard?				
15	Are the fire extinguishers tested on periodic basis?				
16	Is the fixed fire protection system (Fire pumps, down comers, wet risers, hydrant valves, first aid hose reels, automatic sprinkler systems, spray systems, clean agent systems) maintained and in working condition?				
17	Is the fire water storage tank cleaned on periodic basis?				
Fire Detection and Alarm System					
18	Is the fire detection system installed in building and in working condition?				
19	Is the fire detection system installed in building tested and inspected on periodic basis?				
20	Is the fire alarm system in working condition?				
21	Is the fire alarm system inspected and tested on periodic basis?				
Emergency Preparedness					
22	Are regular mock drills conducted in building?				
23	Is there a documented emergency management plan?				
24	Are all building occupants / staff trained in usage of fire extinguishers / fixed fire protection systems?				
25	Are all building occupants / staff provided training on emergency preparedness?				
26	Are all building occupants / staff aware of the roles and responsibilities during emergency, and whether same has been documented?				
27	Are emergency evacuation plans pasted in building?				

Sr. No.	Item	Yes	No	NA	Remarks
29	Is there a public address system installed in building and is it working?				
General Points					
30	Are all curtains, ceiling and wall claddings made of fire retardant materials?				
31	Is fire safety executive appointed in building?				
32	Are periodic fire safety audits undertaken for the building?				
33	Is there enough space around building for firefighting vehicle movement?				
34	Are all equipments(like pumps, compressors etc.) used in the building undergoing periodic maintenance?				
35	Is the building maintained free from dust and rubbish?				
36	Are all areas in the building regularly monitored for any anticipated fire hazards during day to day activities?				
37	Is there a work permit system in place in the building premises to control and monitor the different work activities in the buildings?				
38	Are all combustible and flammable material stored in its designated places?				
39	Is FSC (Fire Safety Certificate) obtained for building?				

Do's and Don'ts during Fire Emergency

Do's

- Don't panic and stay calm.
- Raise alarm and alert everyone in the premises
- Escape first and then call for help.
- Use nearest available exit route.
- While leaving the premises, close all doors and windows behind you if possible but must ensure that nobody is left behind and you are safe.
- Know the location of the gas connection shut off valves, located in the building premises.
- Use only escape route as they are built for the egress purpose
- Use staircase, "Don't use lifts".
- If you are trapped in room, close the door and block the gaps which might let smoke and fumes come inside.
- Shout from window to attract the attention of the rescue team as well as others.
- Always crawl low under the smoke and try to keep your mouth covered.

Don'ts

- Never stand up in fire always crawl low under the smoke and try to keep your mouth covered.
- Never go back into burning building for any reason.
- Do not stop to collect your belongings.
- Don't secure open fire and smoke check doors as they limit the spread of fire and smoke when they are in closed position.
- Don't be tempted to clutter the stairs, corridors and lobbies as they are your escape routes.
- Never use lift in case of fire, always use staircase.
- Don't shout or run. This tends to cause panic to others.

Link to Important Documents

Sr. No.	Description	Link
1	National Building Code – 2016	https://gidm.gujarat.gov.in/codes-and-standards-related-fire-safety
2	IS 15683:Portable fire extinguishers – Performance and construction	
3	IS 2190: Selection, installation and maintenance of First aid fire extinguishers.	
4	IS 15105: Design and Installation of fixed automatic sprinkler fire extinguishing systems—code of practice	
5	IS 9457: Safety colours and safety signs - Code of Practice	
6	IS 12349: Fire protection-safety signs	
7	IS 12407: Graphic symbols for fire protection plans	
8	IS15325: Design and installation of fixed automatic high and medium velocity water spray system - code of practice	
9	IS 2553: Safety Glass – General purpose	
10	IS 13039: External Hydrant Systems--Provision and Maintenance	
11	Fire drill and inspection guide	USER MANUAL AND GUIDES | GujFireSafetyCoP

Save yourself, save others

Be prepared and stay alert!

GUJARAT INSTITUTE OF DISASTER MANAGEMENT

BUILDING RESILIENCE

Gujarat Institute of Disaster Management

Koba-Gandhinagar Road, B/h Pandit Deendayal Energy University,
Village – Raisan. Gandhinagar—382007. Gujarat, India.
Ph. (079) 23275804 to 25 | Fax: (079) 23275814
Email: info-gidm@gujarat.gov.in | Website: www.gidm.gujarat.gov.in