# CENTRAL POLYTECHNIC COLLEGE

**THARAMANI, CHENNAI**

**Regulation 2023**

## 1122 Diploma in Fire Technology and Safety

| | | | | | |
|---|---|---|---|---|---|
| 1122233110 | Fire Engineering | L | T | P | C |
| Theory | | 3 | 0 | 0 | 3 |

**Prepared by**
**Mr P.M.Subramanian, Guest Lecturer, FTS Department**

### UNIT 3 FIRE PREVENTION AND PROTECTION

Fire Source : Sources of ignition – fire triangle – principles of fire extinguishing – active and passive fire protection systems – various classes of fires – A, B, C, D, E.Protection : Types of fire extinguishers – fire stoppers – hydrant pipes – hoses –monitors – fire watchers – layout of stand pipes – fire station- fire alarms and sirens – maintenance of fire trucks – foam generators – Escape from fire rescue operations –fire drills – notice-first aid for burns.

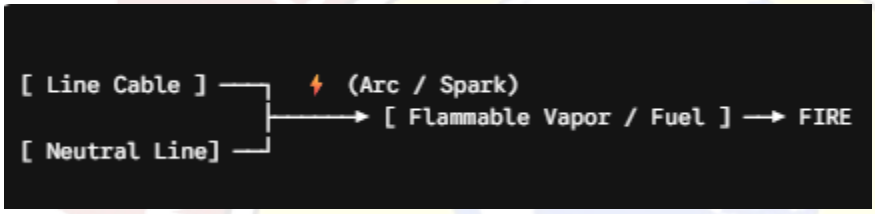
**Fire Source** :

Sources of ignition

In Fire Engineering, a **source of ignition** provides the minimum thermal energy required to raise the temperature of a combustible fuel-air mixture to its ignition point, initiating self-sustaining combustion.

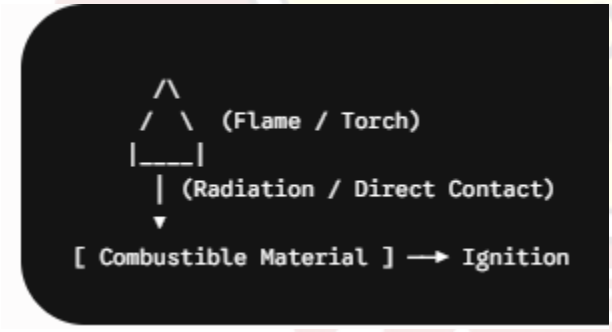
**1. Electrical Ignition Sources** Occurs when electrical energy converts into thermal energy through faults or improper insulation.

- **Causes:** Arcing, short circuits, overloading, loose connections, and static electricity discharge.




**2. Thermal / Open Flame Sources** Direct exposure to high-temperature objects or bare flames transferring heat via conduction, convection, or radiation.

- **Causes:** Naked flames (matches, gas burners), hot work (welding/cutting torches), and hot surfaces (exhaust pipes, boiler walls).

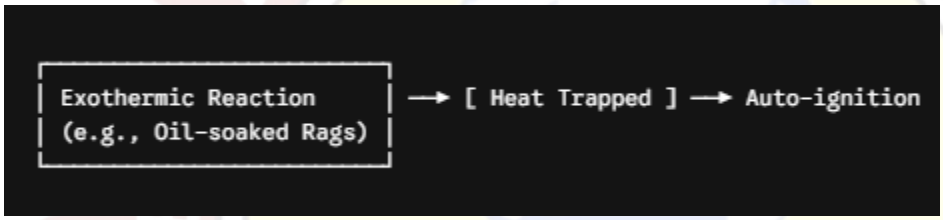



**3. Mechanical Ignition Sources** Generated by physical work converted into heat energy.

- **Causes:** Friction (unlubricated bearings, slipping V-belts) and impact sparks (metal tool striking concrete or steel).


**4. Chemical Ignition Sources** Heat generated internally through exothermic chemical reactions without an external heat application.

- **Causes:** Spontaneous combustion (linseed-oil-soaked rags, coal heaps), reaction of acids with organic matter, and oxidation heat buildup.




**Key Control Measures for Diploma Exams**

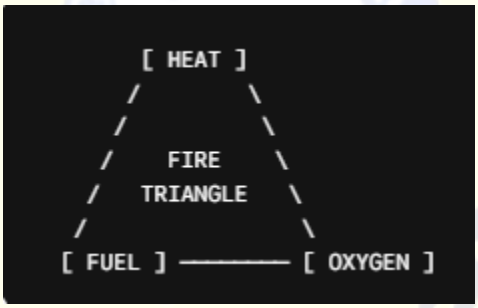
- **Electrical:** Use Flameproof / Intrinsically Safe (Ex) equipment in hazardous zones and maintain proper earthing.
- **Mechanical:** Implement routine lubrication schedules and use non-sparking beryllium-copper tools.
- **Thermal:** Enforce a strict **Hot Work Permit** system and insulate high-temperature steam pipes.

**Fire Triangle:**

The fire triangle is a fundamental concept in fire engineering illustrating the three essential elements required to initiate and sustain combustion. If any one of these components is missing or removed, a fire cannot start or will be extinguished.

**The Three Elements of a Fire Triangle**

- **Fuel:** Any combustible material in solid, liquid, or gas form (e.g., wood, paper, petrol, LPG).
- **Oxygen:** The oxidizing agent that supports combustion (normally derived from ambient air, which contains about 21% oxygen; a minimum of 16% is typically required to sustain flaming combustion).
- **Heat:** The source of thermal energy that raises the fuel to its ignition temperature (e.g., a spark, open flame, or friction).




**Significance in Fire Extinction**

Fire suppression and extinguishment methods are directly based on breaking the fire triangle by removing at least one element:

- **Starvation (Removing Fuel):** Shutting off a gas supply valve or clearing dry brush from a wildfire path.
- **Smothering (Removing Oxygen):** Covering a fire with a fire blanket, foam, or carbon dioxide ($CO_2$) extinguisher to isolate the fuel from ambient air.
- **Cooling (Removing Heat):** Applying water to absorb thermal energy and lower the fuel temperature below its ignition point.

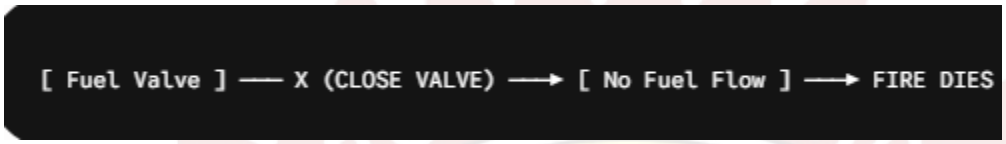
**Principles of Fire Extinguishing:**

In Fire Engineering, the **principles of fire extinguishing** are based on removing or disrupting one or more components of the **Fire Tetrahedron** (Fuel, Heat, Oxygen, and the Uninhibited Chemical Chain Reaction).

### 1. Starvation (Removal of Fuel)

Starvation is the process of depriving the fire of combustible material.

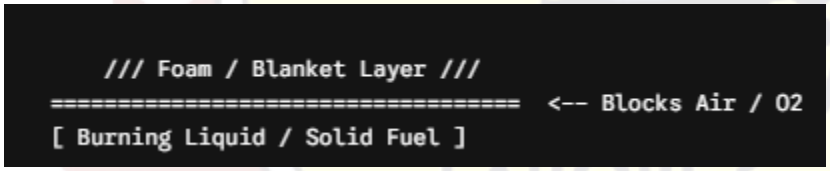
- **Mechanism:** Removing unburned fuel from the vicinity of the fire, cutting off the fuel supply, or dividing the fuel into smaller, isolated sections.
- **Examples:** Closing a gas pipeline valve, removing nearby wooden furniture, or creating firebreaks in forest fires.




### 2. Smothering (Removal of Oxygen)

Smothering involves isolating the fire from the surrounding air to reduce the oxygen concentration below the level required to sustain combustion (typically below 16%).

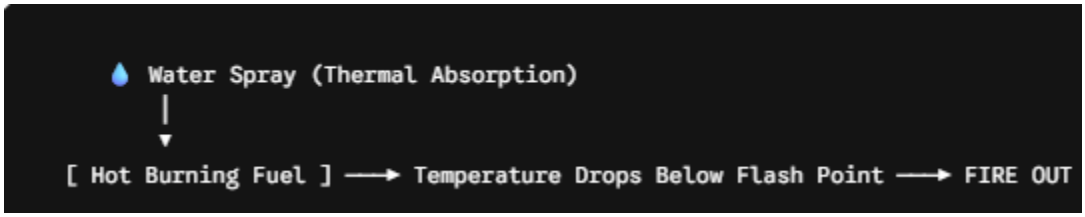
- **Mechanism:** Creating a barrier over the burning material or displacing air using an inert gas.
- **Examples:** Blanketing a liquid fire with foam, discharging a $CO_2$ extinguisher, or throwing a fire blanket over a pan fire.




### 3. Cooling (Removal of Heat)

Cooling involves absorbing thermal energy from the fire to drop the fuel's temperature below its flash point or ignition point.

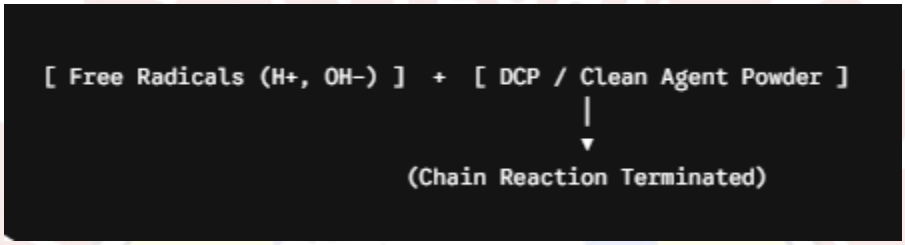
- **Mechanism:** Applying an extinguishing agent with high latent heat of vaporization to absorb heat.
- **Examples:** Applying water jets or water fog to Class A fires (wood, paper, textiles)



### 4. Flame Inhibition (Interruption of Chemical Reaction)

Inhibition involves stopping the rapid oxidation chain reaction occurring within the flame zone using chemical agents.

- **Mechanism:** Reactive free radicals (H and OH) maintaining the combustion process are neutralized by active chemical radicals released by the extinguishing agent.
- **Examples:** Applying Dry Chemical Powder (DCP) like Monoammonium Phosphate or Halon/Clean Agents.




### Summary

| Method | Removed Component | Key Extinguishing Agents | Primary Fire Classes |
|---|---|---|---|
| **Cooling** | Heat | Water, Water Mist | Class A (Solids) |
| **Smothering** | Oxygen | Foam, $CO_2$, Fire Blanket | Class B (Liquids), Class C (Gases) |
| **Starvation** | Fuel | Manual Isolation / Valve Cutoff | All Classes (Process / Pipeline Fires) |

| | | | |
|---|---|---|---|
| **Inhibition** | Chemical Chain Reaction | Dry Chemical Powder (DCP), Halon substitutes | Class B, Class C, Electrical Equipment |

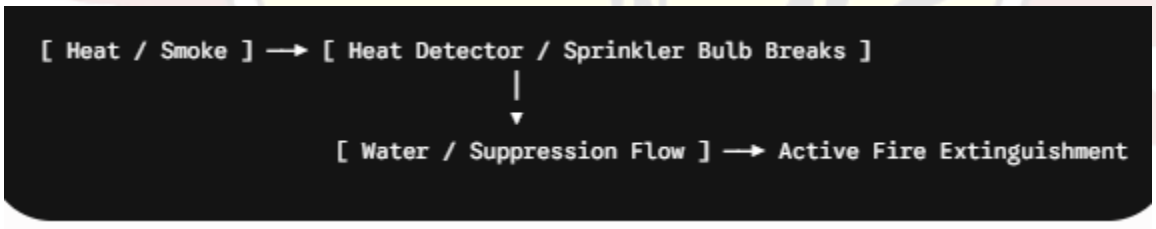
**Active and Passive Fire Protection Systems:**

Active and passive fire protection systems form the dual-defense approach in fire engineering, where active systems take dynamic action to detect or extinguish fires and passive systems rely on structural containment to slow the spread of fire and smoke.

**Active Fire Protection Systems (AFP)**

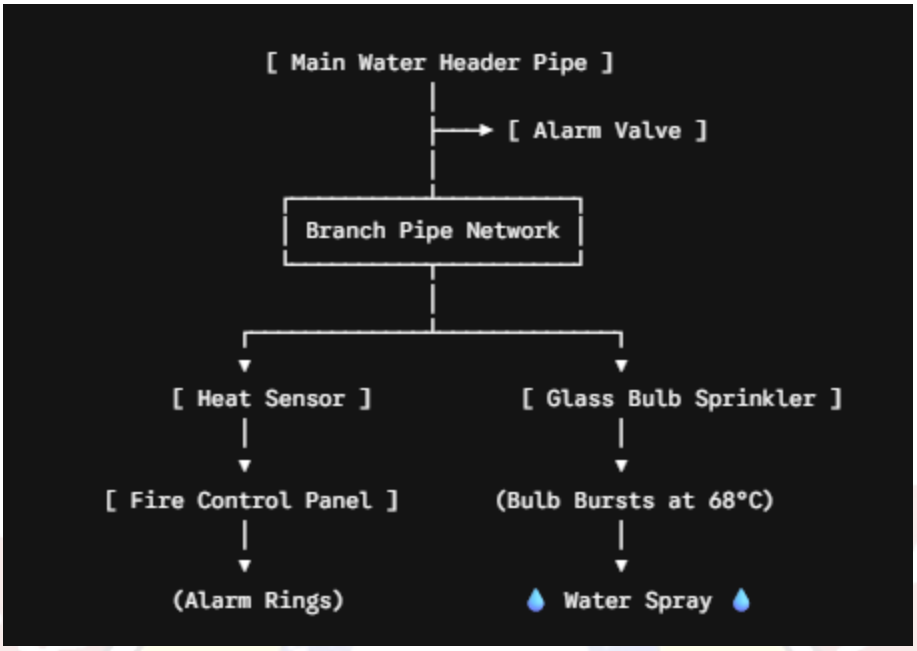
AFP systems require dynamic physical action, human operation, or automatic sensor triggering (powered or mechanical) to detect, control, or suppress a fire emergency.

- **Detection Systems:** Smoke detectors, heat sensors, manual call points (MCP), and fire alarm control panels.
- **Suppression Systems:** Automatic sprinkler systems, fire hydrant/riser networks, CO2 total flooding systems, and portable fire extinguishers.




Active protection includes systems that dynamically detect, control, or suppress fires manually or automatically upon activation.

- Detection & Alarm Systems: Smoke, heat, and flame detectors linked to a Fire Alarm Control Panel (FACP) to alert occupants (as per IS 2189).
- First-Aid Extinguishers: Portable extinguishers selected and installed based on fire classes (as per IS 2190:2024).
- Water-Based Fixed Systems: Automatic sprinklers (IS 15105), wet riser systems, external fire hydrants, and hose reels.
- Special Suppression Systems: CO2 total flooding or Dry Chemical Powder (DCP) systems for electrical and chemical hazards.

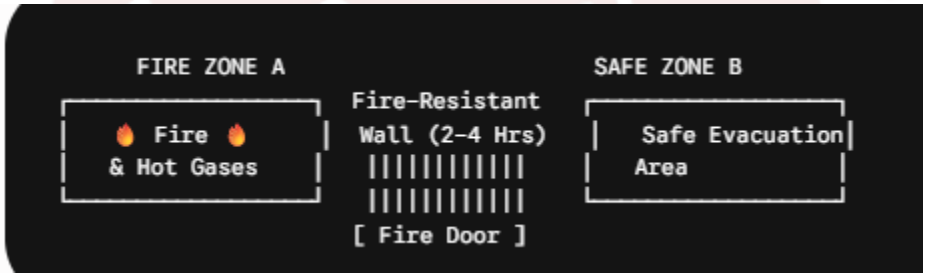



Automatic Sprinkler & Detection System

**Passive Fire Protection Systems (PFP)**

PFP systems are built directly into the structure of a facility to contain fire within a specific compartment, preserving structural stability without requiring electricity, manual intervention, or mechanical activation.

- **Compartmentation:** Firewalls, floor slabs, and fire-rated doors designed to withstand fire for specific durations (e.g., 1 to 4 hours).
- **Structural Fireproofing:** Intumescent paint or concrete encasements applied to structural steel beams to prevent collapse.
- **Penetration Seals & Dampers:** Fire stops sealed around cable trays and automatic fire dampers placed inside HVAC ductwork.




Fire Compartmentation

Passive protection uses structural elements to limit the spread of fire and smoke without requiring mechanical activation or human intervention.

- Firewalls & Compartmentation: Dividing buildings into fire zones using 2–4 hour fire-resistance-rated masonry or concrete walls.
- Fire Doors & Dampers: Fire-rated doors installed along escape routes and automatic thermal dampers inside air-conditioning (HVAC) ducts to isolate smoke.
- Structural Fireproofing: Encasing structural steel beams in concrete or applying intumescent paint to prevent structural collapse under high heat.

**Comparison**

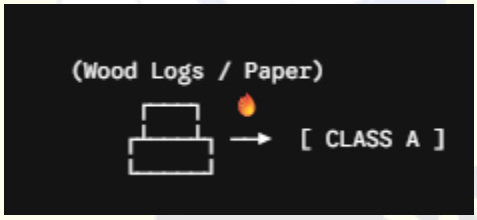
| **Feature** | **Active Fire Protection (AFP)** | **Passive Fire Protection (PFP)** |
|---|---|---|
| **Primary Goal** | Suppress or extinguish active flames. | Contain fire and maintain building stability. |
| **Trigger Mechanism** | Requires manual or automatic activation. | Operates continuously without activation. |
| **Power Source** | Needs electricity, water pressure, or human effort. | Requires no external power source. |
| **Core Examples** | Sprinklers, extinguishers, fire hydrants. | Firewalls, fire doors, fireproof coatings. |
| **IS Code Context** | IS 15105 (Sprinklers), IS 2190 (Extinguishers). | National Building Code (NBC) Part 4 Fire Safety. |

**Various Classes of Fires – A, B, C, D, E.**

Fires are categorized into distinct classes based on the type of fuel involved, allowing fire engineers to select the appropriate extinguishing agent as per Indian Standards (IS 2190) and the National Building Code (NBC).

**1. Class A Fires: Carbonaceous / Solid Combustibles** Fires involving organic solid materials that form glowing embers upon burning.

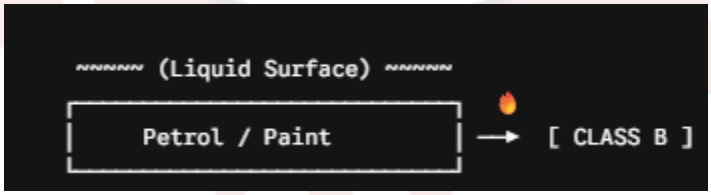
- **Fuels:** Wood, paper, cloth, rubber, plastics, and trash.
- **Extinguishing Media:** Water (Cooling), Dry Chemical Powder (DCP), ABC Powder.




**2. Class B Fires: Flammable Liquids**

Fires involving liquids or liquefiable solids that emit flammable vapors above their flash point.

- **Fuels:** Petrol, diesel, kerosene, paints, thinners, and grease.
- **Extinguishing Media:** Mechanical Foam (Smothering), CO2, Dry Chemical Powder. *(Never use water streams)*.

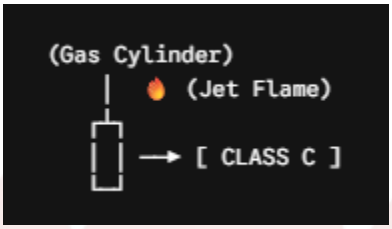



**3. Class C Fires: Flammable Gases**

Fires resulting from the ignition of compressed, liquefied, or dissolved flammable gases.

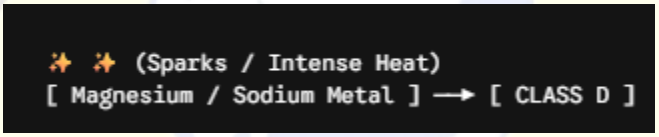
- **Fuels:** LPG (Liquefied Petroleum Gas), CNG, Acetylene, Methane, and Hydrogen.

- **Extinguishing Media:** Dry Chemical Powder (DCP), Carbon Dioxide ($CO_2$). The primary action is isolating the gas valve (Starvation).




**4. Class D Fires: Combustible Metals** Fires involving active metals that burn at extremely high temperatures and react violently with water.

- **Fuels:** Magnesium, Sodium, Potassium, Titanium, and Aluminium swarf.
- **Extinguishing Media:** Special Dry Powder (Ternary Eutectic Chloride - TEC / Metal Fire Extinguisher), dry sand.




**5. Class E Fires: Electrical Fires**

Fires involving energized electrical equipment. Electrical energy acts as a continuous heat source until isolated.

- **Fuels:** Transformers, switchboards, motors, circuit breakers, and electrical wiring.
- **Extinguishing Media:** Carbon Dioxide (CO2), Dry Chemical Powder. *(Water and foam are strictly prohibited due to conductivity hazards)*.

**Fire Classification Quick Reference Table**

| Fire Class | Fuel Source | Key Symbol | Primary Extinguishing Action | Suitable Extinguisher |
|---|---|---|---|---|
| **Class A** | Solid Carbonaceous (Wood, Paper) | Green Triangle / Letter A | Cooling | Water, Foam, ABC Powder |
| **Class B** | Flammable Liquids (Petrol, Oils) | Red Square / Letter B | Smothering | Foam, CO2, DCP |
| **Class C** | Flammable Gases (LPG, CNG) | Blue Circle / Letter C | Starvation / Inhibition | DCP, CO2 |
| **Class D** | Active Metals (Mg, Na, K) | Yellow Star / Letter D | Blanketing / Smothering | Special Metal Powder (TEC), Dry Sand |
| **Class E** | Energized Electrical Equipment | Black Circle / Electrical Symbol | Non-conductive Blanketing | CO2, Dry Chemical Powder |

**Protection:**

In Fire Engineering, Fire Protection refers to the design, installation, and application of systems, structures, and practices aimed at safeguarding life, property, and the environment from fire hazards.

As per the National Building Code (NBC) of India (Part 4: Fire and Life Safety) and Bureau of Indian Standards (BIS), fire protection is broadly classified into Passive Fire Protection and Active Fire Protection.

## Key Indian Standards

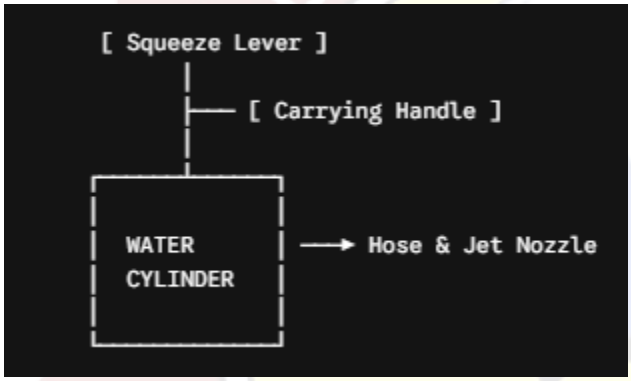
| System | Indian Standard (IS Code) | Purpose |
|---|---|---|
| First-Aid Fire Extinguishers | IS 2190 | Selection, installation, and maintenance guide. |
| Automatic Sprinklers | IS 15105 | Design and installation of fixed sprinkler systems. |
| Fire Alarm Systems | IS 2189 | Code of practice for automatic fire detection. |
| Building Code | NBC Part 4 | Universal fire and life safety guidelines for India. |

**Types of fire extinguishers:**

In fire engineering, portable fire extinguishers are active fire protection devices classified by their extinguishing agent and operational mechanism as per Indian Standards (IS 15683 / IS 2190).

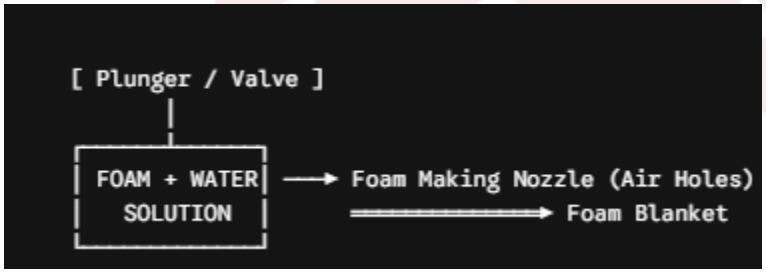
**1. Water Type Extinguisher** Designed specifically for solid combustible materials by providing a cooling effect.

- **Class of Fire:** Class A (Wood, paper, textile, rubber).
- **Color Band (IS Standard):** Signal Red.
- **Mechanism:** Cools the fuel below its ignition temperature. *(Never use on electrical or liquid fires)*.




**2. Mechanical Foam Type Extinguisher (AFFF)** Contains Aqueous Film Forming Foam mixed with water to smother liquid surface fires.

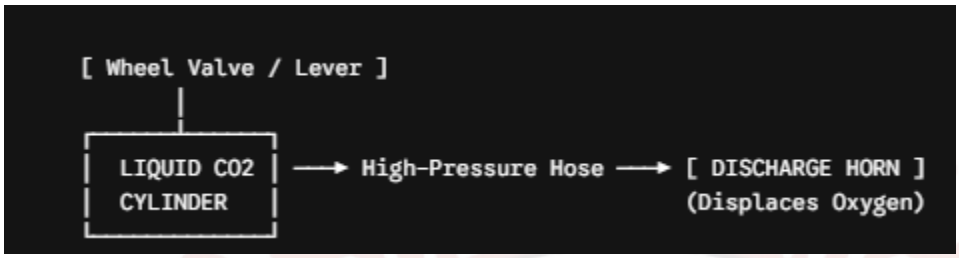
- **Class of Fire:** Class A and Class B (Petrol, diesel, paints).
- **Color Band (IS Standard):** Cream / Pale Cream.
- **Mechanism:** Forms a floating foam blanket over liquid fuel to cut off oxygen and trap flammable vapors.




### 3. Carbon Dioxide ($CO_2$) Type Extinguisher

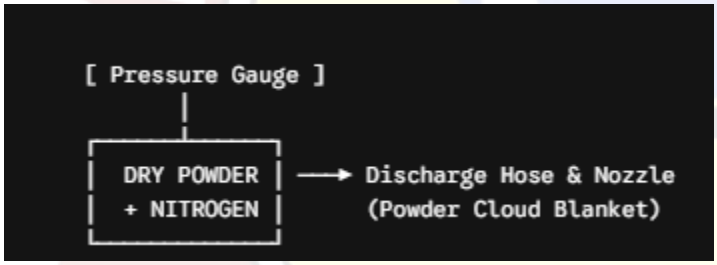
Contains liquefied $CO_2$ under high pressure, which discharges as a cold gas.

- **Class of Fire:** Class B, Class C, and Class E (Electrical risks).
- **Color Band (IS Standard):** Black.
- **Mechanism:** Displaces oxygen (smothering) and provides rapid local cooling without leaving conductive residue. Features a non-conductive discharge horn.




**4. Dry Chemical Powder (DCP / ABC) Extinguisher** Contains sodium bicarbonate, potassium bicarbonate, or monoammonium phosphate powder pressurized with nitrogen.

- **Class of Fire:** Class A, B, C, and E (Universal / Multipurpose).
- **Color Band (IS Standard):** Blue.
- **Mechanism:** Interrupts the chemical chain reaction of flames and smothers the fuel bed.




**5. Clean Agent / Special Powder Extinguishers** Uses electrically non-conductive vaporizing liquid gases (e.g., Novec 1230, FE-36) or specialized dry chemicals (Ternary Eutectic Chloride) for critical applications.

- **Class of Fire:** Class D (Combustible metals like Na, Mg) and sensitive electronic servers (Clean Agent).
- **Color Band (IS Standard):** Yellow (Class D) / Green (Clean Agent).
- **Mechanism:** Chemically inhibits combustion without water damage or residue.

| Extinguisher Type | Target Fire Class | Extinguishing Principle | Color Code (IS 15683) | Key Application |
|---|---|---|---|---|
| **Water** | Class A | Cooling | Signal Red | Wood, Paper, General Trash |
| **Mechanical Foam** | Class A & B | Smothering & Cooling | Cream | Petrol, Diesel, Paint Stores |
| **Dry Chemical Powder (DCP)** | Class A, B, C & E | Chain Reaction Inhibition | Blue | Electrical Panels, Gas Pipelines |
| **Carbon Dioxide ($CO_2$)** | Class B, C & E | Oxygen Displacement | Black | Server Rooms, Transformers |
| **Special Metal Powder / Clean Agent** | Class D / Sensitive Electronics | Blanketing / Radical Scavenging | Yellow / Green | Metal Machining, Data Centers |

**Fire Stoppers:**

In fire engineering, a fire stopper (or firestop system) is a passive fire protection sealing assembly used to close gaps, joints, and penetrations in fire-resistance-rated walls and floor slabs. When pipes, electrical cables, or HVAC ducts pass through fire barriers, fire stoppers restore the original fire-resistance rating of the assembly, preventing the spread of fire, smoke, and toxic gases between compartments.

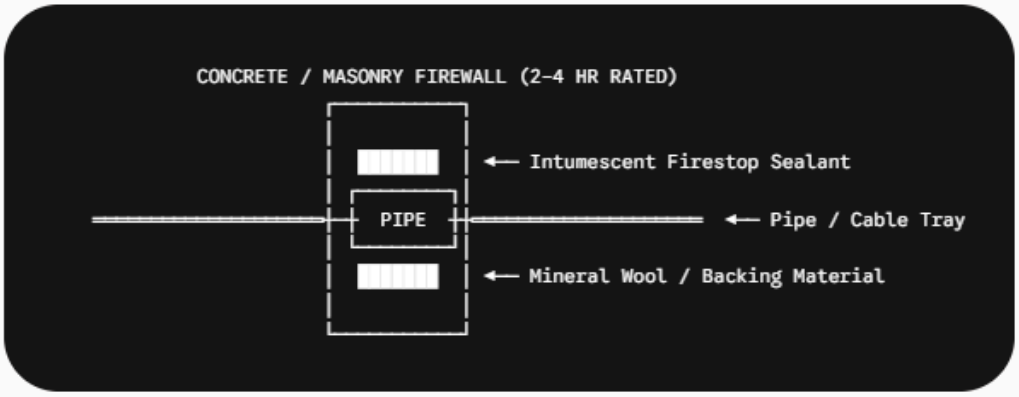
Functions of Fire Stoppers

- Compartmentation Integrity: Maintains the continuity of fire-rated walls and floors (e.g., 1 to 4 hours rating) as per NBC Part 4.
- Smoke Seal: Prevents the movement of toxic gases and smoke into clean exit corridors and adjacent rooms.
- Water & Sound Resistance: Provides waterproofing against firefighting water discharge and acoustical insulation during normal operations.

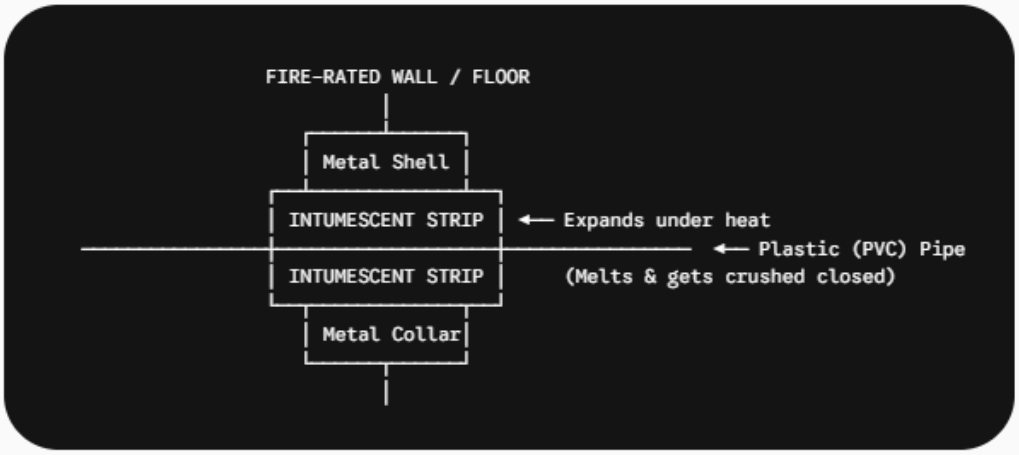
Types of Fire Stoppers

- Intumescent Sealants & Mastics: Flexible materials applied around small cable bundles or metal pipes. They expand when exposed to heat, sealing off the gap tightly.
- Firestop Collars & Wraps: Used specifically for plastic/combustible pipes. Under high heat, the plastic pipe melts, and the intumescent inner lining of the collar expands up to 25–50 times its original volume to crush and completely block the melting pipe opening.
- Firestop Bricks & Modules: Reusable elastomeric blocks used in large openings (like cable trays) that require frequent wiring additions.
- Firestop Mortar / Cement: Non-shrinkable, light-weight cementitious compounds used for filling large penetration voids in floor slabs and concrete walls.

1. Pipe / Cable Wall Penetration Firestop Assembly




2. Intumescent Collar for Combustible (PVC) Pipes



**Key Technical Parameters**

| Parameter | Specification / Standard |
|---|---|
| **Primary Standard (India)** | National Building Code (NBC) Part 4 / IS 12458 |
| **Testing Standard** | ASTM E814 / ISO 834 / BS 476 Part 20 |
| **Fire Resistance Ratings** | F-Rating (Flame resistance duration) & T-Rating (Thermal transfer limit) |
| **Expansion Ratio** | Intumescent materials expand 10x to 50x their original volume at 180°C–200°C |

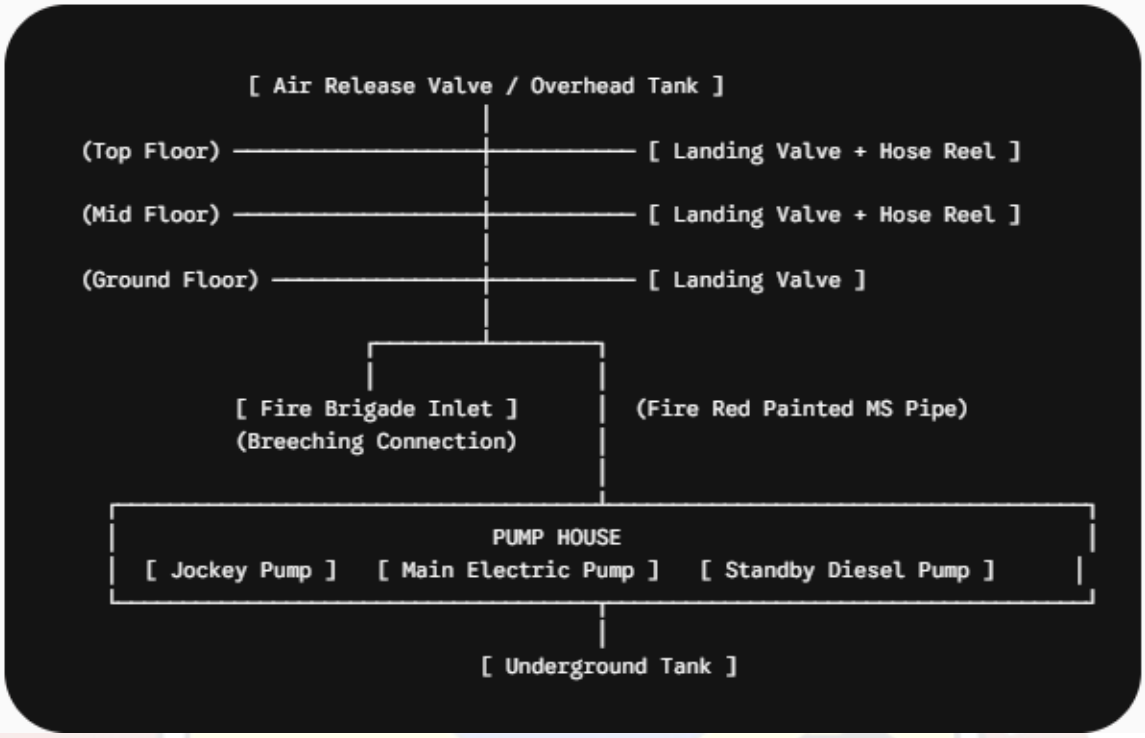
**Hydrant Pipes:**

In fire engineering, a **hydrant pipe system** (also known as a fire riser or fire main system) is an assembly of heavy-duty piping installed inside and around a facility. It provides a continuous, high-pressure water supply to landing valves and hose connections, enabling firefighters and trained personnel to extinguish fires efficiently.

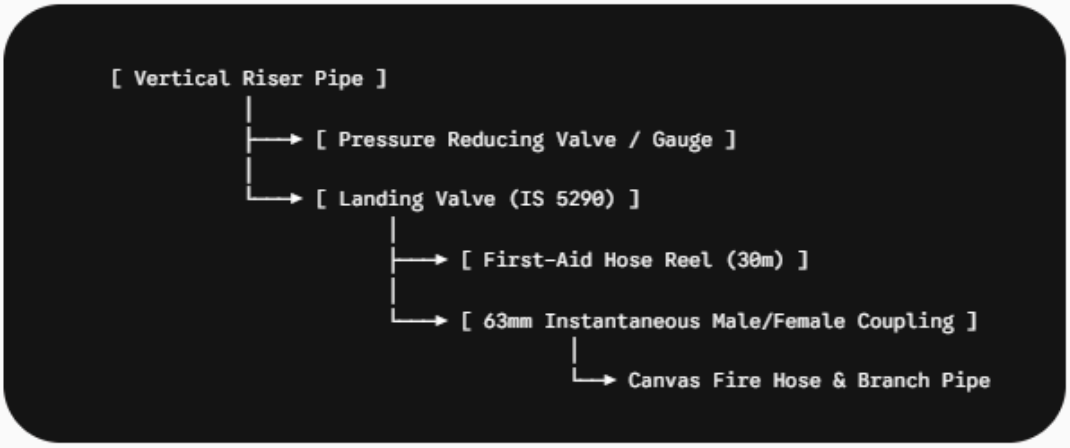
## Types of Hydrant Pipe Systems

- **Wet Riser System:** A pipe network permanently charged with water under dynamic pressure from fire pumps. It is used in buildings taller than 15 meters as per NBC Part 4.
- **Dry Riser System:** A pipe network kept empty of water during normal conditions. In an emergency, the fire brigade pumps water into the system via an external Fire Brigade Connection (Breeching Inlet). Used in buildings up to 15 meters or unheated structures.
- **Downcomer System:** A vertical pipe network connected directly to an overhead water tank, pressurized by gravity or an automatic booster pump located on the roof.
- **Yard Hydrant / External Ring Main:** A horizontal underground or aboveground piping network running around the perimeter of a plant or facility, serving external standpost hydrants.

1. Wet Riser Hydrant Pipe Network




2. Landing Valve & Outlet Point



### Key Components of Hydrant Pipe Systems

- **Riser Pipes:** Heavy-grade Mild Steel (MS) or Galvanized Iron (GI) pipes conforming to **IS 1239 / IS 3589**, painted Fire Red (Shade 536 of IS 5).
- **Landing Valves:** Gunmetal or stainless steel outlet valves (conforming to **IS 5290**) installed at strategic floor locations and staircase landings.
- **Fire Brigade Breeching Inlet:** A 2-way or 4-way collector head installed at ground level for external fire engines to pump water into the riser.
- **Air Release Valves:** Installed at the highest point of the riser to automatically purge trapped air, preventing water hammer damage.
- **Pressure Gauges & PRVs:** Installed to ensure working pressure at any landing valve remains within **3.5 to 7.0 kg/cm²**.

## Key Indian Standards (IS) Reference for Diploma Exams

| Parameter / Element | Standard / Guideline | Requirement / Specification |
|---|---|---|
| **Code of Practice for Internal Hydrants** | **IS 3844** | Guidelines for installation and maintenance of internal risers. |
| **External Hydrant System Code** | **IS 13039** | Selection and layout for yard hydrants and ring mains. |
| **Landing Valve Specifications** | **IS 5290** | Standard dimensions, materials (Gunmetal/SS), and pressure testing. |
| **Pipe Identification Color** | **IS 2379 / IS 5** | Fire Red (Shade 536). |

| | | |
|---|---|---|
| **Standard Landing Valve Pressure** | **NBC Part 4** | Minimum 3.5 kg/cm^2, Maximum 7.0 kg/cm^2 at the nozzle. |

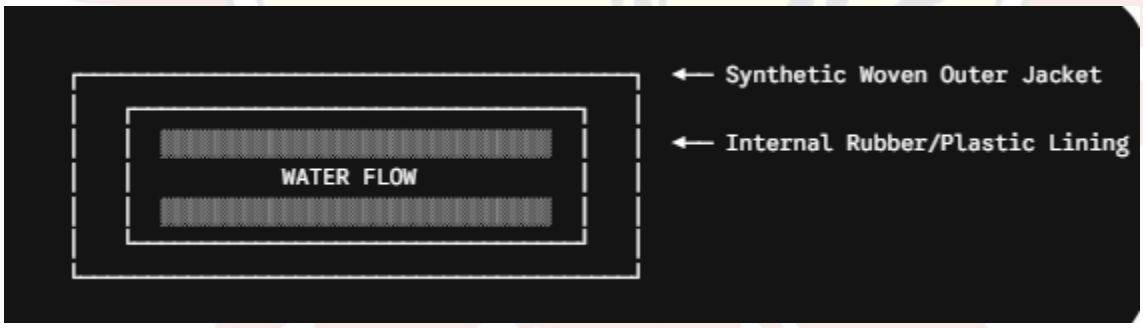
**Hoses:**

In fire engineering, a fire hose is a flexible, high-pressure conduit used to convey water or extinguishing agents from a water source (such as a fire engine, pump, or hydrant) to the point of fire application.

**1. Delivery Hoses**

Delivery hoses transport pressurized water from a pump or hydrant to the nozzle. They operate under internal positive pressure.

- **Percolating Hose:** Constructed from unlined natural flax or hemp canvas weave. A small fraction of water seeps (percolates) through the fabric weave, keeping the outer surface wet to protect the hose against burning embers.
- **Non-Percolating Hose (Reinforced Rubber Lined - RRL):** Features a synthetic woven jacket (polyester or nylon) lined internally with a smooth vulcanized rubber or plastic membrane. It prevents water loss, minimizes friction loss, and handles higher working pressures.




**2. Suction Hoses**

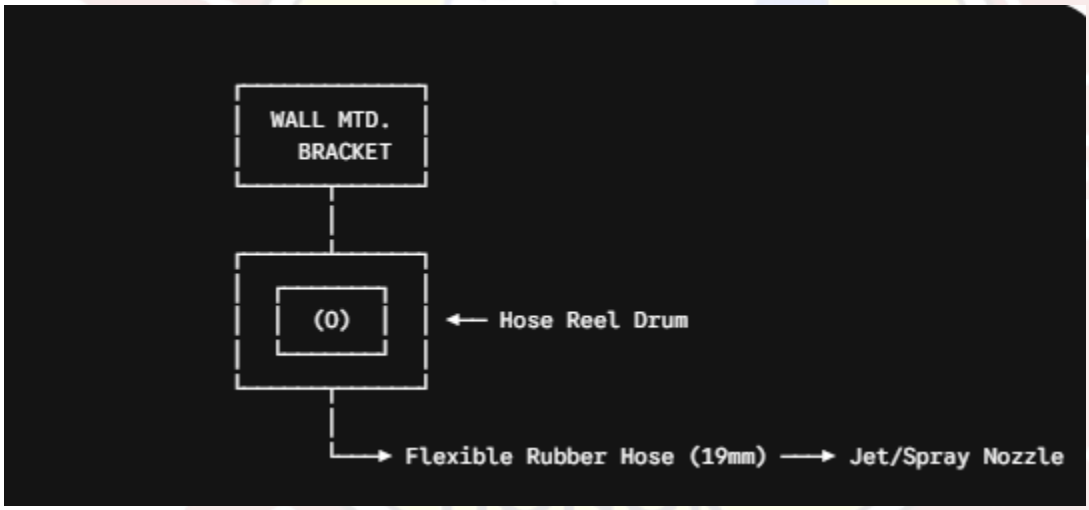
Suction hoses are used on the intake side of a fire pump to draw water from open static sources like tanks, ponds, lakes, or mobile tenders.

- **Hard Suction Hose:** Reinforced with an internal helical steel wire embedded within thick rubber layers. This rigid structure prevents the hose wall from collapsing inward under atmospheric vacuum when the pump creates negative pressure.

- **Soft Suction Hose:** A short length of large-diameter flexible delivery hose used to connect a pressurized hydrant directly to the pump intake.

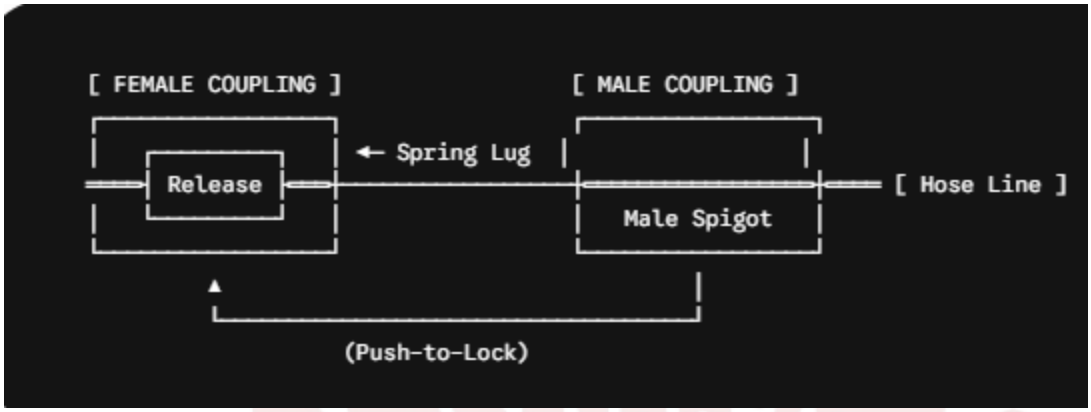

**3. First-Aid Hose Reel**

Installed in internal wet riser systems, this is a small-diameter (19mm or 25mm), non-collapsible, high-pressure rubber hose wound on a drum. It allows immediate single-person operation for first-aid firefighting before main heavy hose lines are deployed.




4. Fire Hose Couplings

Hose couplings enable quick connection between hose lengths, pumps, hydrants, and nozzles. In India, **63mm Instantaneous Couplings** (Male and Female interlocking spring-loaded lug assembly) are the standard fitting.




Summary

| Hose Type | Standard IS Code | Primary Material | Standard Diameter | Working / Test Pressure |
|---|---|---|---|---|
| **Delivery Hose (RRL)** | **IS 636** | Polyester jacket with rubber lining | 63 mm / 38 mm | 14 to 35 $kg/cm^2$ |
| **Hard Suction Hose** | **IS 2410** | Rubber with embedded steel wire | 75 mm to 100 mm | Full Vacuum (~760 mm Hg) |
| **First-Aid Hose Reel** | **IS 884** | Reinforced non-collapsible rubber | 19 mm / 25 mm | 10 $kg/cm^2$ |
| **Couplings & Nozzles** | **IS 903** | Gunmetal / Stainless Steel / Aluminium | 63 mm standard | 15 $kg/cm^2$ |

**Monitors:**

In fire engineering, a fire monitor (also called a water/foam cannon) is a heavy-duty, high-capacity discharge device capable of delivering large volumes of water or foam solution over long distances. Monitors are deployed where standard hand-held hose lines (which typically deliver 300–500 LPM) are insufficient to handle large-scale, high-intensity fires.

## 1. Key Functions and Features

- High Flow Rates: Delivers flow rates ranging from 1,000 LPM to over 20,000 LPM (Liters Per Minute).
- Extended Reach: Can throw water/foam streams 50 to 100+ meters horizontally and vertically.
- Articulated Movement: Rotates 360° horizontally (azimuth) and tilts vertically (elevation) from -45° to +85°.
- Reaction Force Management: Fixed mounting or heavy bases absorb high thrust reaction forces, eliminating operator fatigue and reducing personnel hazards.

## 2. Classification of Fire Monitors

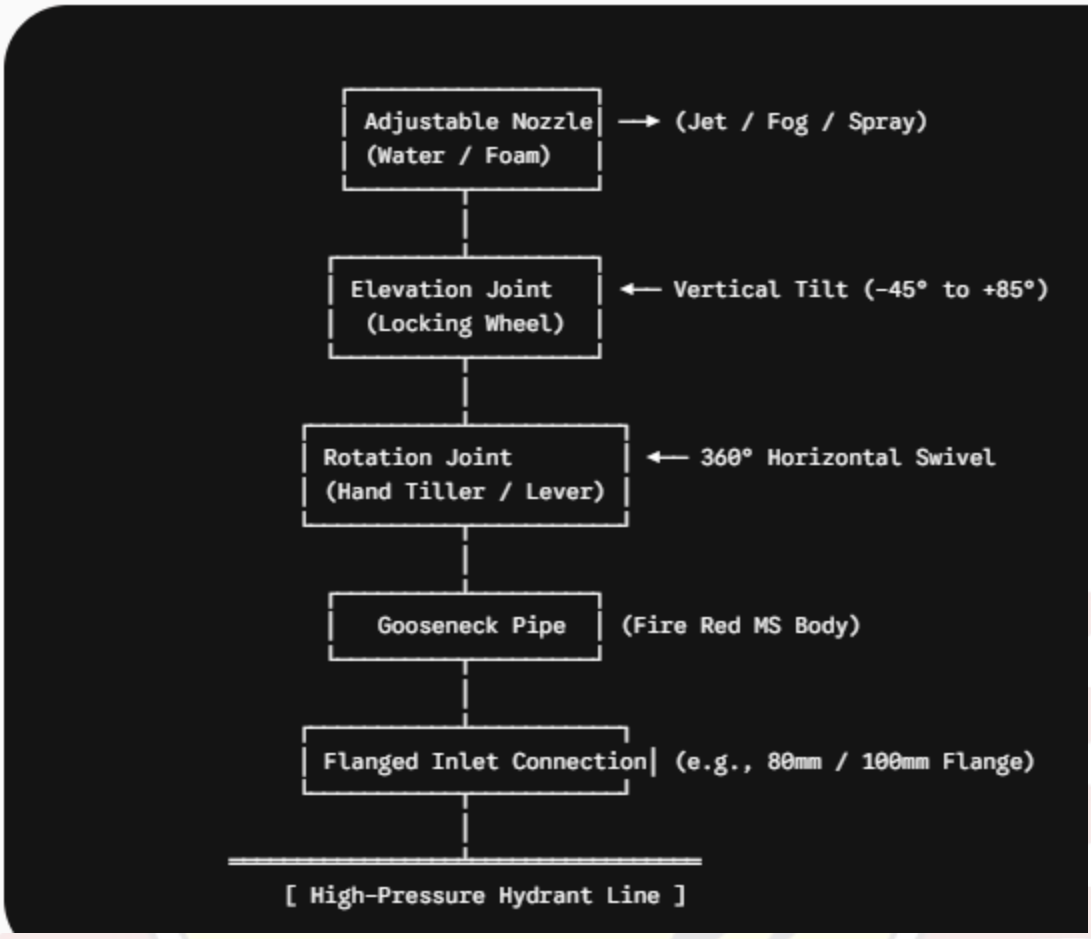
### A. Based on Mounting / Portability

1. Fixed / Ground-Mounted Monitors: Permanently bolted to concrete foundations or steel risers in high-risk industrial sites (oil refineries, chemical plants, tank farms).
2. Portable / Ground Monitors: Mobile units transported to site and anchored on ground legs/spikes for temporary high-volume deployment.
3. Trailer / Vehicle-Mounted Monitors: Mounted on mobile trailers, fire tenders, or foam tenders for flexible field positioning.
4. Tower / Elevated Monitors: Installed on elevated steel towers (10 to 30 meters high) to spray directly over bulk fuel storage tanks.

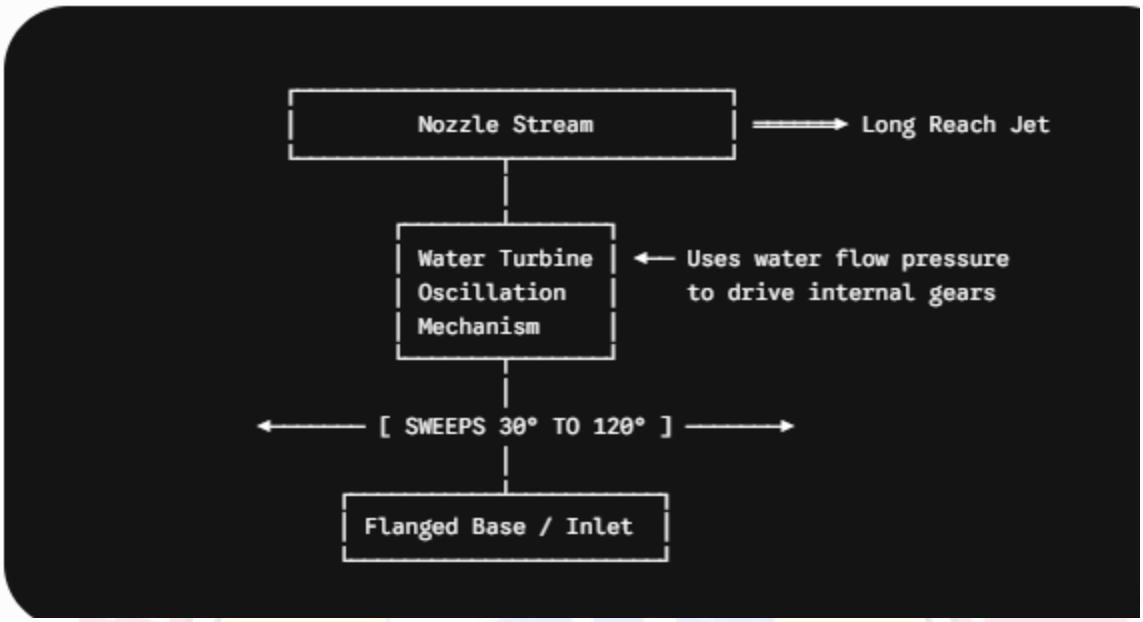
### B. Based on Operation

1. Manual Monitors: Operated directly by firefighters using handwheels, tiller bars, or worm-gear hand cranks.
2. Remote Controlled / Oscillating Monitors: Driven by electric, hydraulic, or water-turbine motors, enabling remote control from safe zones or automatic sweeping (oscillating) patterns.

Sketch 1: Fixed Manual Fire Monitor Assembly



Sketch 2: Water-Driven Automatic Oscillating Monitor




## 4. Key Components

- **Flanged Inlet Base:** Connects directly to the high-pressure water supply network (typically 80 mm, 100 mm, or 150 mm ANSI flanges).
- **Swivel Joints:** Precision ball-bearing joints sealed with nitrile or Viton O-rings to allow smooth rotation and elevation without leaking.
- **Gooseneck / Curved Pipe:** Designed with smooth internal curves to minimize turbulence and friction losses inside the monitor body.
- **Master Stream Nozzle:** Can be set for **solid jet** (long reach) or **fog/spray pattern** (heat radiation shielding). May include a self-educting foam inductor attachment.

## 5. Key Indian Standards (IS) Reference

| Parameter / Element | Standard / Guideline | Requirement / Specification |
|---|---|---|
| **Water / Foam Monitor Code** | **IS 8410** | Specifications for manual and high-capacity fire monitors. |
| **Foam Making Monitors** | **IS 10502** | Design requirements for self-educting foam monitors. |
| **Flange Fittings** | **IS 6392 / ANSI B16.5** | Standard inlet connection dimensions. |
| **Standard Operating Pressure** | **OISD-STD-116 / NBC** | Minimum 7.0 $kg/cm^2$ working pressure at the monitor base. |
| **Body Painting / Shade** | **IS 5** | Fire Red (Shade 536) epoxy or polyurethane finish. |

## 6. Applications in Fire Engineering

- **Refineries & Petrochemical Complexes:** Cooling atmospheric storage tanks during boilover or rim seal fire risks.
- **Aircraft Hangars & Helipads:** Rapid application of Aqueous Film-Forming Foam (AFFF) over large fuel spill fires.
- **Port / Marine Terminals:** Protecting oil jetties and LPG/LNG unloading docks.
- **Transformer Yards:** High-volume water deluge for power grid transformers.

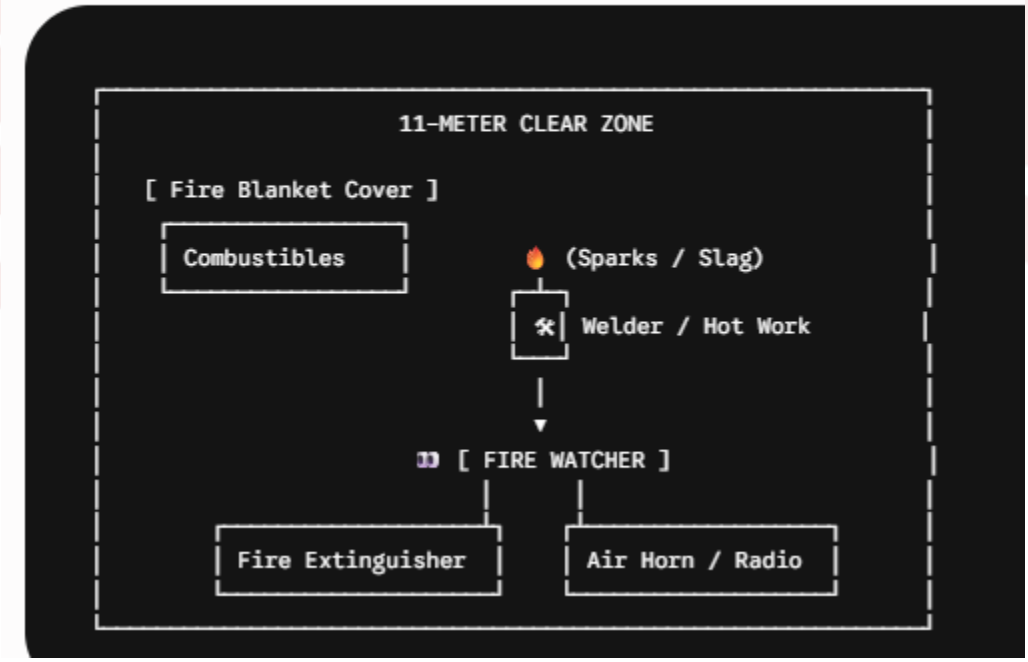
**Fire Watchers:**

In fire safety and loss prevention, a **fire watcher** is a trained person dedicated to monitoring hot work operations (such as welding, cutting, grinding, or brazing) to detect and extinguish small fires before they spread.

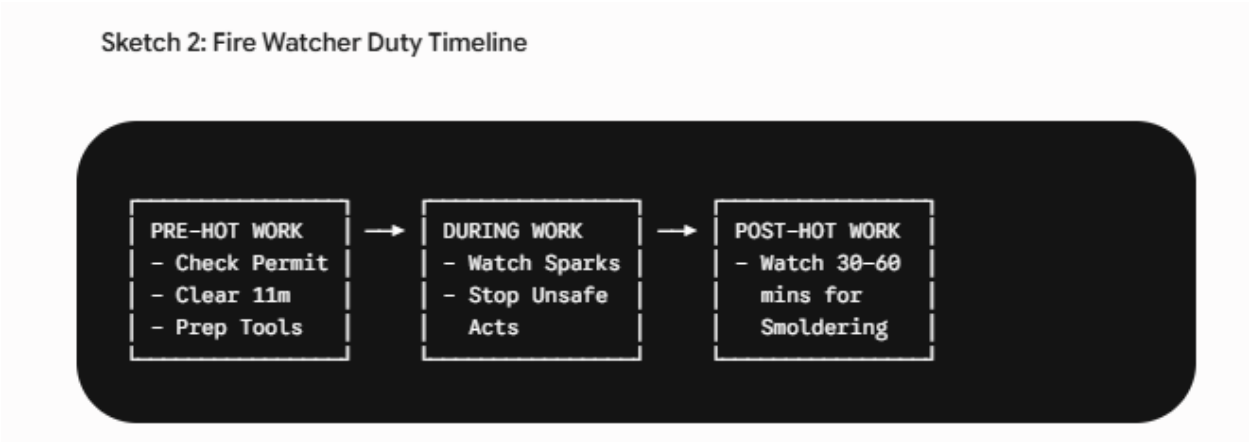
**1. Primary Responsibilities of a Fire Watcher**

- **Pre-Hot Work Inspection:** Verifies that a valid **Hot Work Permit (HWP)** is issued, ensures all combustible materials within an 11-meter (35 ft) radius are cleared or covered with fire blankets, and checks that firefighting equipment is operational.
- **During Hot Work Operations:** Maintains continuous visual observation of the work area, slag, and flying sparks; alerts the operator of hazards; and immediately uses portable extinguishers or activates the plant alarm if a fire breaks out.
- **Post-Hot Work Monitoring:** Remains at the hot work site for a mandatory period (typically **30 to 60 minutes**) after operations stop to inspect for smoldering embers or hidden hot spots.

Sketch 1: Hot Work Area Setup & Fire Watcher Position



Sketch 2: Fire Watcher Duty Timeline




### 3. Essential Tools and PPE for a Fire Watcher

- **Extinguishing Equipment:** Charged portable fire extinguisher (typically ABC Powder or CO2) and a pressurized water hose/fire bucket.
- **Protection Equipment:** Fire-resistant blanket, welding shield/goggles, leather gloves, safety shoes, and helmet.
- **Communication Devices:** Air horn, whistle, or two-way radio to raise an immediate alarm in case of emergency.

### 4. Key Indian Standards & Regulatory References

| Code / Regulation | Topic / Provision |
|---|---|
| **IS 3016** | Code of practice for fire precautions in welding and cutting operations. |
| **OISD-STD-105** | Work Permit System in Oil and Gas Industry (mandates fire watcher deployment). |
| **Factories Act, 1948** | Section 37 (Precautions in case of fire during hot processes). |

| | |
|---|---|
| **NBC Part 4** | Fire and Life Safety guidelines regarding hazardous construction/maintenance works. |

**Layout of Stand Pipes:**

Standpipe systems consist of vertical and horizontal pipe networks installed throughout a building to deliver high-pressure water directly to landing valves and hose reels on each floor as per IS 3844 and NBC Part 4.

Classification of Standpipe Layouts

Class I System: Designed for fire brigade and trained personnel use, equipped with 63 mm landing valves.

Class II System: Designed for building occupants as first-aid protection, equipped with 19 mm or 25 mm hose reels.

Class III System: A combination system providing both 63 mm landing valves for firefighters and hose reels for occupants on every floor.

Key Components of Standpipe Layout Architecture

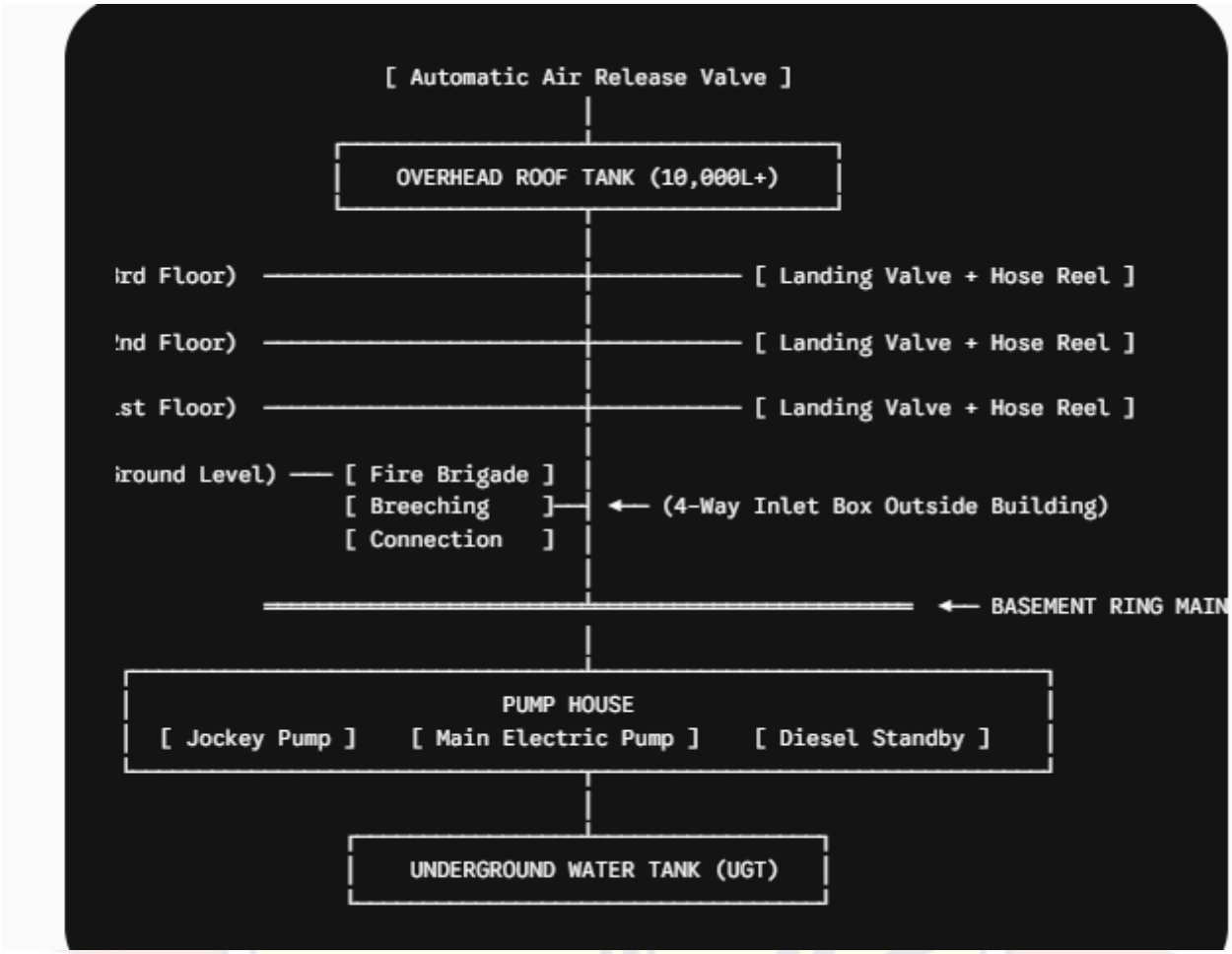
Underground Tank & Pump Room: Provides static water storage connected to a jockey pump (maintains system pressure), a main electric pump, and a standby diesel pump.

Horizontal Ring Main: A closed-loop header pipe running through the basement or ground level that feeds all vertical standpipes, ensuring equal pressure distribution.

Vertical Risers: MS/GI pipes (minimum 100 mm nominal bore) installed vertically within fire-rated staircase enclosures or protected fire escape corridors.

Fire Brigade Connection (Breeching Inlet): A 2-way or 4-way external inlet box located at ground level for fire engines to feed water directly into the standpipe system.

Roof Terminal & Air Release Valve: Installed at the highest point of the riser to purge trapped air automatically and connect to an overhead roof supply tank.




**Layout & Placement Rules as per NBC Part 4 / IS 3844**

- **Location:** Risers must be located in protected staircase enclosures, pressurised lobbies, or fire towers to remain accessible during an evacuation.
- **Coverage Distance:** No point on any floor should be further than 30 meters from a landing valve/hose reel connection.
- **Pipe Diameter:** Minimum 100 mm NB (Nominal Bore) for buildings up to 45 meters; 150 mm NB for buildings exceeding 45 meters in height.
- **Operating Pressure:** Maintained between 3.5 kg/cm² and 7.0 kg/cm² at any landing valve outlet. Pressure reducing valves (PRVs) are installed on lower floors to prevent excess static pressure.
- **Pipe Identification:** All standpipes must be painted Fire Red (Shade 536 of IS 5) and labeled with direction-of-flow arrows.

**Standpipe Layout Technical Specifications**

| System Component | Minimum Pipe Size | Recommended Pressure | Applicable Indian Standard |
|---|---|---|---|
| **Main Risers (Internal)** | 100 mm to 150 mm MS | 3.5 to 7.0 kg/cm² | IS 1239 / IS 3844 |
| **External Yard Main** | 150 mm Cast Iron / MS | 7.0 kg/cm² | IS 13039 |
| **Landing Valve Outlet** | 63 mm Instantaneous | Minimum 3.5 kg/cm² | IS 5290 |
| **First-Aid Hose Reel** | 19 mm / 25 mm Rubber | 2.0 to 3.5 kg/cm² | IS 884 |

**Fire Station:**

A **fire station** is a operational headquarters designed to house fire tenders, firefighting personnel, rescue equipment, and control systems for rapid response to fire and rescue emergencies.

In fire engineering, the design and functional layout of a fire station are governed by **NBC Part 4 (Fire & Life Safety)** and guidelines from state fire services (e.g., Delhi Fire Service, MFSC).

## 1. Key Functional Zones of a Fire Station

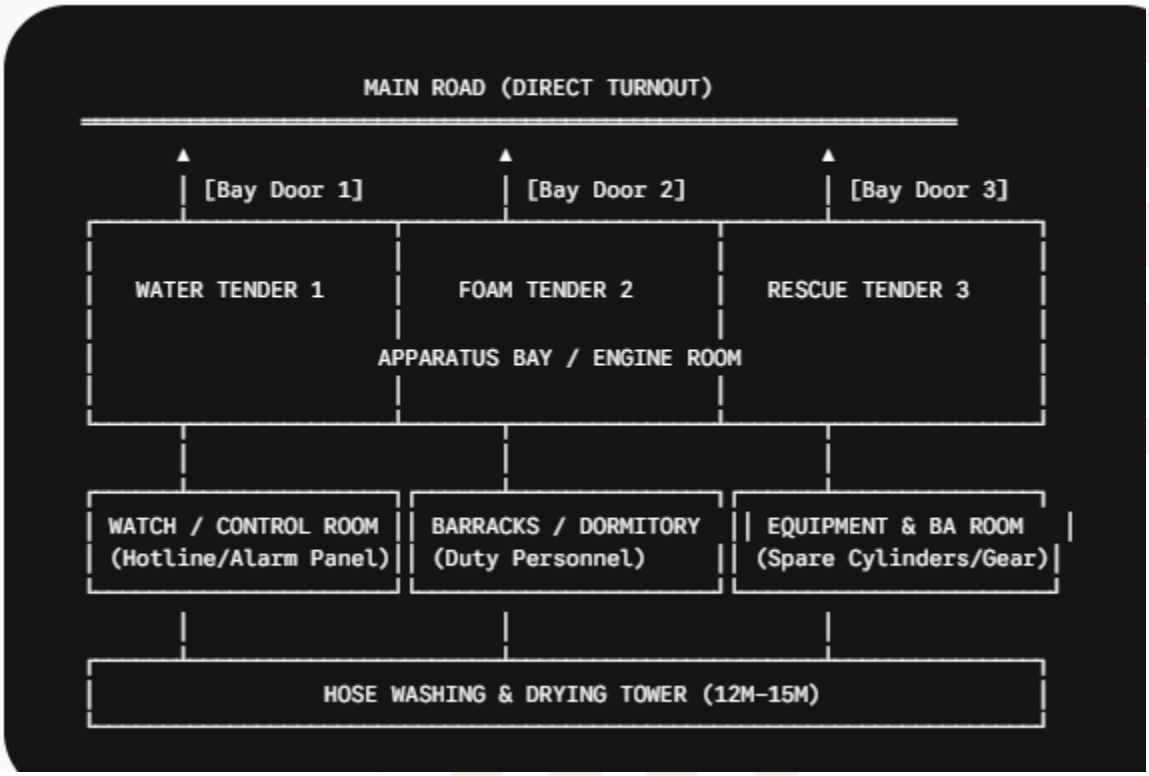
- **Apparatus Bay (Engine Room):** The core operational area where fire engines, water tenders, foam tenders, and hydraulic platforms are parked for immediate turnout.
- **Watch Room / Control Room:** The communication center equipped with hotlines, wireless communication, fire alarm receivers, and turnout bell controls.
- **Personnel & Living Quarters:** Includes the duty officer's room, firefighters' barracks, mess, recreation room, and washrooms.

- **Maintenance & Decontamination Zone:** Facilities for hose washing, hose drying towers, breathing apparatus (BA) set servicing, and equipment storage.

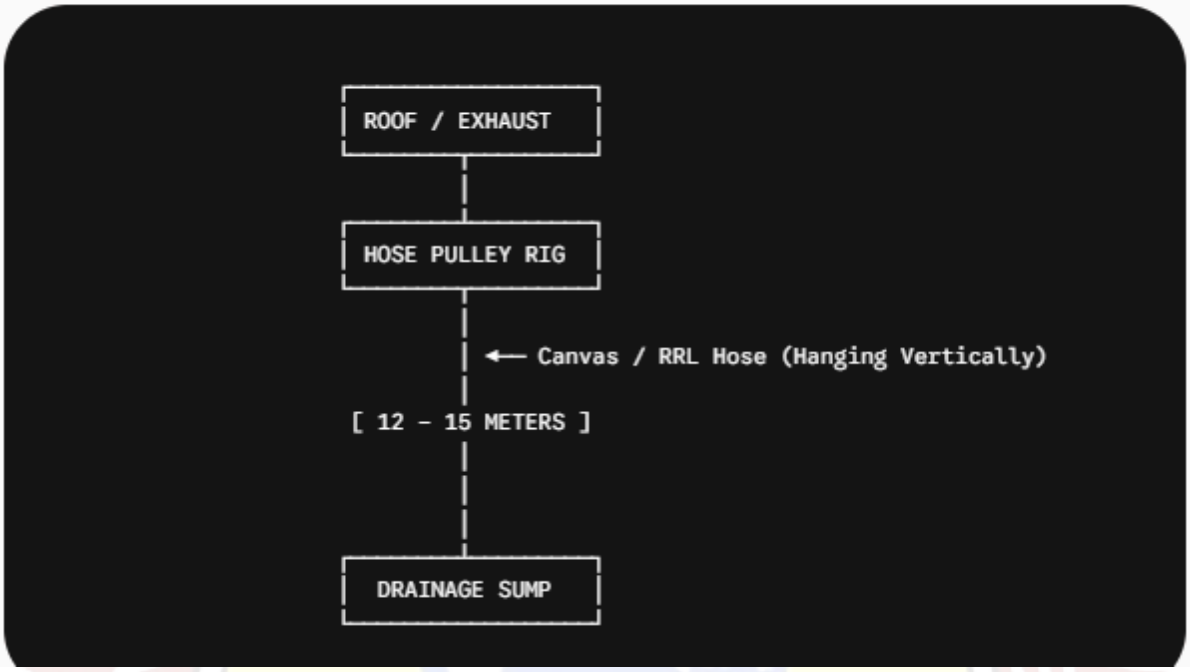
## 2. Essential Site & Design Requirements

- **Location & Accessibility:** Situated on main roads with wide access gates (minimum 6 meters wide) to allow unobstructed turnout of large appliances.
- **Response / Turnout Time:** Layout must facilitate a turnout time of **under 1 minute** (60 seconds) from receiving an alarm.
- **Bay Doors:** Drive-through or quick-opening roll-up doors (minimum 4.5m height and 4.0m width per bay) with direct access to the main road.
- **Hose Drying Tower:** A vertical tower (12–15 meters high) used to hang wet canvas/RRL delivery hoses vertically for natural air drying to prevent fungal decay.

Sketch 1: Functional Floor Layout of a Standard Fire Station



Sketch 2: Hose Drying Tower Cross-Section




## 4. Key Operational Features for Exams

| Component / Parameter | Specification / Requirement |
|---|---|
| **Standard Turnout Time** | 60 seconds (Day & Night) |
| **Apparatus Bay Dimensions** | Min. 4.0 m width $\times$ 12.0 m length per appliance |
| **Door Clearance Height** | Min. 4.5 meters vertical clearance |
| **Hose Tower Height** | 12 to 15 meters for full 15m/30m hose lengths |

| | |
|---|---|
| **Communication Systems** | P&T Hotline, Very High Frequency (VHF) Radio, Automatic Turnout Bells |

**Fire Alarms and Sirens:**

In fire engineering, **fire alarms and sirens** form the critical early warning and audio-visual notification component of active fire protection systems. Governed primarily by **IS 2189** (Code of Practice for Selection, Installation, and Maintenance of Automatic Fire Detection and Alarm System) and the **National Building Code (NBC) Part 4**, these devices ensure immediate evacuation and alert emergency response teams.

## 1. Key Functions of Fire Alarms and Sirens

- **Early Detection & Notification:** Detects smoke/heat or manual initiation and immediately alerts building occupants.
- **Audio-Visual Evacuation Signal:** Emits loud, distinct sound waves along with flashing strobe lights to guide occupants, including hearing- or visually-impaired persons.
- **System Interfacing:** Automatically triggers auxiliary safety systems (e.g., stopping HVAC blowers to prevent smoke spread, releasing fire doors, grounding elevators, and starting smoke extraction fans).

## 2. Classification of Fire Alarm Systems

### A. Conventional Fire Alarm System

- The building is divided into simple radial zones.
- Detectors in a specific zone share a common wire loop. When activated, the panel indicates the *zone number* but not the exact room or detector location.

### B. Addressable / Intelligent Fire Alarm System

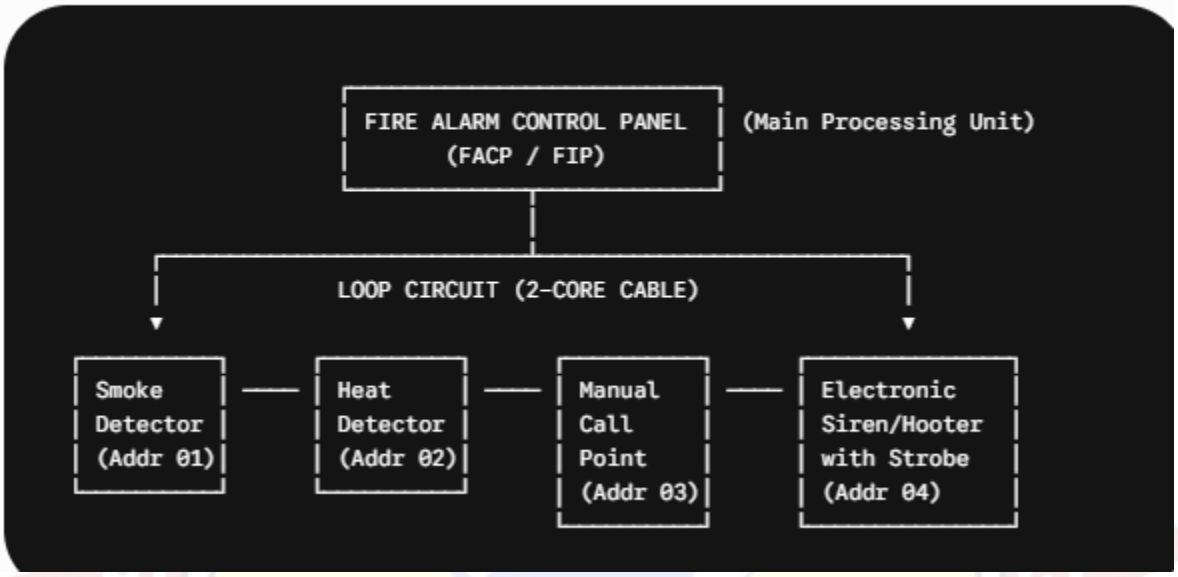
- Every detector, manual call point (MCP), and sounder/siren has a unique digital microchip address on a loop circuit.
- The Fire Alarm Control Panel (FACP) pinpoints the exact physical location of the activated device on an LCD interface.

## 3. Notification Devices (Sirens, Hooters, & Visual Indicators)

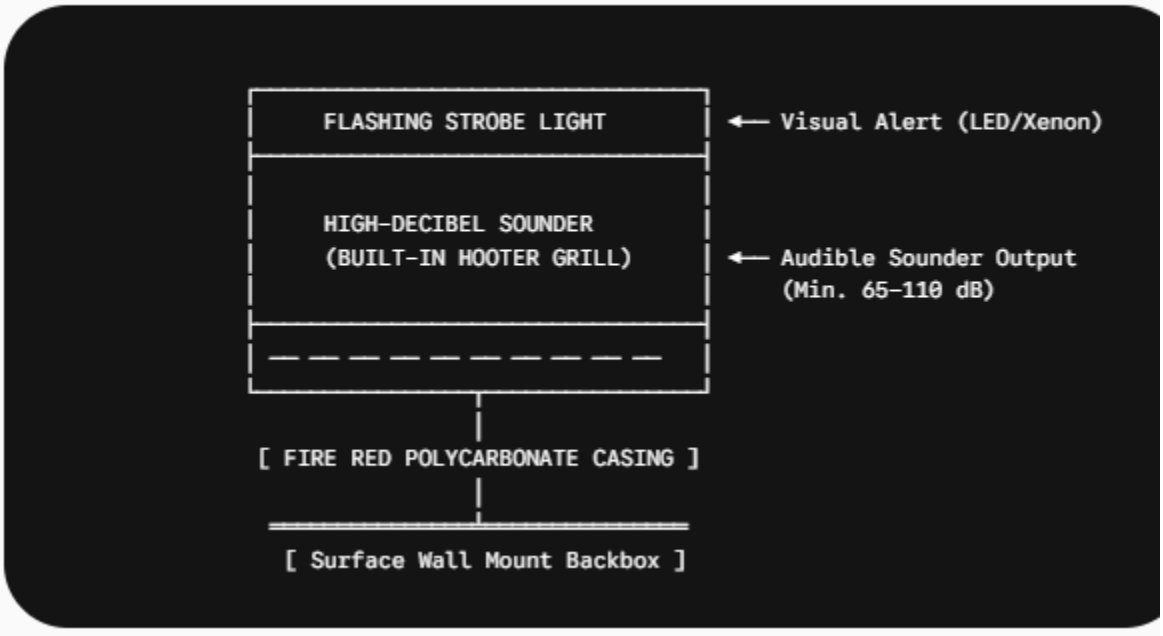
- **Electronic Hooters / Sirens:** High-decibel sounders generating continuous or dual-tone wailing sounds.
- **Strobe Lights / Flashing Beacons:** High-intensity Xenon or LED flashing visual alerts mounted alongside audible sounders.

- **Public Address (PA) / Voice Evacuation Systems:** Integrated speakers that broadcast clear, pre-recorded or live voice instructions to prevent panic during evacuation

Sketch 1: Basic Addressable Fire Alarm System Layout




Sketch 2: Electronic Hooter / Siren with Strobe Light



## 5. Key Technical Standards and Requirements (IS 2189 / NBC)

| Parameter / Feature | Standard Requirement / Specification |
|---|---|
| **Primary Code (India)** | **IS 2189** (Automatic Fire Detection & Alarm Code) |
| **Audible Sound Level** | Minimum **65 dB(A)** or **5 dB(A) above ambient noise** (Max 110 dB) |
| **Sounder Frequency** | 500 Hz to 1000 Hz (Dual-tone wail / sweep signal) |
| **Standby Power Supply** | Battery backup for **24 hours normal duty + 30 minutes alarm duty** |
| **Manual Call Point (MCP) Height** | Mounted **1.2 m to 1.4 m** above finished floor level near exits |
| **Wiring Requirements** | Fire-resistant / Armored copper cables (e.g., FRLS grade) |

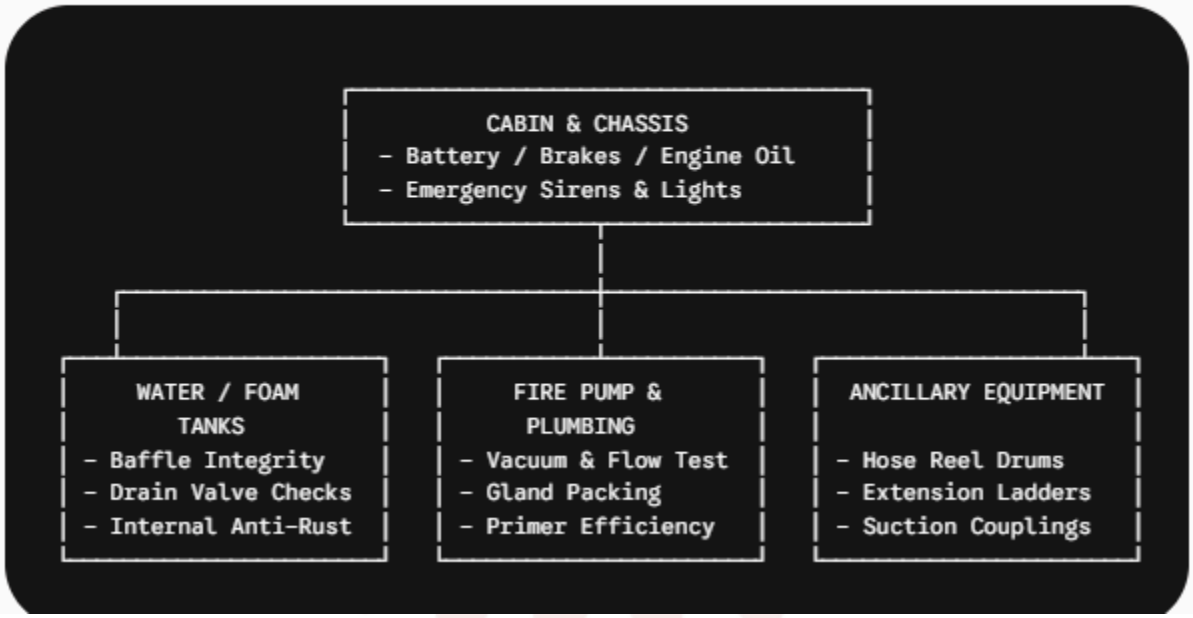
**Maintenance of Fire Trucks:**

Maintenance of fire trucks (fire tenders) ensures maximum operational readiness, prevents mechanical failure during emergency turnouts, and extends vehicle service life in compliance with Indian Standards (IS 951, IS 6067) and the Motor Vehicles Act.

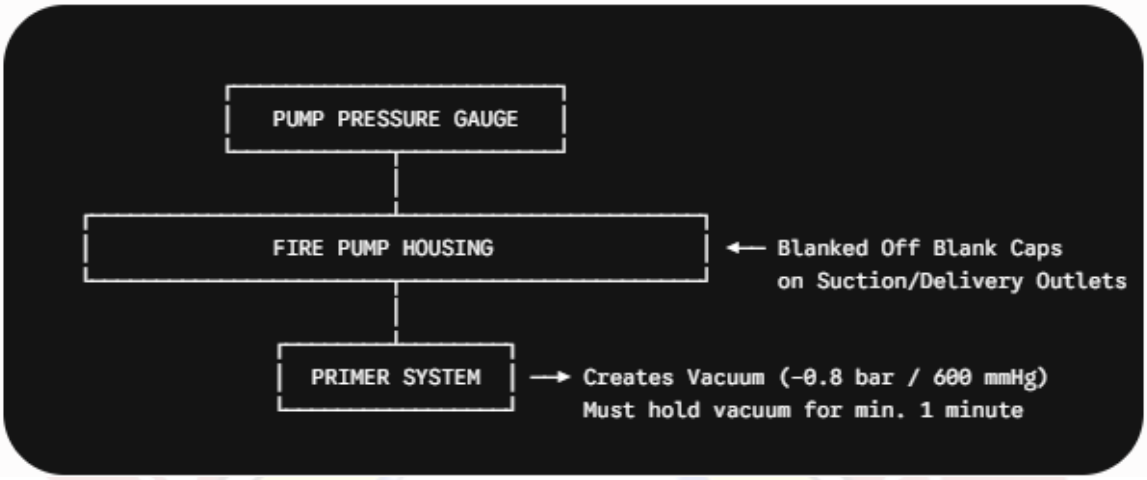
**Categories of Maintenance Schedules**

- **Daily Inspection (First-Line Check):** Performed by the driver/operator at the start of every shift (e.g., fuel level, battery, air pressure, sirens, water tank level).
- **Weekly / Monthly Preventive Maintenance:** Systematic servicing including filter replacements, pump packing adjustments, greasing swivel joints, and testing auxiliary gear.
- **Annual Overhaul & Performance Testing:** Comprehensive mechanical overhaul, engine calibration, structural integrity checks, and full hydrostatic/vacuum pump testing.

Sketch 1: Key Maintenance Sub-Systems of a Fire Truck



Sketch 2: Pump Vacuum Test Setup (Crucial Maintenance Test)




**Maintenance Checklist by Sub-System**

**1. Engine & Chassis Maintenance**

- **Fuel & Oil:** Maintain fuel tank above 3/4 capacity at all times. Check engine oil, coolant levels, and transmission fluid daily.
- **Electrical & Battery:** Test 12V/24V batteries, alternator output, flashing light bars, multi-tone sirens, and searchlights.
- **Brakes & Tyres:** Inspect air brake tank pressure (maintain above 6–8 kg/cm^2), check tyre tread depth, and maintain inflation pressure.

**2. Fire Pump & Priming System**

- **Dry Vacuum Test:** Seal all outlets with blank caps, run the primer to create a vacuum of at least 600 mm Hg (0.8 bar). Vacuum drop should not exceed 50 mm Hg per minute.
- **Gland Packing & Seals:** Inspect mechanical shaft seals and adjustable gland packing. Allow a minor cooling drip rate (10–15 drops/min) during operation to prevent overheating.
- **Impeller & Strainers:** Clean suction strainers and flush internal pump casings to clear sediment or rust.

**3. Water / Foam Tanks & Piping**

- **Tank Integrity:** Inspect internal anti-surge baffle plates and anti-corrosion epoxy coatings. Clean sediment drain valves.

- **Valves & Couplings:** Lubricate quick-acting ball valves, delivery landing couplings, and suction threads with graphite grease.

**Fire Truck Maintenance Log Matrix**

| Maintenance Frequency | Key Inspection Items | Governing Code / Standard |
|---|---|---|
| **Daily (Shift Change)** | Engine start-up, water tank level, siren/lights, brake air pressure. | Fire Service Rules / IS 951 |
| **Weekly** | Dry vacuum test, hose reel operation, PTO (Power Take-Off) engagement. | IS 6067 |
| **Monthly** | Battery electrolyte levels, foam proportioner testing, ladder locks greasing. | OISD-STD-115 / NBC |
| **Annually** | Hydrostatic pressure test of pump (1.5x working pressure), deep lift flow test. | IS 1370 / Motor Vehicles Act |

**Foam Generators:**

In fire engineering, a foam generator is a specialized mechanical device designed to mix water, foam concentrate, and air in precise proportions to produce large volumes of fire-extinguishing foam.Foam generators are primarily used for Medium Expansion and High Expansion foam applications, enabling rapid total flooding of enclosed, hard-to-reach areas such as basements, cable tunnels, aircraft hangars, and ship holds.

1. Classification by Foam Expansion Ratio

Low Expansion Foam (< 20:1): Produced by foam branchpipes and monitors; used for open flammable liquid spills (petrol tanks).

Medium Expansion Foam (20:1 to 200:1): Produced by medium expansion branchpipes/generators; creates a thick blanket over liquid spills in bunded areas.

High Expansion Foam (200:1 to 1000:1): Produced by powered foam generators; rapidly fills three-dimensional volumes to extinguish fires by total encapsulation, smothering, and cooling.

2. Working Principle of a Foam Generator

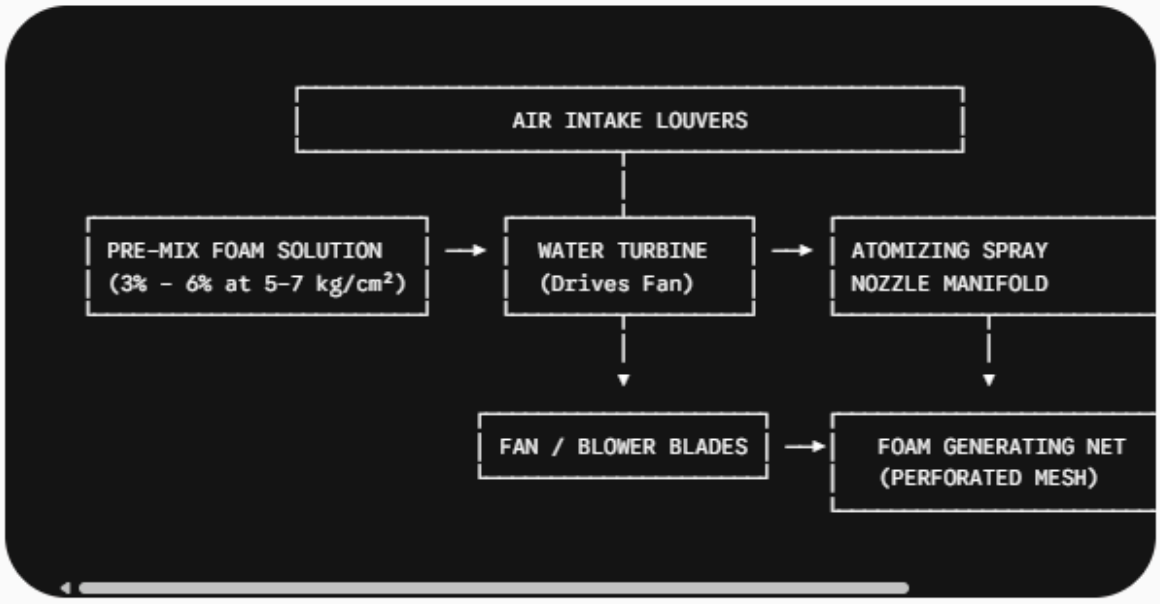
Solution Supply: A pre-mixed solution of water and foam concentrate (typically 3% or 6% ratio) is delivered under pressure to the generator nozzle.

Atomization: The internal spray nozzles atomize the solution into a fine mist directed toward a porous screen or mesh net.

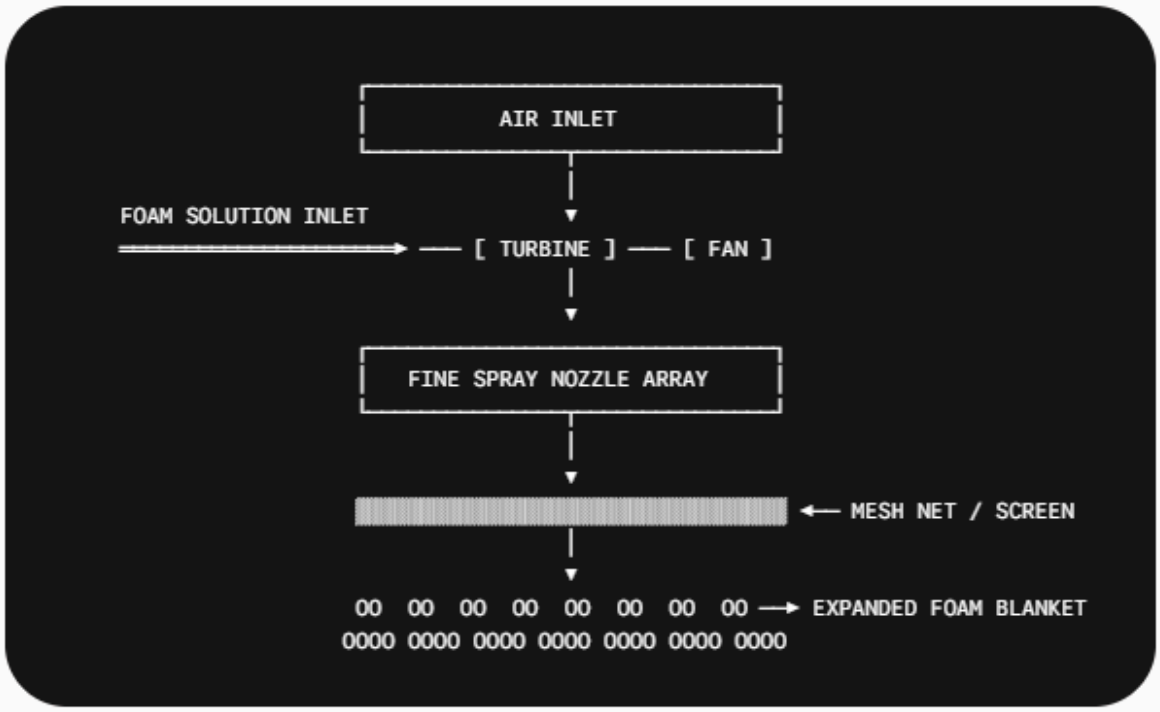
Air Entrainment: Air is introduced into the chamber—either drawn naturally via a venturi effect or forced through an internal water-turbine-driven fan.

Foam Bubble Generation: As the solution mist and high-velocity air pass simultaneously through the mesh net, surface tension forms billions of lightweight, uniform foam bubbles.

Sketch 1: Water-Turbine Driven High Expansion Foam Generator




Sketch 2: Cross-Sectional View of High Expansion Generator



## 4. Major Components of High Expansion Generators

- **Foam Solution Inlet & Bypass Valve:** Connects to 63mm instantaneous fire hose fittings; includes a bypass valve to adjust water flow to the turbine.
- **Water Turbine:** Powered directly by the water pressure of the incoming foam solution, driving the internal fan without requiring external electrical power.
- **Blower Fan:** Draws ambient air at high velocity to achieve high expansion ratios.
- **Spray Manifold / Nozzles:** Disperses the foam solution evenly across the entire surface area of the mesh.
- **Foam Screen / Net:** Stainless steel or nylon mesh screen where air and liquid mist combine to create foam bubbles.

## 5. Applications in Fire Engineering

- **Basements & Underground Car Parks:** Rapidly fills large subterranean spaces where smoke visibility is zero and physical entry is hazardous.
- **Cable Vaults & Tunnels:** Smothers deep-seated electrical cable insulation fires.
- **Ship Holds & Engine Rooms:** Flood-extinguishes enclosed machinery areas.
- **Hazardous Chemical Warehouses:** Prevents toxic gas vapor release and smothers flammable liquid pools.

## 6. Key Indian Standards

| Parameter / Element | Standard / Guideline | Requirement / Specification |
|---|---|---|
| **High Expansion Foam Systems Code** | **IS 12835** | Code of practice for fixed high-expansion foam systems. |
| **Foam Concentrate Specifications** | **IS 4989** | Synthetic, AFFF, and High Expansion concentrate requirements. |
| **Foam Equipment & Branchpipes** | **IS 10502** | Design and performance guidelines for foam equipment. |

| | | |
|---|---|---|
| **Expansion Ratios** | **NBC Part 4** | High expansion: > 200:1; Medium expansion: 20:1 to 200:1. |
| **Operating Pressure** | **Standard Field Specs** | Nominal working pressure of 5.0 to 7.0 $kg/cm^2$ at the inlet. |

**Escape from Fire Rescue Operations:**

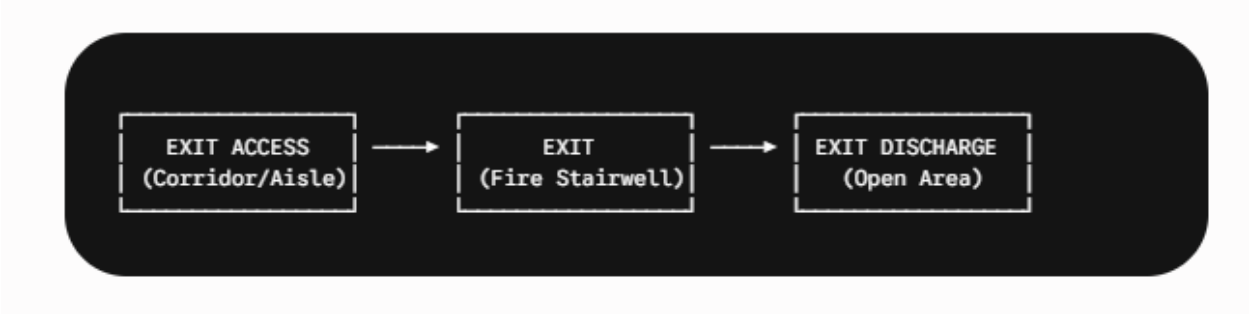
In fire engineering, **escape and fire rescue operations** refer to the techniques, structural pathways, and tactical procedures designed to safely evacuate building occupants and perform search and rescue during a fire emergency.

As per the **National Building Code (NBC) Part 4 (Fire & Life Safety)** and Indian diploma curricula, escape and rescue operations are divided into **Self-Evacuation (Means of Escape)** and **Fire Brigade Rescue Operations**.

## 1. Components of Means of Escape (Egress Architecture)

Occupant escape relies on an uninterrupted, fire-protected path consisting of three primary stages:

1. **Exit Access:** The corridor or aisle leading to a safe exit. Maximum travel distance is usually restricted to **22.5 m to 30 m** depending on occupancy.
2. **Exit:** A fire-rated enclosed component (e.g., pressurized fire tower or smoke-proof staircase with fire doors) providing continuous safety.
3. **Exit Discharge:** The final door discharging directly into an open space or safe public thoroughfare.



## 2. Special Architectural Escape Features

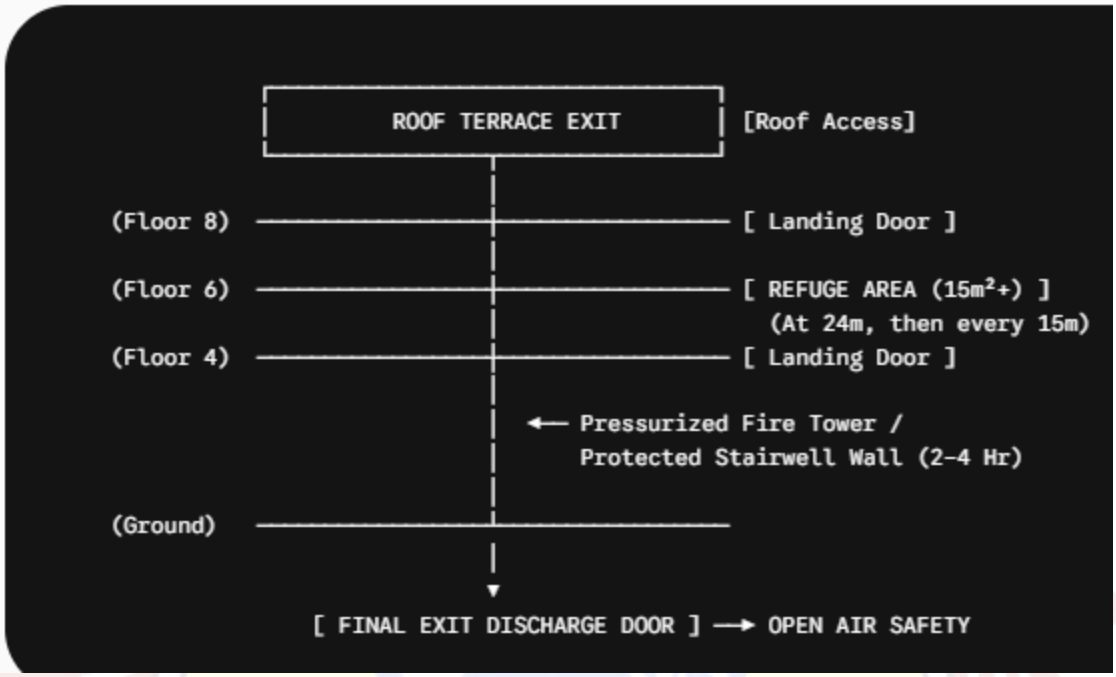
- **Pressurized Staircases:** Air blowers inject outside air into stairwells to create positive pressure, keeping smoke out when fire doors open.
- **Refuge Area:** A protected, fire-resisting space inside high-rise buildings designed for occupants to wait safely during phased evacuation. Mandatory at **24 meters height** and every **15 meters height thereafter** in buildings >24 m.
- **Horizontal Exit:** A fire-resisting wall or door partition dividing a floor into two distinct zones, allowing occupants to escape horizontally to a safe area on the same level.

## 3. Fire Brigade Rescue Operations & Equipment

When primary egress routes are compromised by heavy smoke or fire, emergency responders deploy specialized rescue gear:

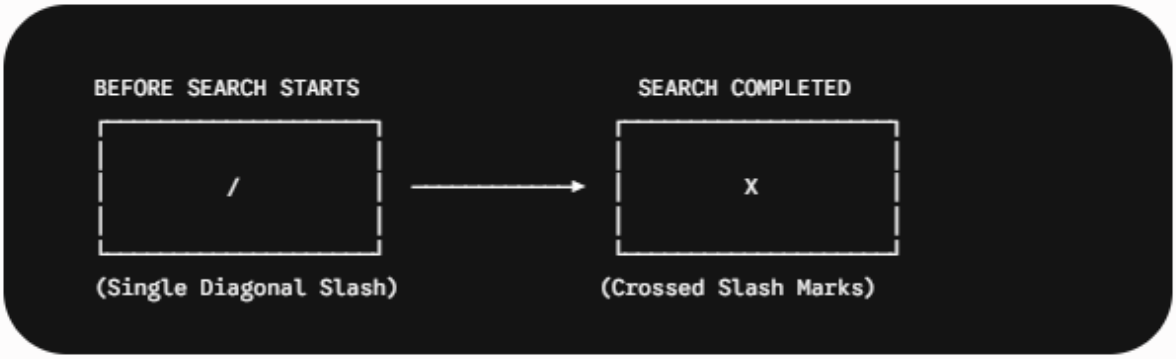
- **Extension & Hook Ladders:** Used for second/third-floor window and balcony rescues.
- **Aerial Hydraulic Platforms & Turntable Ladders (TTL):** Truck-mounted articulated boom platforms used to reach victims trapped on high-rise upper floors.
- **Inflatable Cushion / Rescue Jump Pad:** Deployed at ground level directly below windows for emergency low-height jumps when all exit routes are blocked.
- **Continuous Escape Chutes:** Heat-resistant fabric tubes allowing rapid sliding evacuation from multi-story windows.

## Sketch 1: High-Rise Escape & Refuge Area Layout (NBC Part 4)




## Sketch 2: Tactical Search & Rescue Pattern (Slash Marking System)

Firefighters use standard markings on doors during systematic search operations to manage team accountability: FSM.How (Facility & Servic...



## 5. Summary Table

| Parameter / Feature | NBC Part 4 / Indian Standard Provision |
|---|---|
| **Minimum Staircase Width** | **1.25 m** (Residential), **1.5 m** (Educational), **2.0 m** (Assembly/Hospitals) |
| **First Refuge Area Requirement** | Mandatory at **24 m height**, then every **15 m** above |
| **Max Travel Distance** | **22.5 m** (Un-sprinklered), **30 m** (Sprinklered business/industrial) |
| **Fire Door Rating** | Minimum **2 Hours Fire Resistance Rating (FRR)** with panic bar release |
| **Smoke Pressurization Level** | **50 Pa** differential pressure in stairwells against adjacent spaces |

**Fire Drills**:

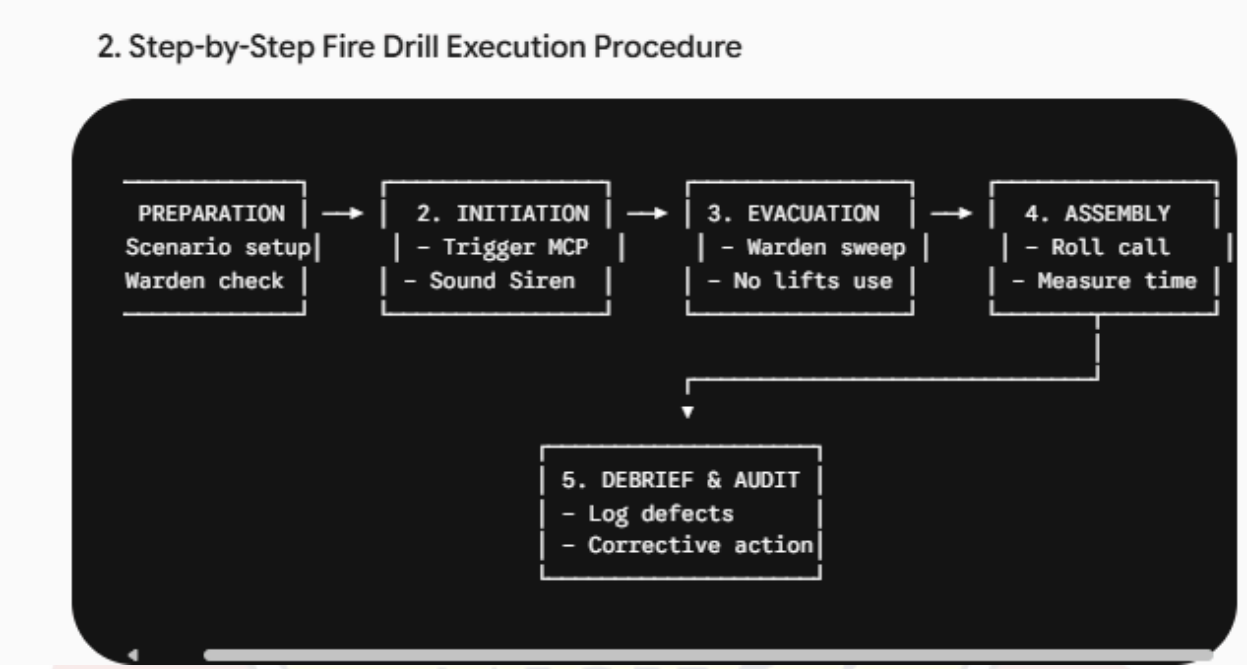
In fire engineering, a **fire drill** is a simulated, supervised emergency practice designed to rehearse building evacuation procedures, test life safety systems, and train occupants and fire wardens on systematic action during a fire.

In India, fire drills are governed by the **National Building Code (NBC) Part 4 (Fire & Life Safety)** and the **State Fire Services Act**. As per NBC 2016 Annex D, fire drills must be conducted **at least once every 3 months for the first two years** after building commissioning, and **at least once every 6 months thereafter**.

## 1. Key Objectives of a Fire Drill

- **Inculcate Muscle Memory:** Prevents panic by training occupants to automatically use protected staircases instead of lifts.

- **Test Emergency Infrastructure:** Verifies the operation of Manual Call Points (MCPs), sounders, strobes, public address (PA) systems, and automatic door releases.
- **Verify Warden Readiness:** Evaluates floor wardens on floor sweeping, accounting for occupants, and assisting non-ambulant persons to designated refuge areas.
- **Identify Bottlenecks:** Pinpoints delayed response times, blocked escape routes, locked emergency doors, or audio dead zones.




**Planning & Scenario Creation:** A fake origin of fire is decided (e.g., electrical shaft on Floor 3).

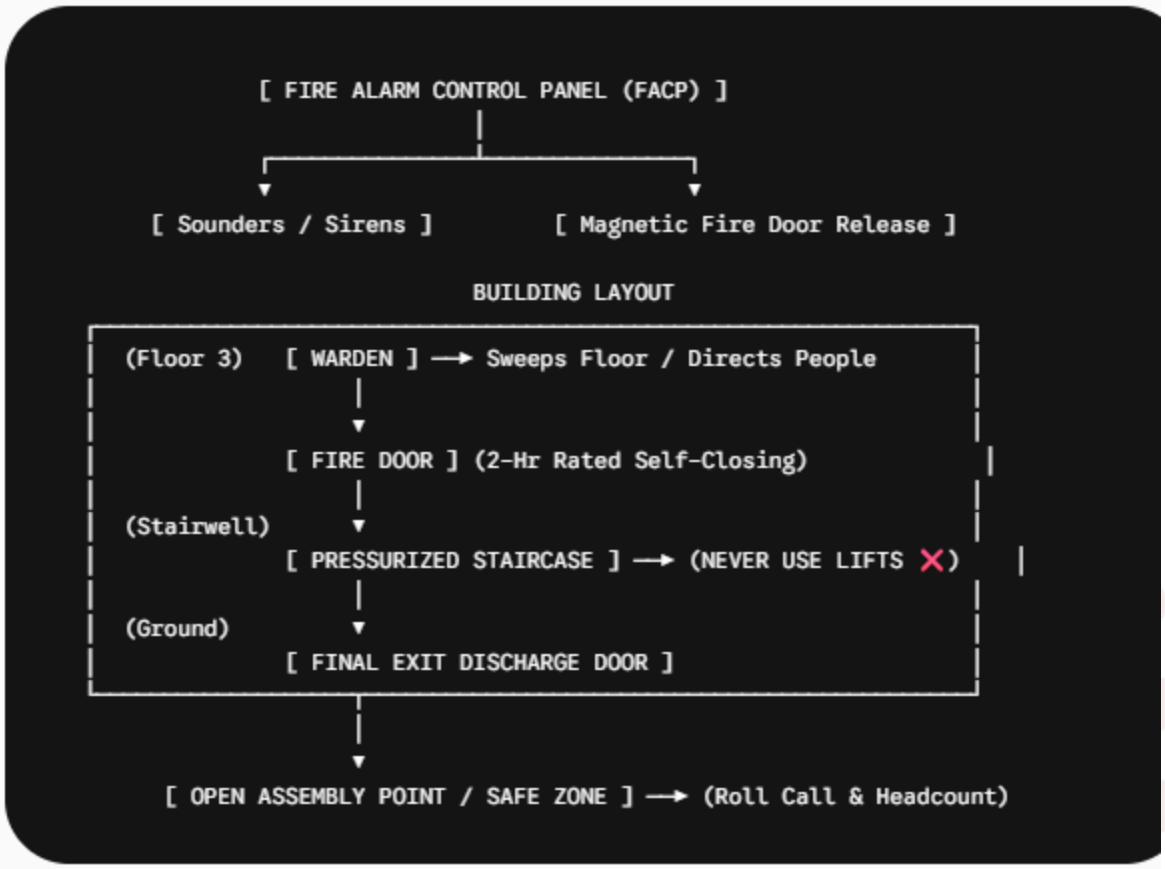
**Alarm Initiation:** The drill begins by breaking/activating an MCP or triggering a real alarm signal.

**Phased Evacuation:** Floor wardens sweep their respective floors, check washrooms, close doors behind them, and direct occupants down pressurized staircases.

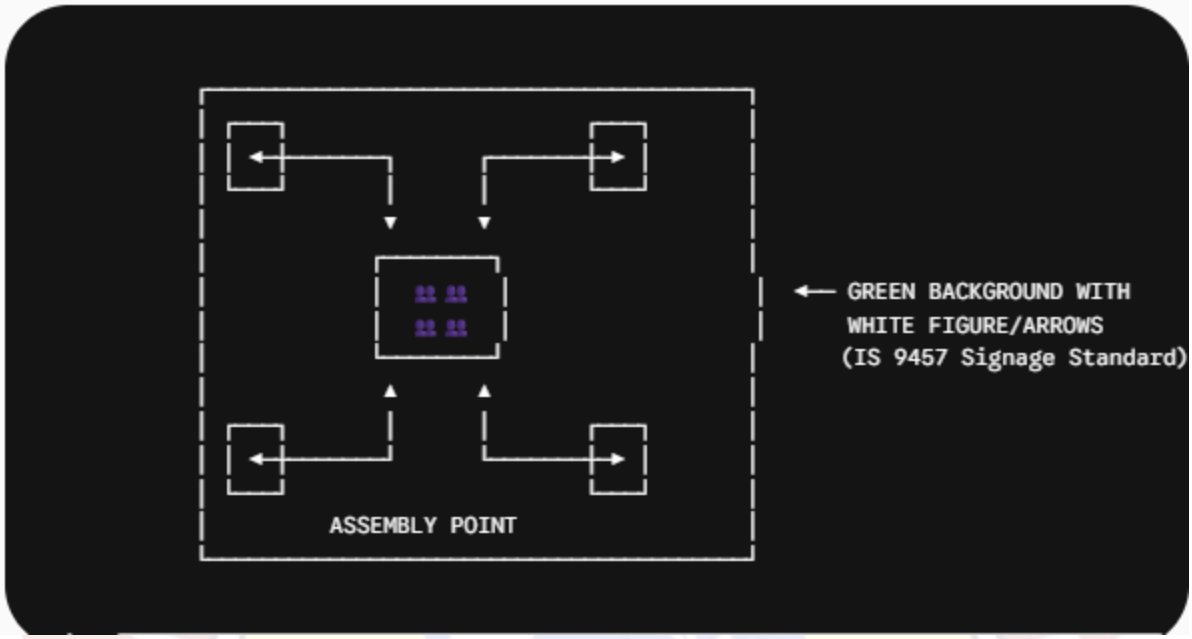
**Assembly & Accountability:** Occupants gather at the designated Assembly Point outside the building to undergo a roll-call check.

**Debrief & Logbook Entry:** Emergency leads measure total evacuation time and record all observations in the official Fire Safety Register.

Sketch 1: Building Evacuation Architecture During a Fire Drill



Sketch 2: Assembly Point Signboard Setup (IS Graphic Standard)




## 4. Roles and Responsibilities During Drills

| Role | Key Duties During Drill |
|---|---|
| **Chief Fire Marshal / Safety Officer** | Initiates drill, monitors overall timing, liaises with municipal fire service, leads debrief. |
| **Floor Fire Wardens** | Wears high-vis vests, clears floor, ensures no one uses elevators, directs movement to stairs. |
| **Searchers / Sweepers** | Checks toilets, server rooms, and remote spaces to confirm complete clearance. |
| **Assembly Point Coordinator** | Maintains attendance registers, performs roll calls, reports missing persons to Chief Marshal. |

**Fire Prevention Notice:**

In fire engineering, a **Fire Protection Notice** (also known as a **Fire Action Notice**) is a standardized, highly visible instructional sign posted along escape routes and key building areas. It provides clear, step-by-step instructions on what actions occupants must take upon discovering a fire or hearing a fire alarm.

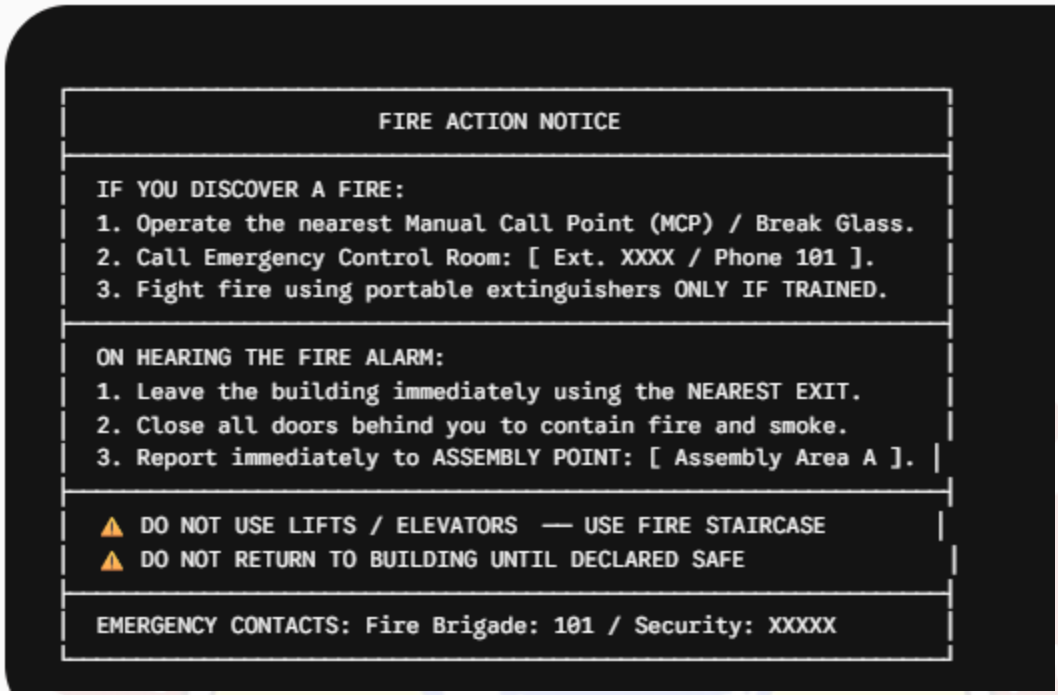
As per the **National Building Code (NBC) Part 4** and **IS 9457 / IS 12349** (Safety Signs and Symbols), these notices serve as vital passive emergency communication tools to prevent panic and ensure orderly evacuation.

## 1. Key Essential Contents of a Fire Protection Notice

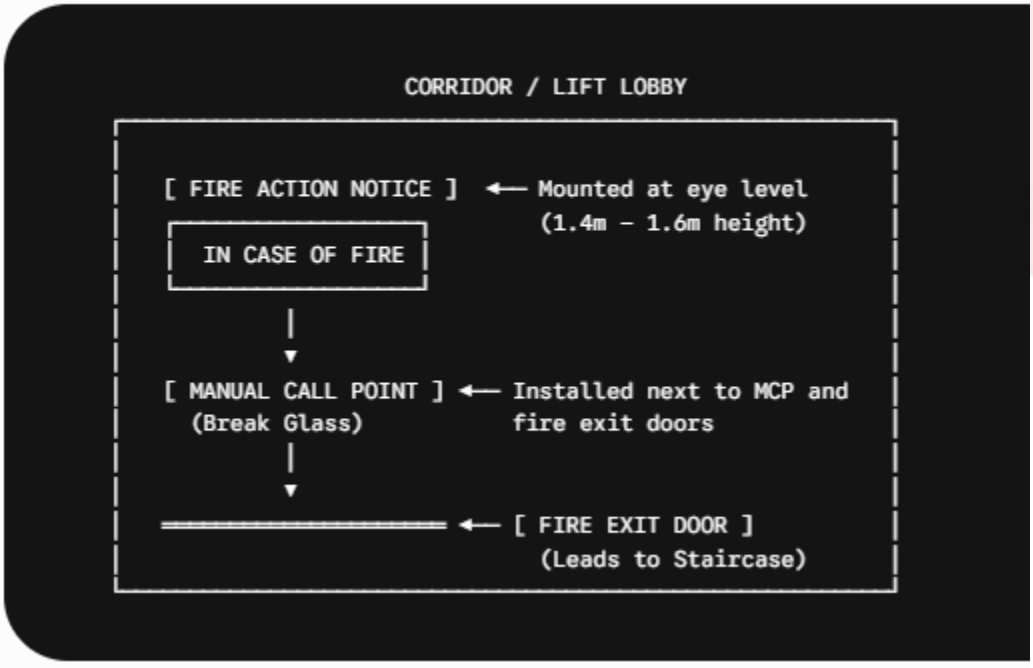
A standard Fire Action Notice is divided into four critical functional sections:

- **Action on Discovering a Fire:** Instructions on raising the alarm immediately via the nearest Manual Call Point (MCP) and notifying the fire control room.
- **Action on Hearing the Fire Alarm:** Immediate evacuation steps, directing occupants to leave the area using designated emergency exit staircases.
- **Prohibition Warnings (Do's and Don'ts):** Critical safety rules, such as **"DO NOT USE LIFTS/ELEVATORS"** and **"DO NOT RUN OR OVERTAKE ON STAIRS."**
- **Assembly Point & Contacts:** Specific location of the external Assembly Point and emergency telephone numbers (e.g., Fire Brigade: 101/112, Plant Emergency Control Room).

Sketch 1: Standard Fire Action / Protection Notice Signboard Format




Sketch 2: Strategic Mounting Locations in a Building



### 3. Color Coding Standards for Safety Signs (IS 9457)

To convey emergency instructions rapidly, Fire Protection Notices utilize standardized safety color schemes as mandated by the Bureau of Indian Standards (BIS):

| Color Scheme | Meaning / Classification | Application Example in Notice |
|---|---|---|
| **Red** | Prohibitive Action / Fire Equipment | "DO NOT USE LIFTS", Fire Hose/Extinguisher locations |
| **Blue** | Mandatory Action | "USE FIRE EXIT STAIRCASE", "CLOSE DOORS" |
| **Yellow / Amber** | Caution / Risk Warning | "WARNING: FLAMMABLE MATERIAL", High voltage risk |
| **Green** | Safe Condition / Egress | "ASSEMBLY POINT", Emergency exit direction signs |

### 4. Placement and Installation Guidelines (NBC Part 4)

- **Mounting Height:** Installed on walls at eye level, typically **1.4 meters to 1.6 meters** above finished floor level.
- **Key Locations:** Mandatory at all exit access corridors, lift lobbies, entry gates, near Manual Call Points (MCPs), and at floor landing entrances to stairwells.
- **Illumination:** Must be constructed with photo-luminescent (glow-in-the-dark) materials or backed by emergency secondary lighting so they remain legible during total power failure or heavy smoke buildup.
- **Language Requirements:** Must be displayed in **English, Hindi, and the local regional language** of the state to ensure universal comprehension by all workers and visitors.

**First Aid for Burns:**

In fire engineering, **first aid for burns** involves immediate life safety protocols, surface cooling, and stabilizing victims before advanced medical help arrives. In India, burn management procedures follow guidelines from the **National Building Code (NBC) Part 4**, the **Factories Act, 1948**, and the **Indian Red Cross Society**.

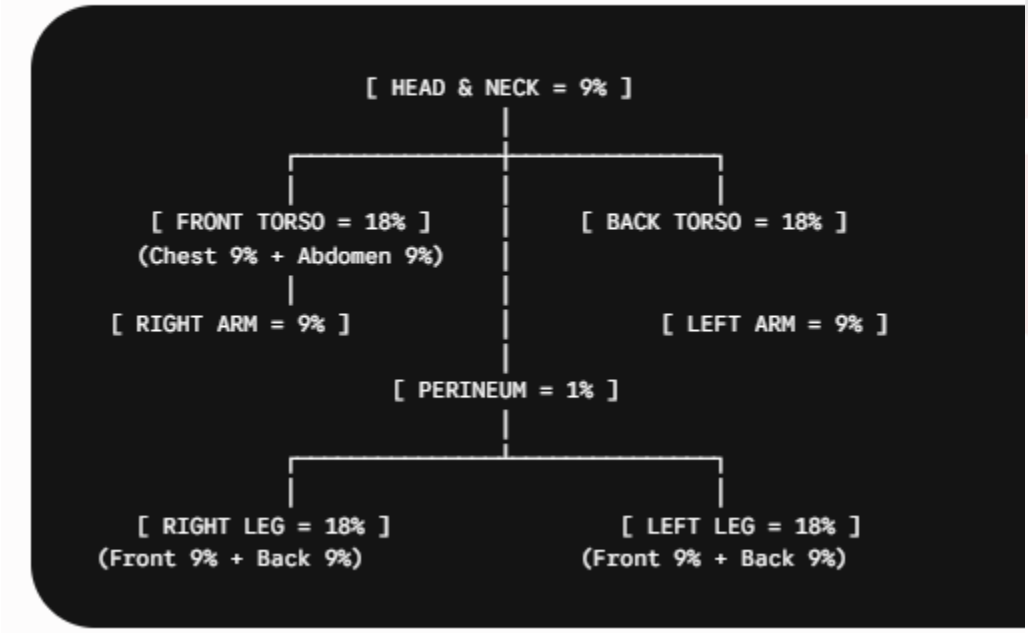
## 1. Classification of Burns by Depth

- **First-Degree (Superficial):** Affects only the outer skin layer (epidermis). Causes redness, mild swelling, and pain (e.g., minor steam burns).
- **Second-Degree (Partial Thickness):** Damage extends into the inner layer (dermis). Characterized by blisters, severe pain, and raw skin.
- **Third-Degree (Full Thickness):** Complete destruction of skin, underlying tissues, nerves, and blood vessels. Skin appears charred, white, or leathery, and may feel painless due to destroyed nerve endings.

## 2. Extent of Burns: Wallace Rule of Nines

For emergency field triage, the total body surface area (TBSA) affected by burns is quickly calculated using the **Wallace Rule of Nines**.

Diploma Exam Sketch (Wallace Rule of Nines):



## 3. Step-by-Step First Aid Protocol (3Cs Method)

### A. COOL (Immediate Thermal Control)

- Cool the burn area with **clean, running tap water** for at least 10 to 20 minutes.
- Do **NOT** use ice, ice water, butter, grease, or ink, as they cause tissue necrosis and introduce severe bacterial infection.

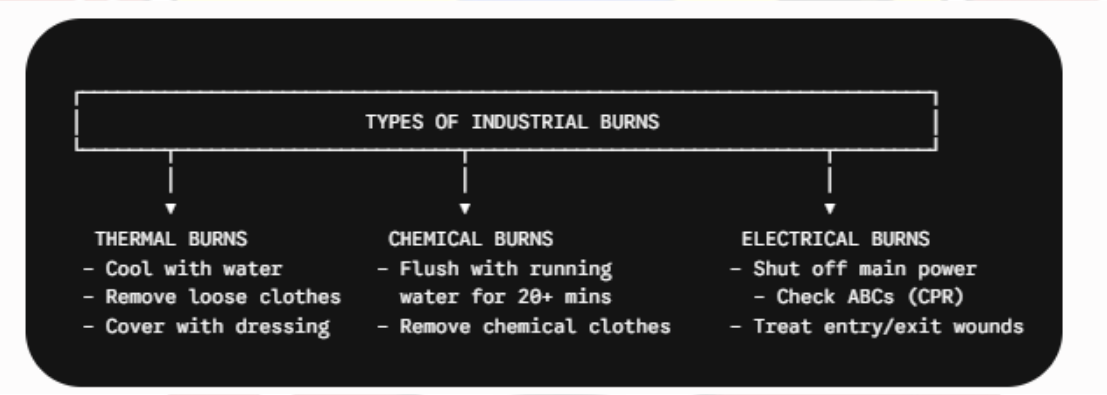
### B. COVER (Protection Against Infection)

- Cover the burn loosely with a sterile, non-adherent burn dressing, clean lint-free cloth, or sterile plastic wrap.
- Do **NOT** pop or puncture blisters, as they act as a natural sterile barrier.

### C. CALL (Emergency Medical Evacuation)

- Arrange immediate transport to a burn unit if the burn covers more than **10% TBSA**, involves chemical/electrical sources, or affects critical areas (face, hands, joints, or airways).

## 4. Specific First Aid Treatment by Burn Type




**Chemical Burns:** Flush affected areas continuously with low-pressure running water for a minimum of **20 minutes** to dilute the chemical agent. Safely strip off contaminated clothing while flushing.

**Electrical Burns:** Isolate the power source before touching the victim. Look for **entry and exit points**, and monitor breathing and pulse continuously (prepare for CPR).

## Summary Table

| Burn Parameter | Standard First Aid Action | Critical Contraindications (DON'Ts) |
|---|---|---|
| **First & Second Degree** | Cool under clean running water for 10–20 minutes; cover loosely. | Do **NOT** pop blisters or apply home remedies (turmeric, paste). |
| **Third Degree** | Cover with sterile dressing, treat for shock, call emergency transport immediately. | Do **NOT** apply water directly to raw third-degree open wounds; do **NOT** pull off melted clothing stuck to skin. |
| **Chemical Exposure** | Continuous emergency water shower flushing for 20+ minutes. | Do **NOT** attempt to neutralize acids with alkalis (causes thermal reaction). |
| **TBSA Threshold** | Refer to a specialized burn center if TBSA > **10%**. | Do **NOT** delay transport for minor treatments. |

----------X----------

CENTRAL POLYTECHNIC COLLEGE
IN
LABORE
HONOR
CHENNAI