International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 4, Issue 9
September 2017

Fire Fighting

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ABSTRACT

The Paper aims to study of importance of fire fighting in a building.Firefighting requires skills in combating, extinguishing, and preventing fires, answering emergency calls, operating and maintaining fire department equipment and quarters, and extensive training in performing firefighting and rescue activities. Firefighters must also have (or be able to acquire) knowledge of department organizations, operations, and procedures, and the district or city street system they will have to negotiate in order to perform their duties.

They must meet minimum physical fitness standards and learn various firefighting duties within a reasonable period,including how to provide other community services in addition to firefighting.

INTRODUCTION

A. FIRE FIGHTING

Firefighting is an emergency allocation of resources, required to deal with an unforeseen problem (Refer Fig.1). Generally they can be classified into two categories:

Fire protection system are used to alert people that a small fire or some overheating has occurred, and that there is a danger of fire happening soon.

Smoke detectors, and heat detectors, the fire alarm panels, sub-control panels, bells, break-glass can be grouped into this area.

Firefighting system: The firefighting system will be used when a big fire has already started. There is a need to extinguish it. Sprinkler systems, and hose reel systems are some of the systems used for firefighting.

Fig.1: FIRE PROTECTION SAFETY ARCH

International Journal of Engineering Technology Science and Research
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ISSN 2394 – 3386
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A.1 PROBLEMS OF FIRE:

A.1 (a) RADIANT HEAT

Many buildings in fire prone areas use fire resistant materials on the roof and walls, but overlook the most important danger - radiant heat. Heat radiating from the fire through conventional windows will set curtains and other flammable objects on fire inside the building or home within minutes.

SMOKE: A DEADLY HAZARD TO LIFE IN A FIRE

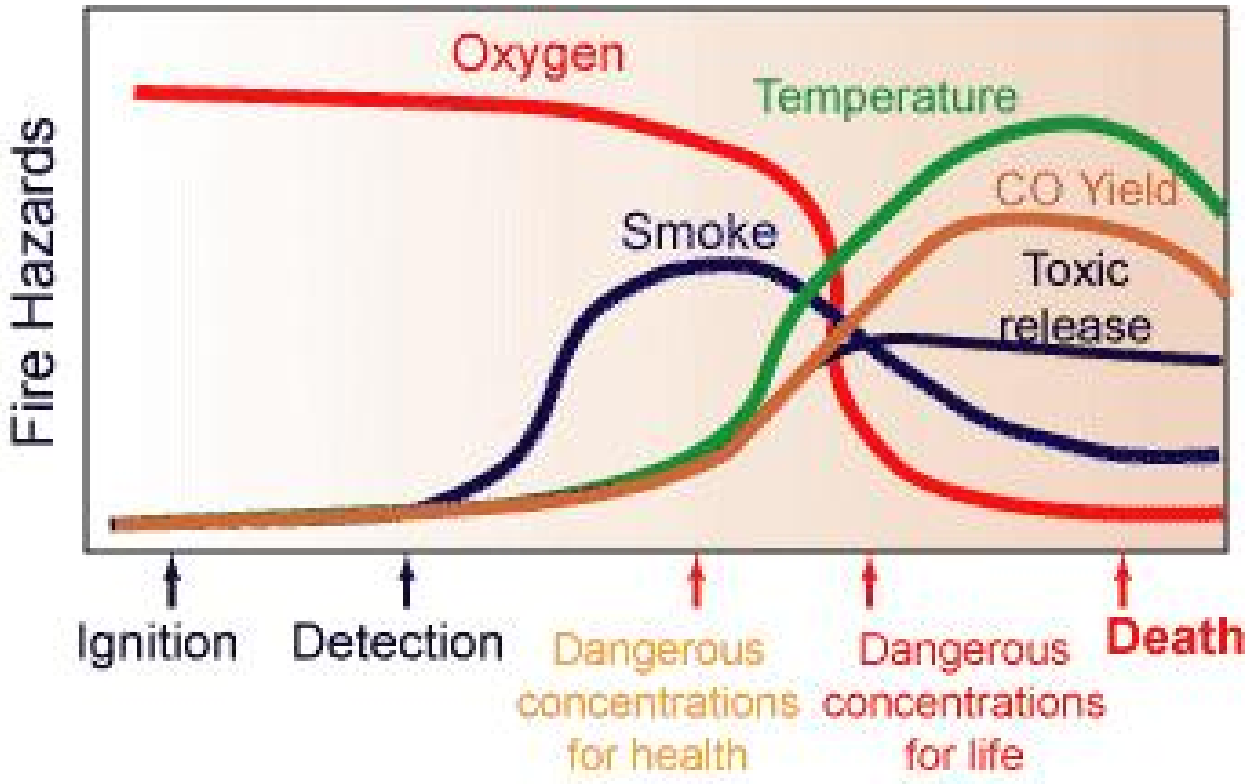

Fig.2: FIRE HAZARD CHART

A.1 (b) SMOKE: A DEADLY HAZARD TO LIFE IN A FIRE

- Smoke from fires is a hot product of combustion.
- Smoke generated during a fire is a hindrance to escape and can be fatal.
- Because smoke is usually much hotter than the surrounding air it has buoyancy and g can move through openings and doors to the top of a building and gradually fill it.
- All the time the heat from the smoke is warming the building and its contents.
- Eventually, other parts of the building, remote from the original fire, can ignite by the heat from the smoke.
- Smoke can spread to different parts of a building (Ref.Fig.3) via ceiling voids, service ducts, lift shafts etc.
- Generally smoke endangers life in a fire situation because: - it reduces visibility including light illumination, - contains poisonous gases.

A.1(c) SMOKE CONTROL SYSTEMS:

Passive smoke control measures (Ref.Fig.6) have been in use for many years. They consist of:

- barriers

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ISSN 2394 – 3386
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- curtains
- gravity venting
- smoke-proof towers
- smoke removal shafts

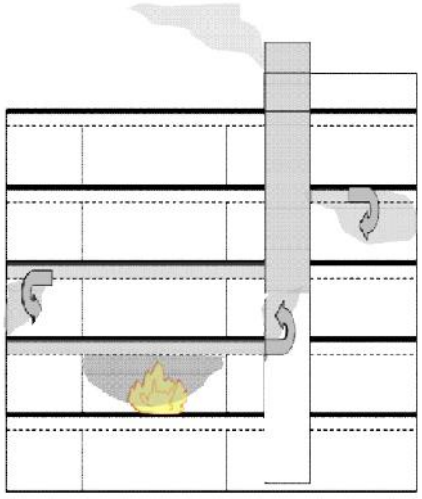

Fig.3: SMOKE SPREAD IN A BUILDING

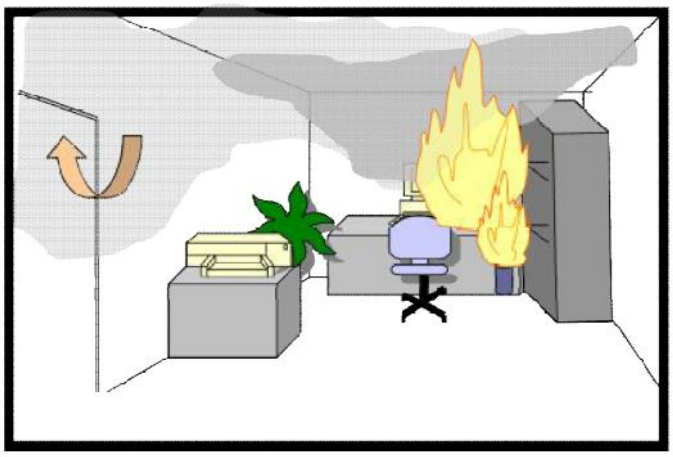

Fig. 4: SMOKE SPREAD IN A ROOM

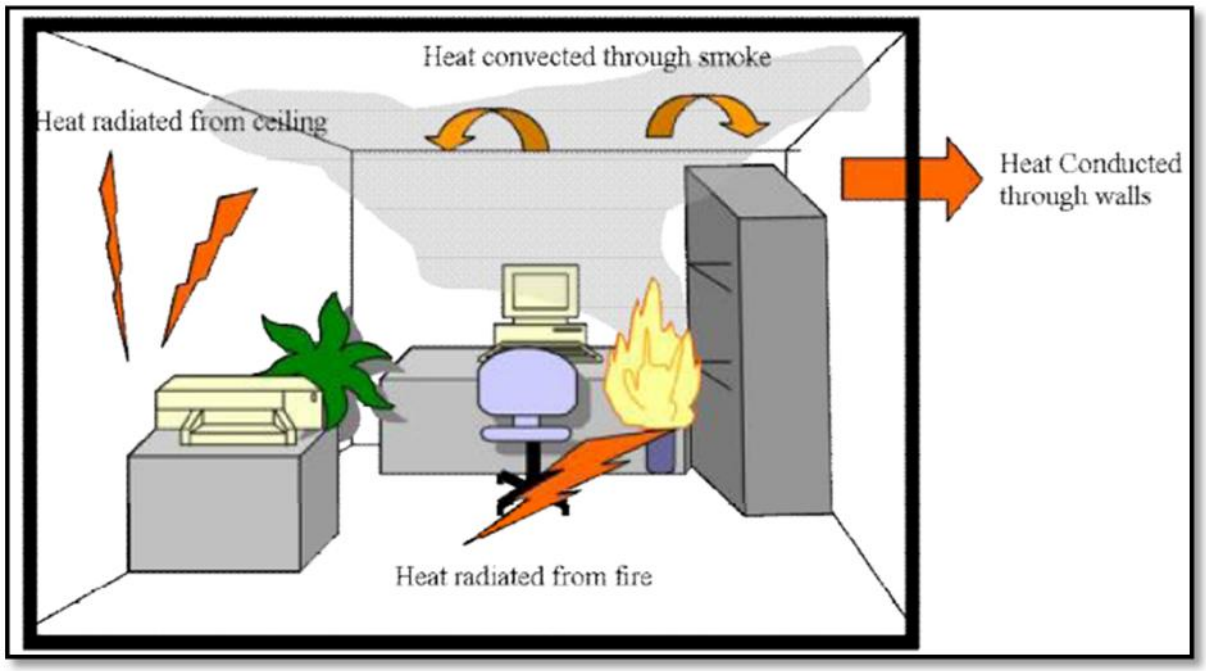

Fig.5: MODES OF HEAT TRANSFER

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ISSN 2394 – 3386
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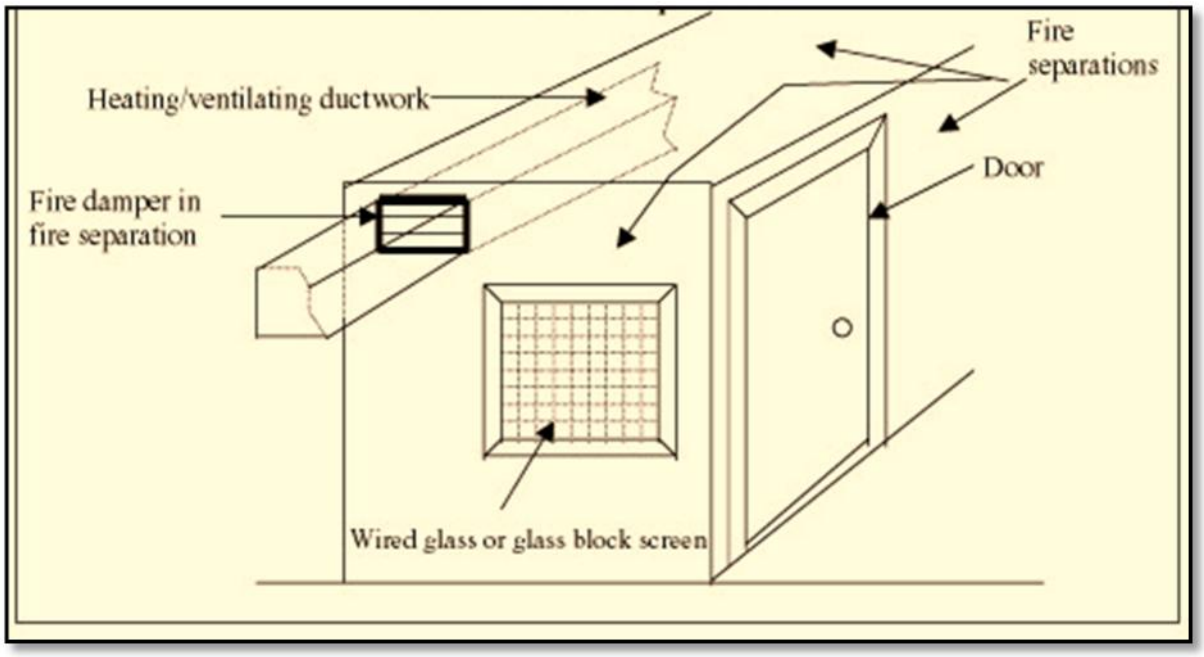

Fig.6: CLOSURES IN FIRE SEPARATION

- Hvac systems

The air handling system in most new high-rise buildings is required by code to have dampers in the system. These dampers are smoke activated and control the spread of fire products from the area of origin to other parts of the building.

- Fire control rooms and stations (Ref.Fig.7)

The room should provide specific information on alarms that have been activated, status of fire protection systems within the building. These rooms or stations frequently have communication systems that allow the transmission of emergency alarms or instructions to building occupants and firefighters alike.

Fig.7: FIRE CONTROL ROOM/STATION

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www.ijetsr.com
ISSN 2394 – 3386
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J Natural ventilation

Natural ventilation takes advantage of a natural resource to aid in the cooling and ventilation of a building. Advantages:

Natural vent system provides excellent air tightness when not required, building's smoke evacuation strategy to further reduce the project's budget, reduce a building's energy consumption:

A.2FIRE DETECTION:

- Fire detection systems aim at detecting the unwanted presence of fire by monitoring environmental changes associated with combustion.
- These systems are designed to notify people to evacuate in the event of a fire or other emergency, to summon emergency services, and to prepare the structure and associated systems to control the spread of fire and smoke.
- Manual Call Points, Isolators, Hooters and Response Indicators are treated as devices and other sensing devices are named as sensors / detectors.
- A fire alarm system consists of interconnected devices and controls to alert building occupants to fire or dangerous conditions and provide emergency responders with information on those conditions.
- Clear and concise information will enable responders to operate efficiently and safely.
- Systems can vary widely in complexity. A basic,fundamental system consists of a control panel, initiating s.

Fig.8 INITIATING DEVICE **Fig.9 CONTROL PANEL** **Fig.10 NOTIFICATION DEVICE**

A.2 (a) TYPES OF FIRE DETECTION SYSTEMS:

- Heat detector
  - Rate-of-rise heat detector
  - Fixed temperature
- Smoke detector
  - Ionization Smoke Detector
  - Photoelectric Smoke Detector
  - Optical Smoke Detectors.
- Beam Detector
- Flame detector

A.2 (a1) HEAT DETECTORS:

- Responds to change in ambient temperature.

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- Heat Detector ideally suited to locations where high sensitivity is required for change in heat and where smoke detectors are found unsuitable for detection of fire.
- Generally, smoke detectors, do not work efficiently in the places where material stores and produces little smoke in the initial stage of out breaking of fire or where adverse environmental conditions are prevailing. Therefore heat detectors are used.
- Rate-of-rise detectors (Ref.Fig.11)

- React to sudden change in ambient baseline temperature.
- A typical alarm may sound when the rate of temperature rise exceeds 12° to 15°F (6.7° to 8.3°C) per minute.

- Fixed temperature(Ref.Fig.12)

- This type of detector reacts when the ambient temperature reaches a fixed point. The most common fixed temperature point is 136.4°F (58°C). Recent technological developments have enabled the perfection of detectors that activate at a temperature of 117°F (47°C), providing increased time to escape.

Fig.11RATE OF RISE DETECTOR **Fig.12 FIXED TEMPRATURE**

A.2 (a2) SMOKE DETECTORS:

- A smoke detector (Ref.Fig.13) is a device that detects smoke. Commercial, industrial, and mass residential devices issue a signal to a fire alarm system, while household detectors, known as smoke alarms, generally issue a local audible and/or visual alarm from the detector itself.

Fig.13SMOKE DETECTOR

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- Detectors sensing the smoke arising out of the bursting of fire are known as **ionization smoke detector**(Ref. Fig.14). **Working** of same is discussed below:
- Invisible products of combustion enter a chamber
- They decrease the current between the –ve& +ve plates
- This causes for circuit break and initiating an alarm signal
- Generally responds faster to flaming fires versus smoldering fires
- Automatically resets when the atmosphere clears

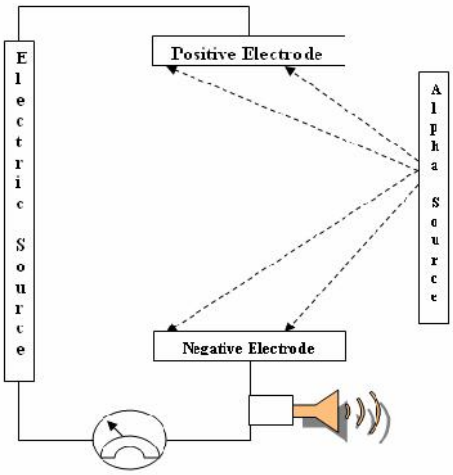

Fig.14 IONIZATION SMOKE DETECTOR **Fig.15 VOICE ALARM**

A.2 (a3) FLAME DETECTORS:

- A flame detector is a detector that uses optical sensors to detect flame.
- TYPES:
  - Ultraviolet
  - Infrared
  - UV/IR
  - IR/IR Flame detection
  - IR/IR/IR Flame detection
  - Visible sensors
  - Video

A.2 (a4) VOICE ALARM:

Voice alarms automatically send a voice evacuation message to speakers in selected areas of high-rises or expansive buildings, hospitals, and other buildings where total evacuation is impractical.The grey panel (Ref.Fig.15) is a voice alarm panel. Thelower window shows the microphone and the manual select switches for the different evacuation zones.

A.3FIRE SUPPRESSION:

Fire suppression systems are used in conjunction with smoke detectors and fire alarm systems to improve and increase public safety.

Fire suppression systems are used to suppress flames in the event of a fire.

There are several methods of suppression systems:-

- Wet sprinkler systems,

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ISSN 2394 – 3386
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- Dry sprinkler systems,
- Deluge sprinkler systems and
- Dry chemical suppression systems

The working principle of fire suppression systems differ for various types, though generally these systems employ a combination of the removal of oxygen and the lowering of the ignition temperature.

The most common method of fire suppression is the lowering of the ignition temperature with large quantities of water. Normal atmospheric oxygen content is approximately 21%. If the percentage falls below 15%, the quantity of oxygen available will no longer support combustion.

To suppress vast fire spots, pressurized water—with or without foams—is extensively used.

A.3 (a) TYPES OF FIRE SUPPRESSION:

- Fire sprinkler systems (wet, dry, pre-action, and deluge)
- Gaseous agents
- Wet and dry chemical agents

A.3 (a1) FIRE SPRINKLER SYSTEMS (WET, DRY, PRE-ACTION, AND DELUGE):

- A grid of pipe work covers all areas of a building.
- Sprinkler heads are fitted into the pipes at regular intervals.
- Water for the system can be pumped from a storage cistern.
- Hydraulic calculation defines sprinkler head spacing & pipe size.

- Layout Systems for Automatic Fire Sprinklers

1. Wet Pipe System
2. Dry Pipe System
3. Deluge System
4. Pre-Action System
5. Mist System
6. Advanced System

- **WET PIPE SYSTEM** (Ref.Fig.16):

- Most common system
- For spaces where there is **no risk of freezing.**
- They are quick to react.
- **Water under pressure is always in the pipe work.**
- Required for **multi-story or high rise buildings.**
- In areas where is greater need for life safety.

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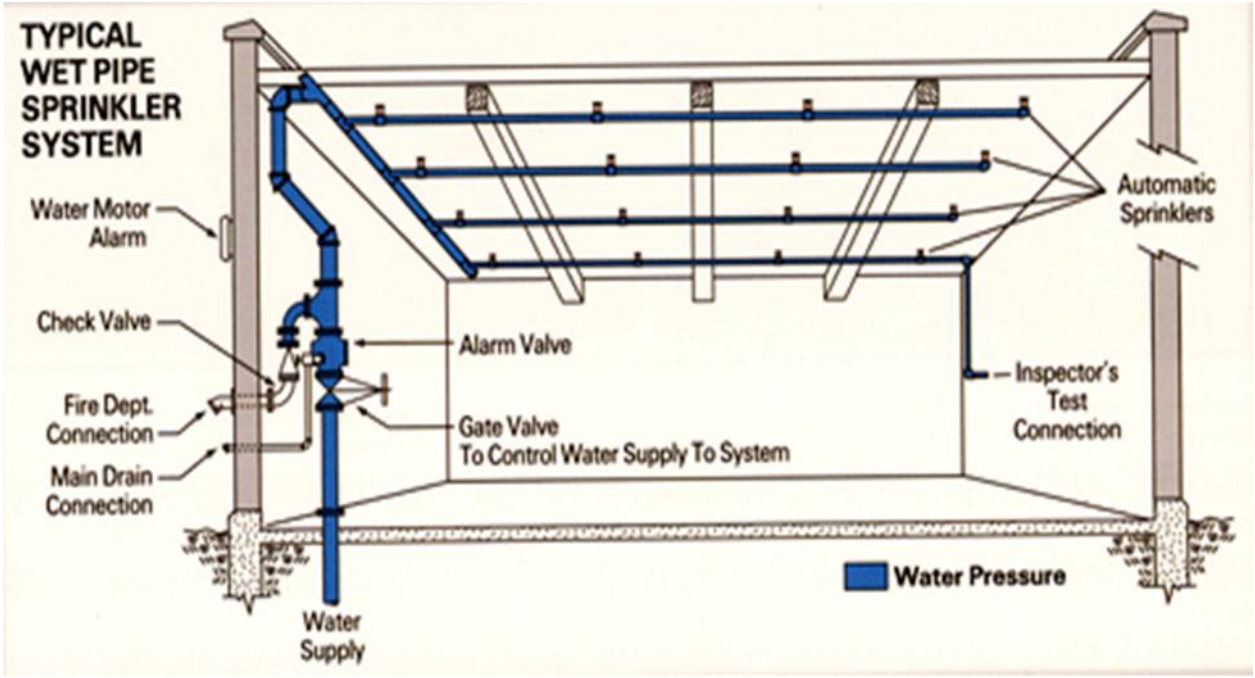

Fig.16WET PIPE SYSTEM

- **DRY PIPE SYSTEM** (Ref.Fig.17):
- Pipe work above the control valves are **filled with air or inert gas under pressure.**
- Below the control valves the pipe work is **charged with water.**
- Sprinkler head operates, the drop in pressure opens the valve.
- Water flows into the pipe work and through the activated sprinkler head onto the fire.
- Dry pipe systems are used **where there is a risk of frost.**

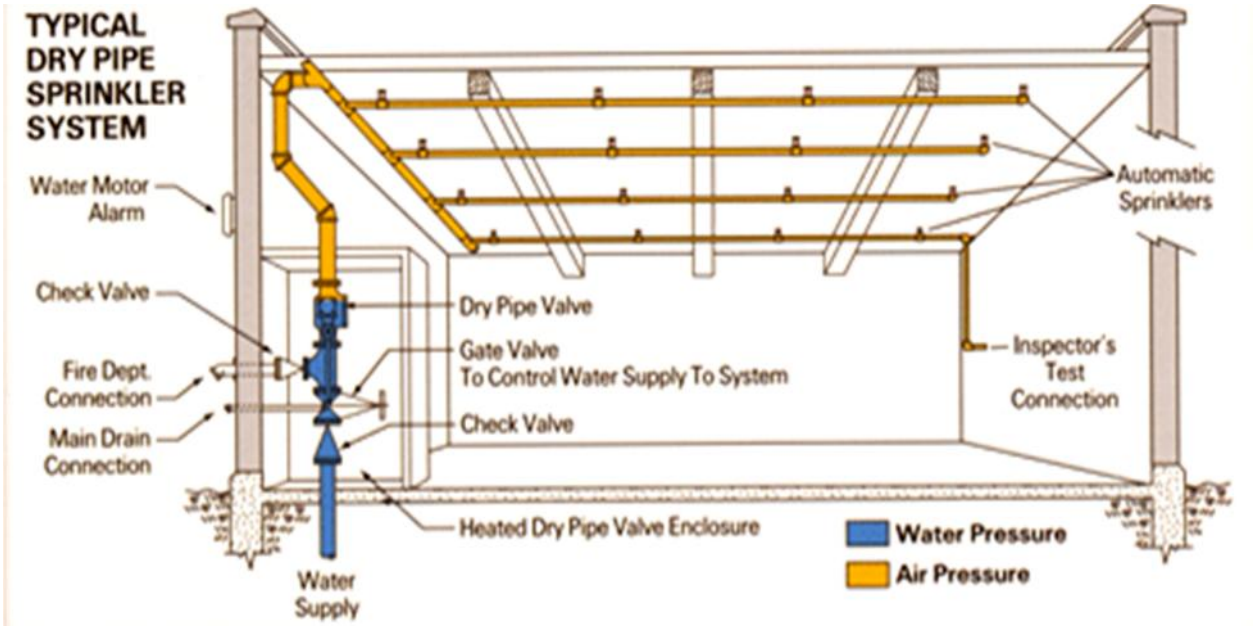

Fig.17DRY PIPE SYSTEM

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www.ijetsr.com
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➢ **DELUGE SYSTEM**:

- Similar to a wet or dry pipe system with two major differences.
- **Standard sprinklers** are used, but they are all open.
- Water will flow from all of the sprinklers simultaneously and deluge the area with water.
- The **deluge valve** is normally closed.
- Valve is opened by activation of a separate fire detection system.
- To control fast-developing fires.

➢ **PRE-ACTION SYSTEM**:

- Similar to dry pipe systems the pipe work is filled with air or nitrogen.
- Water is only let into the pipe work when a detector operates.
- Used where it is not advised to have pipes full of water until there is a fire.
- Suitable for high-value units or equipment like computer stations, biological labs.

➢ **MIST SYSTEM**:

The term 'water mist' refers to fine water sprays in which 99% of the volume of the spray is in drops (less than 1000 microns).

- The use of water mist in fire suppression has following advantages:-
- No toxic and asphyxiation problems
- Low system cost
- Limited or no water damage.

➢ **ADVANCED SYSTEM** (Ref.Fig.18):

- Alternate systems
- Early Suppression Fast Response System
- Extended Coverage System
- Circulating Closed Loop
- Quick Suppression and Early Suppression System

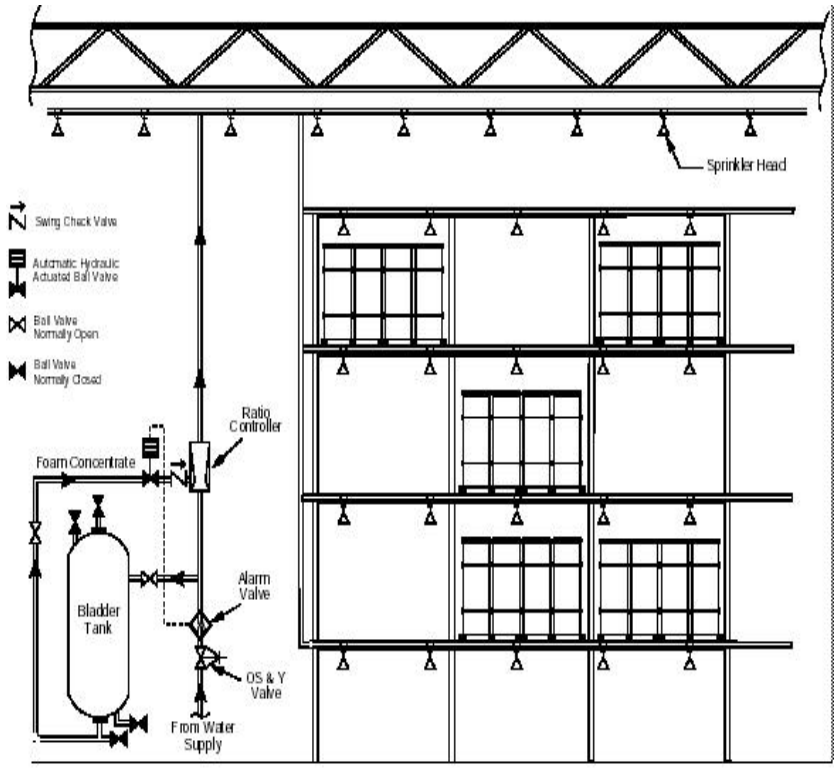

Fig.18ADVANCED SYSTEM

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➢ TYPICAL LAYOUT OF SPRINKLER SYSTEM:

Below images i.e. Fig.19 and 20 shows typical layout of firefighting system in a building.

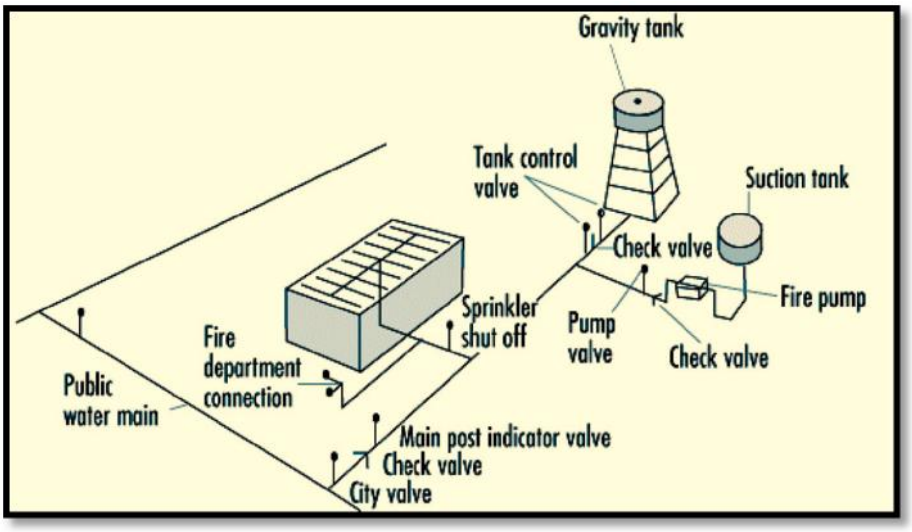
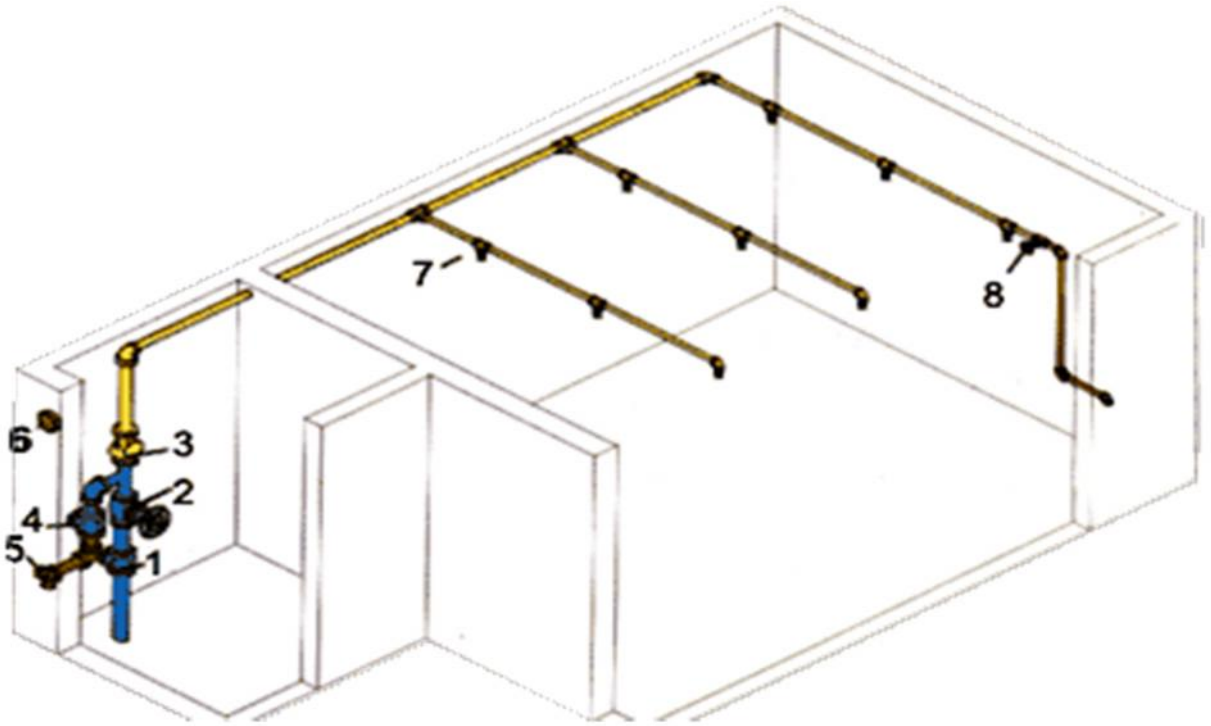


Fig.19SPRINKLER LAYOUT-1



1 – Supply Check Valve
2 – Indicating Valve
3 – Dry Pipe Valve
4 – Fire Department Check Valve
5 – Fire Department Connection
6 – Water Motor Alarm
7 – Automatic Sprinkler
8 – Inspector's Test Valve

Fig.20SPRINKLER LAYOUT-2

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A.3 (a2) GASEOUS SUPPRESSION:

Gaseous fire suppression is a term to describe the use of inert gases and chemical agents to extinguish a fire. It is also known as Clean Agent Fire Suppression. The system typically consists of the agent, agent storage containers, agent release valves, fire detectors, fire detection system (wiring control panel, actuation signaling), agent delivery piping, and agent dispersion nozzles. The agent may be delivered by means of solid propellant gas generators that produce either inert or chemically active gas.

Application:-

There are two methods for applying an extinguishing agent:-

1. Total flooding

Systems working on a total flooding principle apply an extinguishing agent to a three dimensional enclosed

space in order to achieve a concentration of the agent (volume percent of the agent in air) adequate to

extinguish the fire. These types of systems may be operated automatically by detection and related controls

or manually by the operation of a system actuator.

2. Local application

Systems working on a local application principle apply an extinguishing agent directly onto a fire (usually a two dimensional area), or into the three dimensional region immediately surrounding the substance or object on fire. The main difference in local application from total flooding design is the absence of physical barriers enclosing the fire space.

A.3 (a3) SUPPRESSION USING DRY AND WET CHEMICALS AGENTS (Ref.Fig.23):

1. **Automatic fire suppression** systems control and extinguish fires without human intervention.

- **Engineered Fire Suppression Systems** are design specific.

- **Pre-Engineered Fire Suppression Systems** use pre-designed elements to eliminate the need for engineering work beyond the original product design.

2. **Condensed aerosol fire suppression** is a particle-based form of fire extinction similar to gaseous fire suppression or dry chemical fire extinction. The aerosol employs a fire extinguishing agent consisting of very fine solid particles and gaseous matter to put out fires. The condensed aerosol micro particles and effluent gases are generated by the exothermic reaction; until discharged from the device, the particles remain in vapor state. They are cooled and "condensed" within the device and discharged as solid particles.

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