

Fire Accident in Building of Developing Country, India

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Abstract

Fire in building is major threaten for now a days in India. Each year, several people killed, injured and huge losses of property due to building fire accident. To ensure adequate Safety Control measure to avoid fire accident in building is most essential components occupants and owner of building. In past few decade in India, fire Accident occurred time to time in Commercial building, multistoried building, Hospital, shopping mall, Factory warehouse and residential like building and resulted of huge losses of property and lives. Objective to Publish this paper is identify potential risk of fire in building, causes of fire and to ensure adequate fire safety measure to save people lives and protect to property. In this paper, few case studies included to know cause of fire and ensure adequate safety control measure to prevent similar future fire accident.

Key word: Fire Safety in building, Fire Prevention & Control, Cause of Building Fire, Consequence of building Fire, Method to Prevent Building fire, NBC, NFPA

Objective

- Identify Potential risk of fire and minimize or control to building related fire risk.
- Ensure adequate Safety control measure to avoid fire accident in building.
- To save people lives and property.
- To prevent fire to economic growth of society and country.
- Identify and Installation of firefighting system including Fire Fighting, detection and suppression system.
- To ensure engineering measure to use fire resistance Barriers such as walls, partition and floors.
- To create Fire safety awareness among occupants of building.
- To Check and ensure existing control measure is adequate or not to prevent building fire.
- To Ensure Fire related parameter to identify fire related source and control them.

1. Introduction

Fire accident in building is major threatening for developing country. Developed countries have less building fire risk respect to building of developing countries. In Developed Country, Fire Safety rules, regulation, guidelines and codes is strictly enforced, therefore building owner ensure all Fire Safety related compliance, during building design, construction and later to control building fire risk. India is developing country and here are major threaten of fire accident in building. Fire accident results huge losses of lives and property damage. In India, each year fire accident occurs in several building due to negligence and not follow safety rules of building owner or occupant people. Risk, related to fire accident depends on nature of building (such as Commercial building, multistoried building, Hospital, shopping mall, Factory warehouse), existing fire detection & fire fighting system, material used in building and fire safety awareness among occupants of building.



Fig. 1 Sources:

According to NCRB, India in year 2015 total of 18,450 cases of fire accidents were reported in which 17700 people were killed and 1,193 injured. 42.1% deaths were occurred in residential building due to fire accidents. Such Fire accident occurred in different state of India and majority of fire accident occurred in Maharashtra that was 22% of Total fire accident of India.

As per The National Crime Records Bureau Data, Total 113961 People lost their lives due to fire accident during 2010 to 2014. Major death occurred in Maharashtra state and it is approx. 24293. During 2010-14, percentage of women victims are more than man, the number of women victims

was 75039 or 65.8% of all the deaths. The number of male victims on the other hand was 38917 or 34.2% of all the deaths. In year 2010, Fire accident reported was 26025 and in year, 2014 it was reported 19513 there this data shows percentage of accident decrease. The temple fire in Kollam that claimed more than 100 lives has renewed focus on fire accidents. The data available with the National Crime Records Bureau (NCRB) indicates that fire accidents of all types caused more than 1.13 lakh deaths from 2010 to 2014, at a staggering average of 62 deaths per day. Fig. (2), Shows Total numbers of Fire Accident and death during 2010 to 2014.

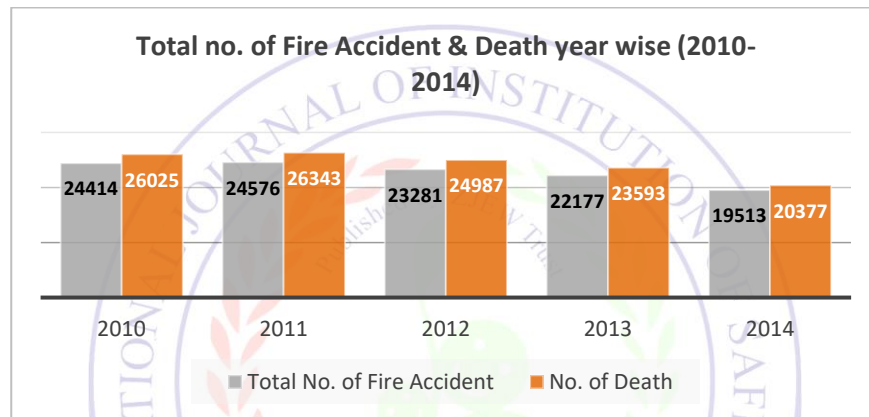


Fig. 2, Sources NCRB,

As per NRCB, Electric short circuit, by fireworks, Gas cylinder and stove bursting are major cause of fire accident and apart from this smoking, use of heater etc. are cause of fire accident. Maharashtra is first state where fire accident occurred more respect to other state of India. Few Indian states name are given in figure (3) that shows total No. of fire accident occurred during 2010-2014 in different state.

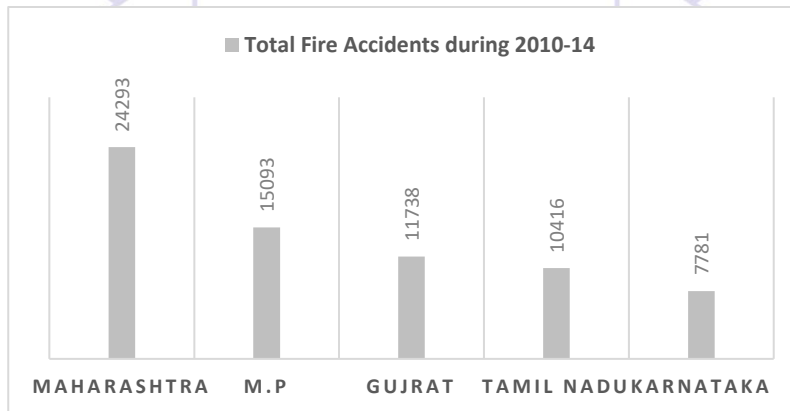


Fig. 3, Sources NCRB,

2. Causes of Fire accident in Building

In building, there may be several cause of fire accident such as electrical Short circuit, Sparking due to loose electrical connection, Over Load electrical equipment, due to cooking appliances, Smoking, use of heater etc. Probability of fire Incident depends on nature of building such commercial, residential, warehouse, public building and presence of potential sources (Flammable materials), that results fire. Commercial building, multistory building, warehouse, hotel like building have potential of high risk of fire due to not follow safety laws and procedures and its results major harm in term of Death and property damage. Causes of Fire in building are:

- Inadequate storage of Combustible material in room of building.
- Cooking and cooking appliances, Heater, Oven used in building,
- Short circuit, loose electrical connection or overload electrical equipments and systems, Static electricity.
- Use of Candles and lighting, Smoking in building
- Flammable material storage or Fuel (LPG) gas cylinder storage near heat sources or live electrical equipment in building area.

Apart from this Fire Crackers, bursting of stove like factor also responsible to cause of fire.

In building, poor fire safety Parameter consideration during design such as fire exit, adequate height of building, ventilation, un-availability of fire fighting and detection system increases risk of fire. Poor method of flammable material storage and unawareness of Safety among people always also create risk and potential of fire accident occurring.

According to the National Fire Protection Association (NFPA), the most common causes of fires in commercial buildings are cooking equipment, heating equipment, electrical equipment and system, Smoking cigrates. Common cause of building fire are given in **Figures 4**.



Cooking



Heating



Electrical equipment (Loose connection/Overload equipment)



Smoking



Candles



Hot Job near Combustible materials/ Fuel (C₂H₂/LPG) cylinder

Fig. 4, Common causes of building fire

As per case study carried out by Institution of safety Engineers (India) in month Dec. 2019, To collect data from different sources such as newspaper, Internet of past decade occurred fire accident and found that major numbers of fire accident were occurred, due to malfunction of electrical equipment and system including short circuit, sparking due to loose electrical connection, overload electrical equipments, electrical heater and second cause of fire accident are cooking and cooking appliances. Third cause is intentional fire such as misuse of heat source e.g child playing with lighter, matches, use of fire crackers, criminal activities etc. Apart from this flammable material storage near heat source, use of candles and incense stick, smoking were also cause of building fire in few cases.

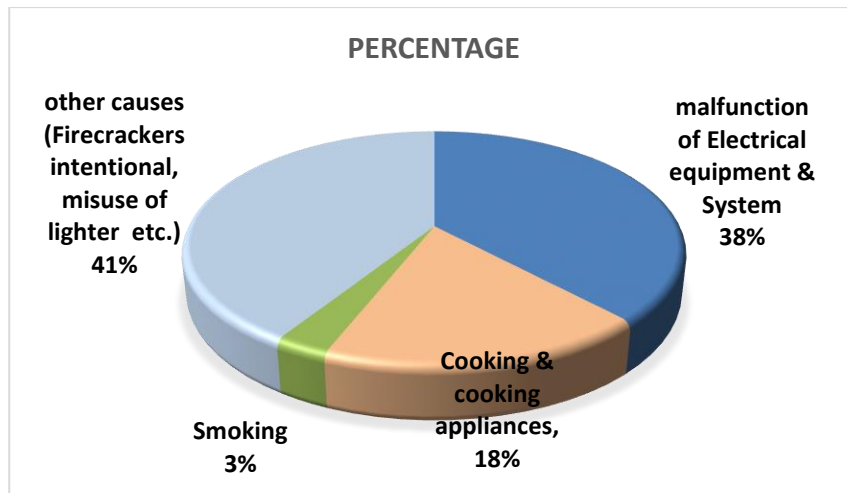


Fig. 5, Sources: As per ISEI case studies

2.1 How Fire Occur in Building

Fire is chemical reaction in which Combustible material combine with oxygen when external source of heat is applied. Combustion occurs continuously when oxygen, heat and a fuel source present (Fig.). In environment of building area, Oxygen is already available and combustible material come in contact with heat sources then fire take place. During fire, heat, smoke and light release and rapidly increases producing flammable vapors.

Fuel + oxygen (presence in air) = combustion of materials (mainly CO₂) + Heat Energy and light.

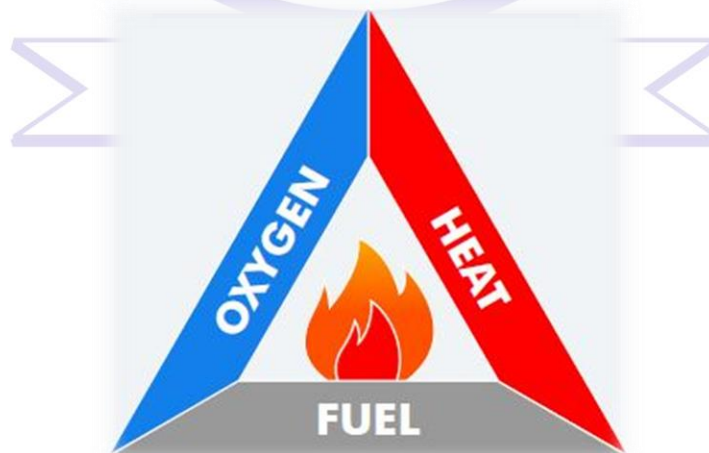


Fig. 6, Fire Triangle

Heat sources may be in the form of malfunction of electrical equipments, sparking due to loose electrical connection, cooking, smoking, misuse of lighter, use of heater etc. Flammable material may be in form of used material in building (wood), home appliances including cooking gas cylinder etc.

3. Commercial building fire (Categories wise) As per NFPA

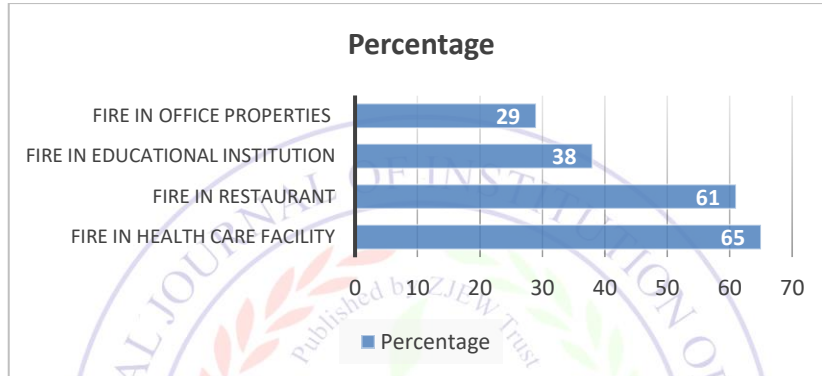


Fig. 7, Sources, NFPA, Fire due to cooking equipment

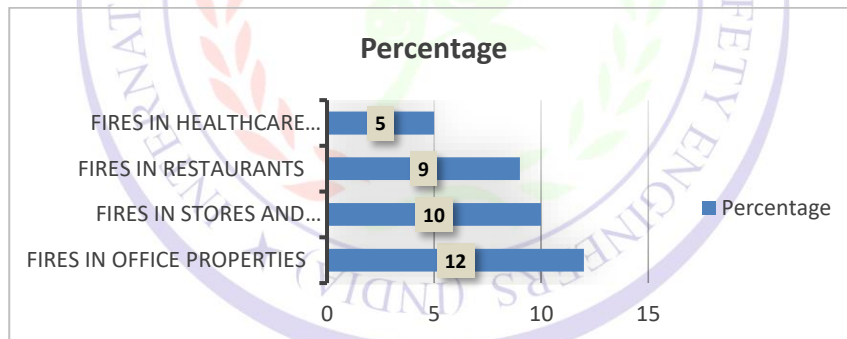


Fig. 8, Sources, NFPA, Electrical & Lighting Equipment

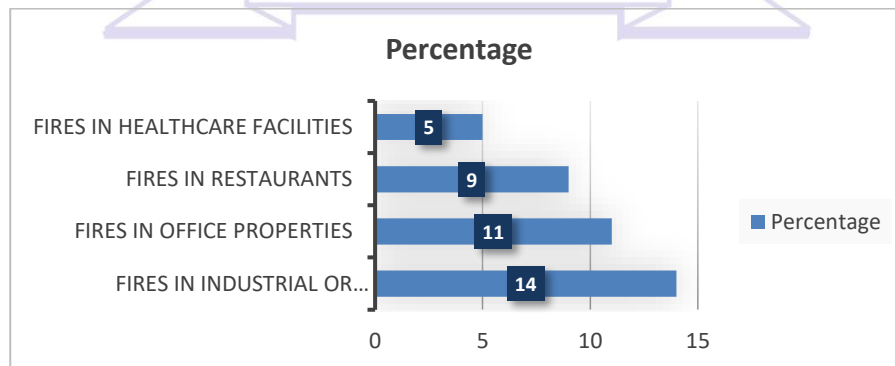


Fig.9, Sources, NFPA, Fire due to Heating Equipment

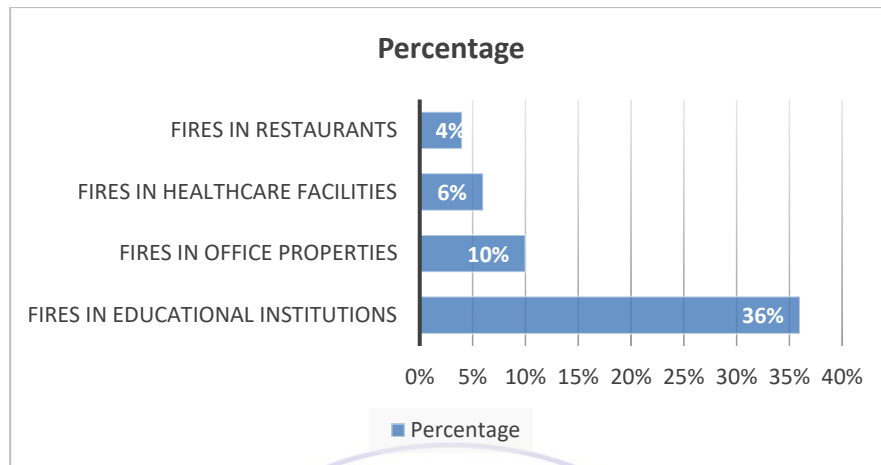


Fig. 10, Sources NFPA, Intentional Fire

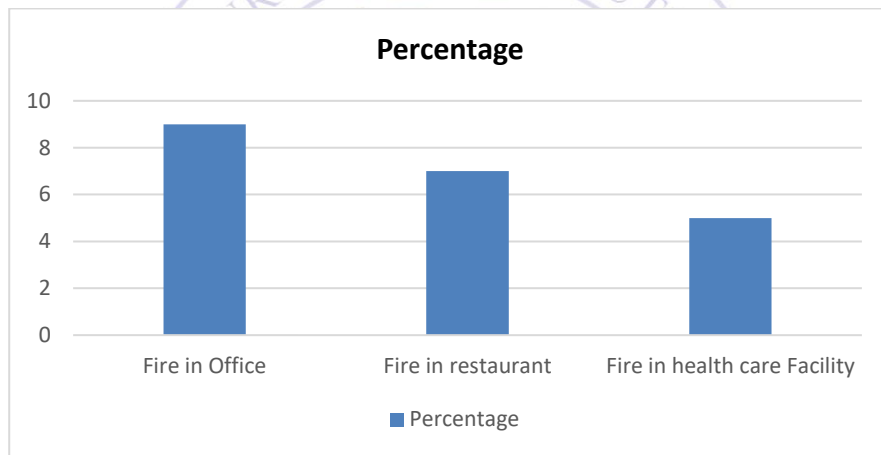


Fig. 11, Sources, NFPA, Smoking material

4. Consequence of Fire and Causes of Death in Fire Accident

The most obvious consequence of fire accident is damage to building, Property and loss of lives. In details, if analyze the impacts of fire accident, then found unexpected losses occurred that can't recover easily or within short time period. Fire accidents lead to cause of Personnel death, injury and huge economic loss of society and country. Major fire fully burnt to building property It results poor country reputation as well as owner of building. Steel lost their Two-third strength, if temperature is increased 600°C therefore building strength also reduced. Timber and other material their nature is flammable can completely burn.

Most common cause of death during fire is suffocation due to inhalation of smoke, it include carbon mono-oxide (poising) and other toxic gas such as hydrogen cyanide due to burning

plastic. Inhalation of carbon monoxide (CO) and other toxic gases that generates during burning, effect to human respiratory system, personnel unable to breathe and maintain required level of oxygen in body parts and its results Death. Carbon monoxide (CO) remove oxygen from blood stream rapidly enters all parts of the human body, including blood, brain, heart, and muscles. As per OSHA limits long-term workplace exposure levels to less than 50 ppm averaged over an 8-hour period. On average, exposures at 100 ppm or greater is dangerous to human health. Other Toxic gases such as phosgene can cause itchy eyes and sore in throat; at higher levels it can cause pulmonary edema and death. Released Smoke during fire are made of components, Particles, Vapours and toxic gases and effects to CNS, Heart, Kidney and such organ failure of human body results death.

Oxygen Level in atmosphere and Personnel health

O2 Level in atmosphere	Description
21 percent	Normal outside air (Good for human health)
17 percent	Impaired judgment and coordination
12 percent	Headache, dizziness, nausea, fatigue
9 percent	Unconsciousness
6 percent	Respiratory arrest, cardiac arrest, death

Table 1, Sources NFPA

In building Fire, hot steam, hot gases releases and material become hot due to burning and when Personnel come in contact with hot steam or Hot material, it lead to cause of burn injury and injury depend on Temperature value of hot material, hot steam or temperature of nearby place. Temperature above 50 degree are dangerous and may lead to cause of burn if temperature increases. Death occurring after a fire is effect of burns, infection, respiratory system failure, organ failure such as Kidney or heart failure, Abnormal clotting etc. is caused of major burn and most death occurred due to fire is within one days.

5. How can minimize the losses during Fire

Effective Fire safety control measure including emergency response plan (ERP), help to control risk related building fire. Losses depend upon Type of Fire, Nature and availability of material in building, Occupants in building and existing fire safety control measure. Effective existing Fire Safety control measure reduce the severity of harm of fire event. Fire Safety Control measure may be in form of presence of Fire Fighting System, effective implementation of Govt. rules and guidelines, Fire Safety Awareness among people, Evacuation plan, availability of emergency exit, emergency lighting, Avoid loose electrical connection and use of standard electrical equipment including power cable, distribution board etc. Immediate Rescue operation and presence of firefighting team can take needful action on time to prevent spread to fire and save lives. Avoid to use lift during fire accident. Incipient stage, shouldering stage and flame are stage of fire, if we control in initial stage then less probability of harm.

6. How to prevent Fire in Building

Fire accident in building can be control by to ensure adequate fire safety control measure parameter. Safety Control measure parameter may be in the form of passive or Active (Fig.12).

During design and construction, need to consider all parameter that are helpful to reduce risk up to acceptable level. Main objective to consider fire safety parameter is to minimize risk to prevent death, injury or building property or others who will be involve controlling fire and rescuing services during case of fire. During building design consider adequate ventilation, design large area into small area to provide effective fire barrier which is known as separation wall or compartments, Provide adequate exist including emergency escape route/exist for safe evacuation during fire.

Building material selection and construction such as use of non-combustible materials, fire resistant coating with building wall or structure, use less smoke emitting materials. Avoid using quick fire spread or flammable material for decoration in escape routes and kitchen room. Escape route must be constructed with high fire rating materials. Provide emergency lighting and signage in exist and access, it help to evacuate to occupants of building easily during fire. Room height should be adequate. Ensure Minimum two staircase with adequate hand railing and width of stair. The maximum travel distance from inside of the building to outside should be not more than 30 meters. Ensure Assembly point nearby building. Depute fire watchman to monitoring

building time to time and take needful action to minimise fire related risk. Impart training time to time of occupants of building to create fire safety awareness. Display emergency contact no. including fire Station contact no. Ensure adequate fire prevention & Control system in building (Fig.12). Underground wiring, standard cable and power supply through adequate rating of circuit breaker, avoid to overload to electrical equipments help to reduce of potential risk of fire. Avoid to misuse of heat source such as lighter, matches and store to fuel gas cylinder such as LPG gas in suitable and safe place and check leakage time to time through soap bubble. Avoid smoking near wood furniture items or other flammable materials. Always ensure fire prevention system including detection, fighting & suppression system. Ensure all applicable compliance during design, construction and after using to building as per guideline of National building code (NBC) of India, National Fire Protection Association (NFPA) and respective state government guidelines and codes.

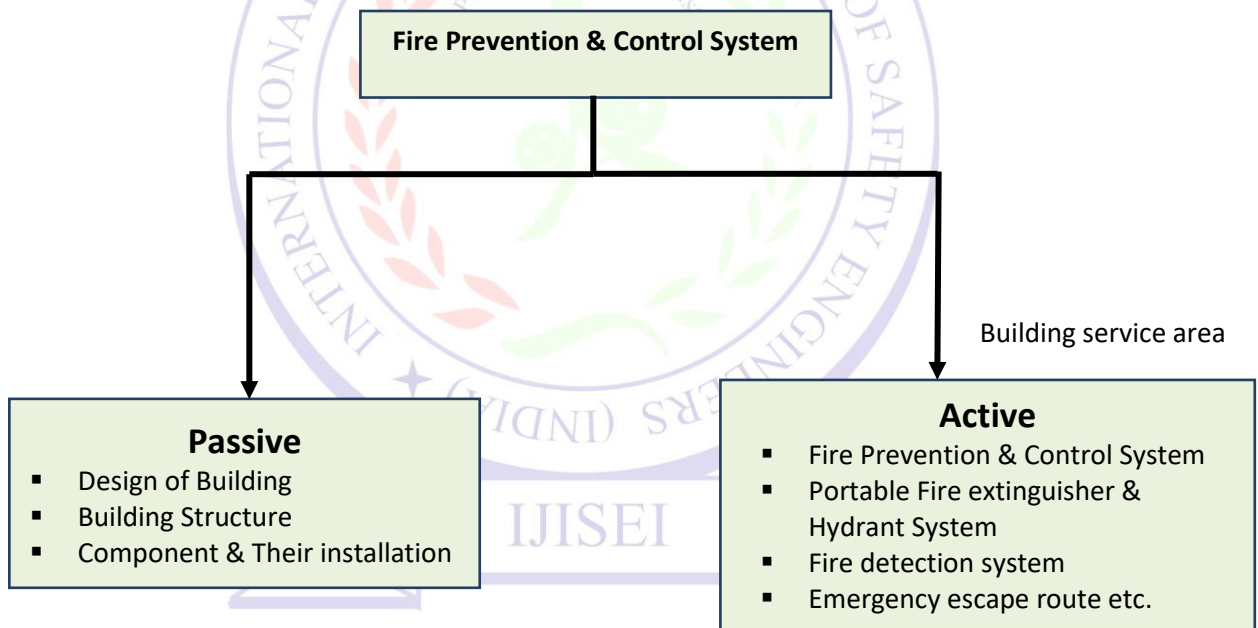


Fig. 12, Fire Prevention & Control system

7. Few major Fire Accident in India

Fire Accident in Hotel Arpit place, Located in Karol Bagh Delhi

On Date 12 Feb. 2019, early morning Fire Occurred in Hotel Arpit place, Located in Karol Bagh Delhi. In this Fire Accident at Least 17 People Killed, several injured and Approx. 35 People

were rescued. As per local media the caused of deaths occur due to suffocation during fire. Video recorded by eyewitness were showing many people jumping from building to save their lives and it results injury and death also. As per ," firefighter statements published in Hindustan Times newspaper, Corridor was paneling with wooden and fire spread in corridor rapidly, so, people couldn't use the corridor to leave the hotel during fire.

As per information received from witness, cause of fire was electrical short circuit. Structure was not fireproof, old wooden was used in door and building for decoration, Non-availability of fire exit and lack of firefighting system availability was caused of huge loss as per witness. Sources (BBC News) & other news sources.

Surat fire: 22 person killed in coaching center blaze

On date May 26, 2019, Time 3:45–4:00 p.m. Fire broken out in Fourth stories building and coaching classes were running on top of building that was shade build. Fire Started from ground floor and spread rapidly and resulted at least 22 People killed in which 21 were students and 1 was teacher. Television footage showed, many students were trying to escape by Jumping off from building top and its also resulted injury and death due to fall.

As per Information received from witness, the cause of fire was short circuit and poor fire safety measure availability of building resulted huge loss. (Sources: Newspaper)

New Delhi building Fire on 8 December 2019

In early morning, fire broken out when factory workers were slipping and at least 43 people were killed, most of them were factory workers, sleeping on various floors inside a building. This six-story building was using as small factory for making paper products and purses.

Main cause of huge loss was poor fire protection devices, Non-availability of emergency exits and outdated electrical systems. Inadequate ventilation was also cause of people death due to asphyxia Sources. As per government sources, this building was no fire NOC. (Sources: Newspaper)

8. Conclusion

Fire in building creates major threat of loss of lives and damage to property. It totally effect to society and country economy. Fire Safety Management is major parameter used to control fire. In initial, during building construction, consider safety parameter such as Fire resistance

Material, Emergency exit and underground wiring including suitable earth leakage circuit breaker. Effective enforcement of Govt. rules related Fire Safety, Ensuring Compliance as per NBC, NFPA help to Prevent Fire related risk. People should know how to operate Extinguisher and hydrant system and it should be in good working condition. Fuel gas cylinder such as LPG should keep away from electrical source, heat sources and well ventilated space. During Cooking, Take all precautionary measure to prevent fire. Time to Time, need to check gas leakage through soap bubble and as per recommendation of manufacturer follow all guidelines. Keep emergency contact no. and immediate report to local govt. authoring for needful action, if any fire accident occur. Small fire can be control through Fire extinguisher. Always consider engineering factor such as adequate height of building, adequate access including emergency exit and ventilation system in building. Avoid loose electrical wiring and use of defective electrical tools.

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