

# Fire Safety and Management Analysis in India: Review

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**Abstract:** The aim of this study is to examine fire safety measures and their implementation in buildings, the required measures according to the modern technology. The case study of major fires in recent years is been discussed, High rise buildings, Hospital fires in Covid-19 and also management comparison with other developed countries. However, the incidents of unfavourable conditions are taken in account and several precautions and measures to reduce them are being reviewed. Design of respective buildings and measures to ensure safety in fire risk situation. Data was collected from journals and related articles; the application of these suggestions is expected to be valuable add-on on existing researches. Also, it is important to aware occupants about the safety measures to be taken in fire breakout around them and other fire prevention methods to adopt for their safety. The study analysed the setup of organizations, their response times, and the management which needs to be enlightened in urban or rural cities in India for effectiveness of these measures.

## 1. Introduction

Fire is rapid oxidation of material in the exothermic chemical process of combustion, releasing heat, light and various reaction product, although it is also a natural process for our ecosystem but can cause fatal accidents leading to destruction. As per report of India there were 11,037 fire accidents reported across the country in 2019 which was 16% less than in 2018. The risk and management are regularly regulated by the government which have caused much downfall in fire accidents and fatalities but still improvisation is a must for sustainable approach. Buildings are places where most of fire accidents takes place which has fatal consequences. Therefore, various systems are being established in buildings by the government and fire safety regulations accordingly specifically to reduces such injuries and property damage. New materials and construction tech is being widely used to like Plastics, durable materials and insulation solutions for adapting the safety measures. The major thing for fire is a system of escape for people, proper evacuation system, HVAC systems and other methods for controlling fire. The new advancements of high-rise buildings which comes with a challenge in fire safety and other sustainable approaches to deal with the same. Over the years construction industry have increased efforts for proper Electric system, ventilation and coating materials to enhance the safety of structure and people. Different scenarios recent of fires in India and their flaws which needs to considered.

## 2. Literature Review

In this research we analysed the current situation in India and discussed about improvements that may be done accordingly for flawless regulation, the Role of Fire services and their response time, Risk and hazard analysis, Data of different states, Urban or Rural cities, and innovative methods of ensuring fire safety accordingly the development. Disaster Management act 2005 discussed the management of the Fire risk, its mitigation and plans to reduce it across the nation. But the main thing is meticulous implementation of such rules thoroughly across states, rural and urban cities. If we look into the recent fires in pandemic times in 2020, we witnessed fires in Covid care hospitals which also caused many fatalities and other problems which need to be look and discussed upon. The growth of fire services in India has been on extemporary basis, without much scientific analysis of situations. The risk varies with residential (high rise, medium and low rise-buildings), industrial, commercial areas or both. Moreover, lack of sustainable planning and institutional capacity and funds are also seen as a major challenge in addressing the improvements in fire and emergency services in India. Various engineering and government councils (NDRF, MHA, SFAC) have discussed the

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same and published reports for managing these situation and improvement of the same but still there is lack of infrastructure which is quite alarming. Accordingly, we discussed the prevention, mitigation and response methods.

## 3. Methodology and Data

### 3.1 Common fire Hazards

Studies of fire have shown most accidental fire starts from Malfunctioning of equipment, misuse of heat sources and Human error

- Kitchen fire from unattended cooking, such as frying, boiling etc.
- Electrical systems that are overloaded, resulting in hot wiring or connections, or failed components.
- Combustibles near equipment that generates heat, flame, or sparks.
- Candles and other often flames
- Smoking (cigarettes, cigars, pipes, lighters, etc.).
- Equipment that generates heat and utilizes combustible materials, Flammable liquids and aerosols.

### 3.2 Fire safety needs

1. Providing adequate level of fire safety in buildings, its effectiveness
2. Crucial aspect is fire prevention is concerned with human responsibility in making sure accidental fires are not allowed to start
3. If a fire does occur occupants should be aware of moving out to safe place as soon as possible, in addition safety of adjacent buildings is also important
4. Stability of high-rise buildings should be considered according to severity of fire
5. Availability of Fire Hydrants and extinguishers

### 3.3 Preventive and safety measures

#### 3.3.1 Fire Alarm System

It is considered the most important since at the outset it can raise alarm, generate evacuation messages and align the functioning of the electromechanical systems which are so very important for the safety of the occupants. All efficient egress design will not be significance if the Occupant are not warned or alarmed of an incident and given the directions to proceed to exit.

#### 3.3.2 Means of Egress

The design and planning of Safe Means of Egress require collaborative working of Architects and MEP (Mechanical, Electrical and plumbing) Engineers to keep the spaces with ease of access and control the smoke ingress in the identified, enclosed and demarcated areas which are in specific classified as Exits and Exit Passageway. The term egress relates to a continuous way of travel from any point in a building or structure to a public way consisting of three separate and distinct parts:

- 1) the exit accesses

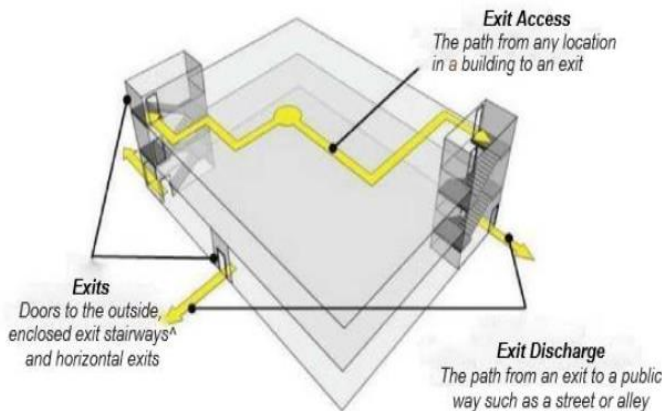
- 2) the exit
- 3) the exit discharges

**3.3.3 Automatic Suppression system**

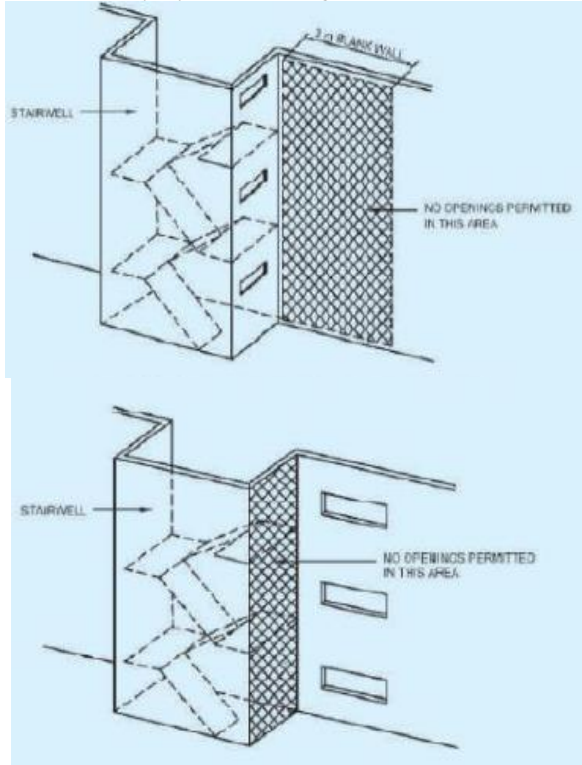
An automatic sprinkler system is designed to detect a fire and extinguish it with water/any other extinguishing agent in its early stages or hold the fire in a compartment and not allow to spread in the building.

**3.3.4 Smoke Extraction System**

In case of fire in a building, whether a residential or commercial it is necessary to extract the smoke from fire zone in order to evacuate people and possible victims, to protect the building structure and facilitate fire-fighter access. It helps to improve the visibility of occupant, reduce the temperature to soar and supply fresh air dilute toxicity of atmosphere. This system is installed in Exits, Lift Lobby, Exit Passageway, Identified Corridors, basement car parking and common areas of access to exits in Basements. Smoke Exhaust system consist of extraction fans, Fire damper, fire rated ductwork etc.



**Fig.1:** Safety layout of building



**Fig.2:** Stairwalls opening

**3.3.5 Electrical Services**

Electrical supply and distribution in any building is an essential service enabling functioning of the important aspects. While in most cases, the cause (or initiation) of fire is attributed to electrical installation which may or may not be correct in consideration is a

known fact that fire initiated due to any reason will involve the - electrical installation and can result in failed functioning of the life safety services, which are so crucial towards requirement of life safety aspects of evacuation annunciation, creating of compartments, pressurization and ventilation of exits, vertical transportation and importantly, fire protection services. In high rise buildings, electrical distribution is to be efficient and safe.

**3.4 Fire Accidents-Hospital fires in India**

Eleven of 24 fires were major and 13 were minor ones. More than half of these fires happened in March and April 2021, when rising Covid-19 cases turned into second wave. Of 59 deaths from hospital fires, 33 deaths were reported from Maharashtra in six fire incidents and Gujarat (21) in three incidents. Counting from August 2020, 43 deaths in Maharashtra and 35 in Gujarat, latest being in Bharuch where 16 patients and 2 nurses died.

- Fire experts blame Overstressed ICUs, ACs and systems unable to bear the rising patient load for frequent fire incidents. Hospitals were not able to expand electrical capacity according to increasing medical equipment. Not fire audit, electrical audit is also needed according to Chief Fire officer in Nagpur. In 13 of 24 cases fire began in ICU as the pressure was on entire system. Fire officials saw ICUs lack cross ventilation, in addition increase of inflammable materials in Hospitals - sanitizer spills, vapour, higher oxygen content in air due to which fire spread quickly which leave minute time for response.
- As per ADSI (Accidental Deaths & Suicides in India)- 2019 report there were 11,037 fire accidents reported across country. The data over five-year period 2015-19 indicated year on year decline. In 2015, there were 17,700 deaths due to fire accidents. While decline in number of accidents due to fire along with death and injuries is promising but significantly higher deaths compared to injuries is alarming. This higher fatality indicated challenges with medical and emergency services delaying with these mishaps, which could help to reduce death toll.
- Fire accidents in Residential Buildings form the major portion of accidents, in 2019 out of 11,037 fire accidents, a total of 6,364 accidents; around 57% occurred in Residential Buildings. A significant decline in the number of fire accidents in Commercial Buildings, Trains & Factories, Mines and Vehicles. However, trend fluctuates. Although there is a slight increase in number of fire accidents in School & Government buildings.

<b>MAY 1:</b> Fire in laboratory of Mazumdar Shaw Hospital, Bengaluru: no death	<b>MARCH 17:</b> Shree Vijay Vallabh Sarvajnik Hospital, Vadodara: no deaths
<b>APRIL 28:</b> Prime Criticare Hospital, Thane: 4 deaths (not Covid patients)	<b>JANUARY 9:</b> Civil General Hospital, Bhandara: 10 deaths
<b>APRIL 25:</b> Ayush Hospital, Surat: 3 deaths	<b>JANUARY 6:</b> Government General Hospital, Guntur: no deaths
<b>APRIL 23:</b> Vijay Vallabh Hospital, Virar: 15 deaths	<b>DECEMBER 9, 2020:</b> Little Flower Hospital, Ahmedabad: no deaths
<b>APRIL 18:</b> Rajdhani Super-Specialty Hospital, Raipur: 5 deaths	<b>SEPTEMBER 28:</b> Chhatrapati Pramila Raje Hospital, Kolhapur: no deaths
<b>APRIL 10:</b> Fire in Well Treat hospital, Nagpur: 4 deaths (non-Covid)	<b>NOVEMBER 27, 2020:</b> Uday Shivanand Hospital, Rajkot: 6 deaths
<b>APRIL 6:</b> Fire in Nashik's Chandwad Covid care centre in a private building: no deaths	<b>SEPTEMBER 21, 2020:</b> Sadguru Hospital, Cuttack, : no deaths
<b>APRIL 4:</b> Fire in Dahisar jumbo centre: no deaths	<b>SEPTEMBER 8, 2020:</b> SSG Municipal Hospital, Vadodara: no deaths
<b>APRIL 4:</b> Patidar Hospital, Ujjain: no deaths	<b>AUGUST 25, 2020:</b> Guru Gobind Singh Hospital, Jamnagar: no deaths
<b>MARCH 31:</b> Safdarjung Hospital, Delhi: no deaths	<b>AUGUST 9, 2020:</b> Swarna Palace hotel converted into isolation facility, Vijaywada: 10 deaths
<b>MARCH 28:</b> LPS Institute of Cardiology, Kanpur: no deaths	

**Fig.3 (a):** Fire escape data



Fig.3(b): Fire rescue bed

**4. Discussions**

**4.1 Role of fire services**

It includes effective fire prevention, creating awareness on fire safety and enforcing inbuilt fire protection arrangements in line with National Building code (NBC). However, majority of states services are unable to enforce such regulation due to lack of proper directives from authorities.

Delhi: presently Delhi Fire Services has 51 operational Fire stations in Urban area, 1 in rural area and 1 Training Centre at Rohini. Based on Norms the recommended response time for first fire tender is 5 to 7 minutes in Urban areas and 20 minutes in Rural areas. But currently there is overall deficiency of 51% as per GIS based analysis. The response time as per SFAC (Standing Fire & Advisory Council) norms Delhi requires additional fire stations: -

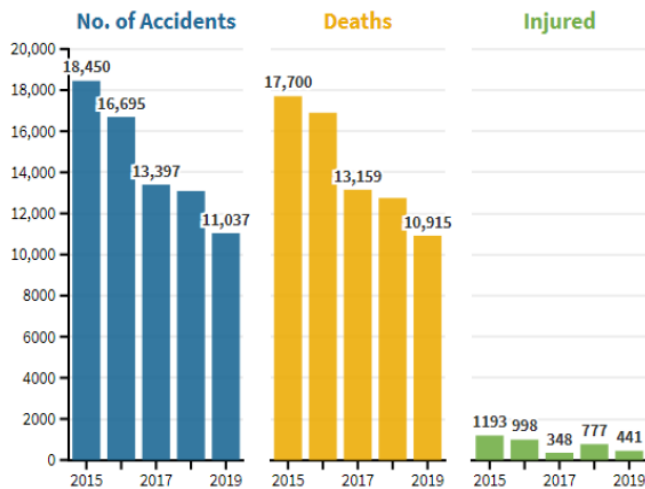


Fig.4: Fire accidents in India ( Source:CR, ADSI Reports)

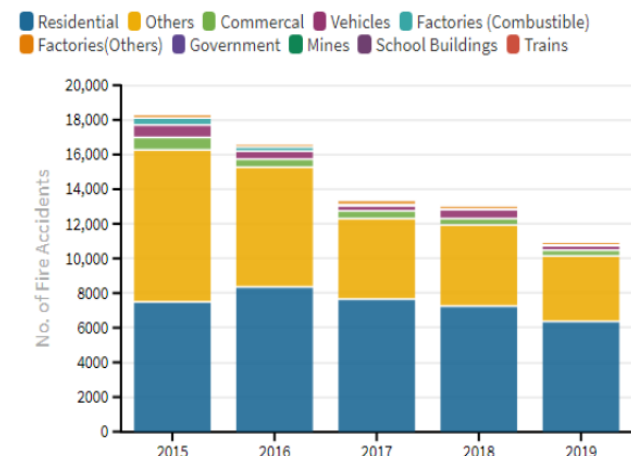


Fig.5: Fire accidents in India-place of occurrence ( Source:CR, ADSI Reports)

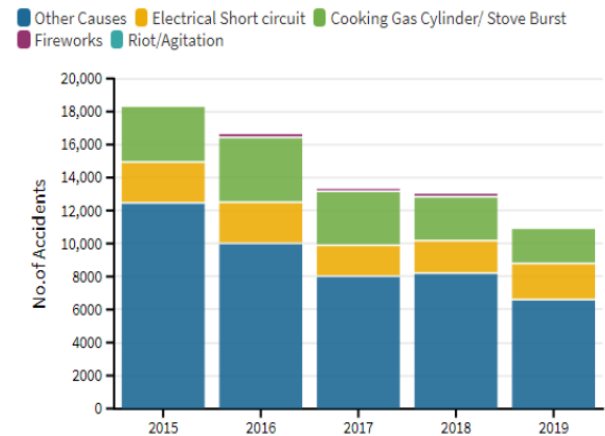


Fig.6: Fire accidents in India-by cause ( Source:CR, ADSI Reports)

**4.2 Case of High-rise Buildings**

In present time of advancements managing fire in High rises would be a greater challenge to be preventive of. As per NBC a building 15 m or above in height is High rise building. Although basic norms of safety should be followed but there would be challenge in evacuation strategies like mock drills and the design of HVAC (Heat Ventilation Air Conditioning) systems etc.

For high rises a Fire Tower would be needed otherwise it would be difficult for fire services to safely reach and work on. Refuge area, area within building for temporary use during egress which is protected from the effect of fire and smoke. Smoke management, all gaps between floor-slabs and facade assembly shall be sealed at all levels by approved fire-resistant sealant material of equal fire rating as that of floor slab to prevent fire and smoke propagation from one floor to another and Air handling Units (AHU) at each floor to avoid spread of fire & smoke through air conditioning ducts. Providing guidance for Emergency Exit signs illuminated and wired with independent electrical circuit.

Table 1:

Urban		Rural		Total
Operational Fire Stations	Additional Fire Stations	Operational Stations/ Posts	Fire Fire	
51	46	1	9	107

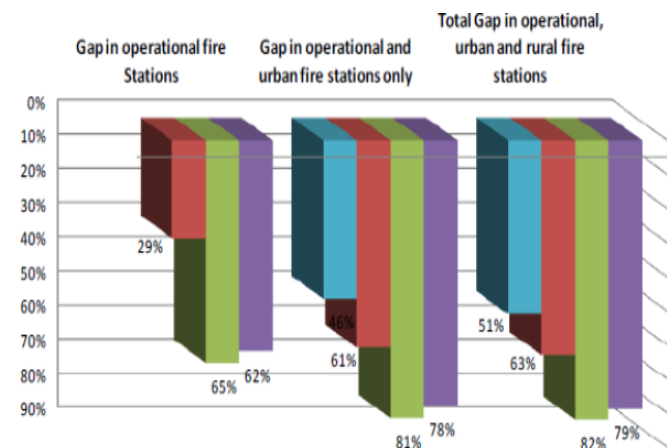


Fig.7: Fire station gap analysis

Table 2: Time and response

<b>Germany:</b> response time in urban areas varies from 8 to 15 minutes
<b>Japan:</b> response time varies from 5 to 10 minutes, depending upon the location of the building
<b>USA:</b> response time varies from (3-4) to 8 minutes
<b>United Kingdom:</b> response time varies from 5 to 8 minutes

**5. Conclusions**

A systematic and well-planned approach have to be implemented in the system for efficient prevention of fire and safety of occupants



across the country. Although current infrastructure is running but is in deficient quantity which need to be work upon. Precision services and financial plans for upcoming years need to be regulated for different aspect of fire operation systems & vehicles, with an active authority to move with an Innovative approach for upcoming challenges like we witnessed in Pandemic (Covid-19) times. Fire in any building cannot be ruled out. Building planner has to consider the worst scenario of smoke and fire in such buildings and increase standards of construction. Efforts of Architects and Engineers should be to use materials causing minimum and least poisonous smoke. Advanced technologies like system formworks, slip formworks and Pre-Fab construction should be adopted and constantly developed to ensure seamless execution of High-rise buildings fire safety arrangement.

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