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## TO STUDY FACTORS GOVERNING FIRE SAFETY ASPECT OF HIGHRISE BUILDING IN AHMEDABAD REGION

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**ABSTRACT:** The present study develops an approach to integrate fire safety assessment and decision making using the important index (IMPI). Methods used includes; physical observations, document review and questionnaire survey. The study finding shows which factor is more important and minimum fire safety factors required in high-rise residential building and provide some practical value, assessment of fire safety and survey of 20 buildings in Ahmedabad region about minimum fire safety measures. The approach can be used to help to reduce the probability of fire occurrence and severity of possible consequences during the fire hazard. The investigation provides the application of Delphi method for determining the 30 factors causes of fire and 15 factors of fire safety measures are selected and ranked by important index (IMPI) method for causes of fire. Overall results show top 15 cause of fire for high-rise residential building which are useful to understand for precautions of fire scenario and current fire precaution percentage taken by some building of Ahmedabad region.

**Index Terms:** Causes of Fire, Delphi Technique, Fire safety management, Important index, Likert scale, Residential

### 1. INTRODUCTION

With the development of urban economy, high-rise buildings and super high-rise buildings become more and more because of high population density and land price. According to one estimate the major losses reported by the Indian insurance companies in the year 2007-2008 indicate, that about 45% of the claims are due to fire losses. According to another estimate about Rs.1000 crores are lost every year due to fire. According to Fire Risk Survey (FRS) 2013, carried out by Pinkerton & Federation of Indian Chambers and Industry, fire accounted for 8.45% of the overall ranking of risks. In 2015, 7,493 cases of fire outbreaks were reported in residential buildings, a 200 per cent increase from 2014 (3,736 cases). In fact, 42 per cent of the deaths due to accidental fire in 2015 happened in residential buildings.

Fire can have a devastating impact on anybody who is unfortunate enough to be near it. We all know that the flames and heat from a fire can cause a great deal of harm – from breathing the hot air killing a person instantly to life threatening or life changing burns on the body.

In many fires affected building have less minimum fire safety measure so that it affects the property and life loss or injuries are there? Costs for improving building fire resistance and installing fire engineering projects are included in the investment budgets. However, the investment benefits are mainly about the reduced losses after the enhancement of the building fire safety level.

## II.LITERATURE REVIEW

### **TITLE: Fire Safety Challenges in the 21st Century**

**Author:** Craig I. Beyler

**Summary:** An economist might find there to be a single fire safety challenge; to minimize the total cost of fire. Others might assert that the current fire losses are clearly socially acceptable, and hence the challenge is to provide the current level of protection at the least cost. Hence the challenge is to provide the best level of protection possible with the current level of expenditure. It is fair to say that today a building can be made and maintained to be as fire safe as is desired. The real questions are: what is safe enough and how can a defined level of safety be achieved at the least cost? We need to determine the effectiveness and cost efficiency of existing methods and search for methods that enhance effectiveness or improve cost efficiency. Fire Prevention, Firefighter Safety, Fire Protection

### **TITLE: Analysis of Factors Affecting fire safety management of residential building**

**Author:** Chirag Gautami, Dr. Mayuri Prajapati, Ronak Khurana

**Summary:** The present study develops an approach to integrate fire safety assessment and decision making using the important index (IMPI) and analytical hierarchy process\_(AHP) method. For achieving aim of this paper, three approaches are used; first one is Delphi method which is used to identify most appropriate factors affecting fire safety management which includes causes of fire and fire protection measures of residential buildings respectively; second method, important index (IMPI) method which is used to find out the relative importance of causes of fire in residential building; third method, analytical hierarchy method which is used to calculate the relative importance of the main group and co-factor under each group.

### **TITLE: Study on Factors Affecting Evacuation Capability of a Fire-Protection Walk in Underground Buildings**

**Author:** Jing-wei Ji\*, Yao Meng, Qing-jie Li, Shao-fan Yang

**Summary:** Fire-protection evacuation walk is the only safe way for people to evacuate from underground buildings with large space. The software Pathfinder was used to simulated the require times for people leave the fire district and the fire-protection walk. the distance between exit of the fire district and the entrance of the stair leading to the out space\_(walking distance in a fire-protection evacuation walk), the exit width of the fire district and the stair leading to the out space are key factors that affect the evacuation ability of a fire-protection evacuation walk when the width of the fire-protection evacuation walk is determined.

## III.OBJECTIVES

- To study prevailing rules and regulation from national building code part-4.
- To identify and analysis minimum fire safety planning parameter of residential building.
- To suggest fire safety improvement measure in construction project.

## IV. RESEARCH METHODOLOGY

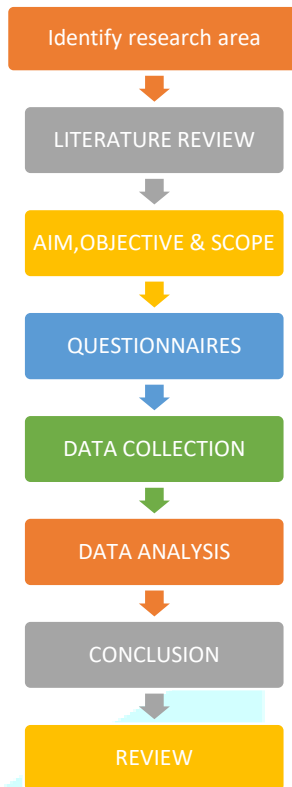


Figure 1 Research Methodology

## V. DATA COLLECTION & IDENTIFY FACTORS GOVERNING FIRE SAFETY

Data collection is the procedure of collecting, measuring and analysing accurate insights for research using standard validated techniques. Questionnaire is made up with the help of standard literatures, National building code guideline (part-4), few lecture videos, meeting with fire safety office. From that 30 factors were analysed and with the help of Delphi technique it reduced to 15 factors which has been used for questionnaire.

There are 3 questionnaires used for this research, first is for frequency index (rarely, sometime, and often), and second is for severity index (little, moderate, immense). These 2 questionnaires are used by Likert scale of 3 and it gave to professionals like fire safety officer, fire engineer, architecture, civil engineer. Third is for survey based on property (yes, no) and it gave to building secretary or builders.

There are 10 professional respondents each for 2 questionnaire and 20 other respondent of building secretary for 1 questionnaire.

## VI. DATA ANALYSIS

### A. Data analysis by Delphi Technique

The Delphi technique was originally proposed based on people's conjecture, judgment, and inspiration. A questionnaire survey was designed and analysis performed using the Delphi method. The Delphi process generally consists of three rounds of survey questionnaires. In the first round, experts respond to a broad question, while each additional round builds upon the responses collected from previous rounds. The process is terminated when consensus is reached. To emphasize greater field experience, at least 5 years of professional experience in the building construction industry was kept as one of the criteria for the selection of experts. Based on existing literature reviews and interviews with 2 experts in the first round of the survey under the Delphi process, 2 major attributes and their sub attributes were selected. In the second round of the survey, the findings of the first round of interviews were presented to the experts. Experts were asked to evaluate the importance of the attributes with ranking system. 15 factors (out of 30) were selected for further analysis.

### B. Data analysis by Important Index (IMPI)

In this technique, for each cause/factor two questions asked: What is the frequency of occurrence for this cause? And what is the degree of severity of this cause? Both frequency of occurrence and severity were categorized on a three-point scale. Frequency of occurrence is categorized as follows: rarely, sometimes and often. Similarly, degree of severity was categorized as follows: little, moderate and immense.

## C. Frequency index:

A formula is used to rank causes of delay based on frequency of occurrence as identified by the participants.

$$\text{Frequency Index (F.I.) (\%)} = \sum a (n/N) * 100/3$$

Where, a = weightage given to each response

n = frequency of response

N = total no. of response

## D. Severity index:

A formula is used to rank causes of delay based on severity as indicated by the participants.

$$\text{Severity Index (S.I.) (\%)} = \sum a (n/N) * 100/3$$

Where, a = weightage given to each response

n = frequency of response

N = total no. of response

## E. Importance index:

The importance index of each cause is calculated as a function of both frequency and severity indices.

$$\text{IMP.I. (\%)} = [\text{F.I. (\%)} * \text{S.I. (\%)}] / 100$$

There are two types of factors mentioned in this research paper, active measures and passive measures. With the help of IMPI value, rank gives in following table and shows it in bar chart for better understanding.

Table 1 Active Factors

Active factors	IMPI	Rank
fire extinguisher	96.67	1
hose reel	93.33	2
fire sprinkler	72	3
exit direction signages	60.66	4
wet riser	60	5
dry riser	58.78	6
fire lift	42.22	7
smoke alarm system	30	8

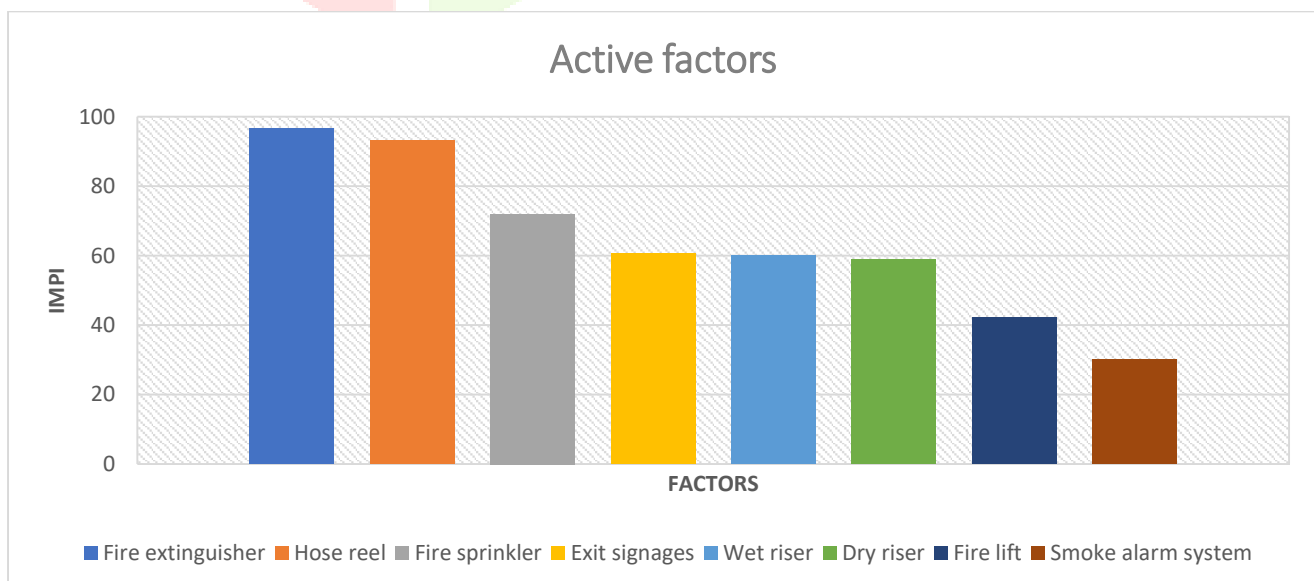


Figure 2 Active Factors

Table 2 Passive Factors

Passive factors	IMPI	Rank
NOC from fire safety	90.22	1
MCB&ELCB	87	2
fire water storage tank	81	3
ventilation	58.66	4
emergency lighting	48	5
inflammable material in staircase room	42.22	6
refugee area	23.33	7

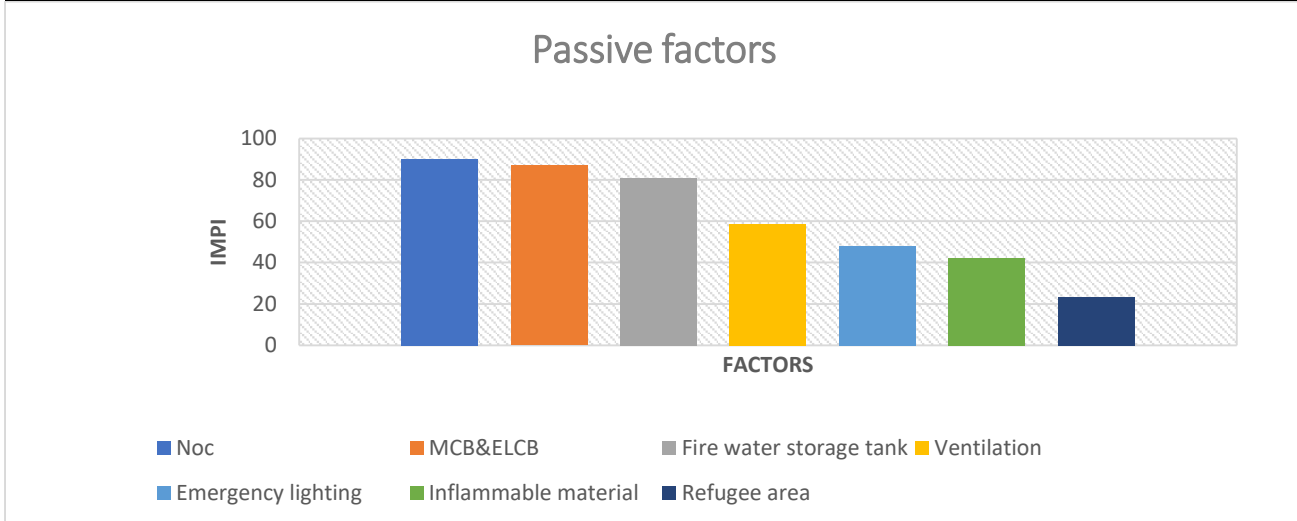


Figure 3 Passive Factors

Third questionnaire is having information about how many fire safety precautions are there in those building in Ahmedabad region. By using that information, we can predict percentage of minimum fire safety is used in those buildings. By calculating it, 63.84% minimum fire safety is there in residential building which is very less and that may affect building while fire accident.

## VII.CONCLUSION

An effectively implemented fire safety management ensures total safety to buildings. Fire safety in residential facilities should be maintained in an appropriate level to safeguard the life of occupants and protect properties. This paper helps to assess the provision of fire safety measures for mitigation the risk of cases of fire. The study concludes with the development of risk analysis checklist which includes 15 factors causes of fire which is verified as acceptable or adequate by field survey of firefighters. The specific findings of research study shows that residential building satisfy overall fire safety for this case study. Moreover, this study mainly focus on most effective measures are impact in high-rise residential buildings which includes the hazardous factors. As per survey, 63.84% minimum fire safety measures are seen in residential high-rise building in Ahmedabad region. Which is very less for safety. The top 15 factors cause of fire which are concluded by analysis are as follow.

Active measures:

1. Fire extinguisher
2. Hose reel
3. Fire sprinkler
4. Exit direction sign
5. Wet riser
6. Dry riser
7. Fire lift
8. Smoke alarm system

Passive measures:

1. NOC from fire safety department
2. MCB&ELCB
3. Fire water storage tank
4. Ventilation
5. Emergency lighting
6. Inflammable materials in staircase room
7. Refugee area

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