

Identification and analysis of accidents and hazards occur during constructions of High Rise Buildings Projects in Pune (Risk Management)

Ar. Daksha Deshmukh

Architecture Department, S. B. Patil College of Architecture & Design

Corresponding Author: Ar. Daksha Deshmukh, d.deshmukh@sapatilarchitecture.com

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ABSTRACT

In the era of peaceful globalization, it is impossible to avoid talking about risk, because it has become an integral part of everyday life. One such industry is the construction industry, where risk is a constant piece of a complex puzzle. But every industry must operate safely, reliably and sustainably to succeed. The industry must identify the hazards, assess the risks involved and reduce the risks to an acceptable level. The paper aims at study of various hazards & accidents that occurs during construction of high rise building in Pune region. The management of construction companies must participate in the context of this research and apply it to ensure safety and minimize accidents on construction sites, including the implementation of safety policies, use of safety equipment, safety measures and accident training. There are various techniques to ensure the safe working environment. It is important to do research to learn more about the risks and how it affects workers in the construction of subway bridges that can cause material damage.

Keywords: Accidents, Hazards, Risk management, high rise building projects

1. INTRODUCTION

Construction site work is regarded as one of the riskiest jobs in the nation. Compared to other industries, the frequency of accidents in the construction sector is increasing daily. Many people who work on high-rise buildings are hurt, killed, or negatively affected in accidents every year.

Construction projects also face a great deal of dangers as a result of the regular accidents that occur there. A significant number of developed nations work to mitigate the reparations and losses brought on by accidents in construction projects, but developing nations are more frequently the victims of construction accidents because they lack safety regulations and are not aware of the issues that pertain to safety. Therefore, the construction accidents had a damaging impact on the project's performance, such as a delay in its completion, a rise in its cost, and a reduction in its productivity.

Due to dwindling surplus usable land in Pune, the demand for high-rise development projects is increasing. The increase in the number of deaths and accidents is a consequence of the rapid development of apartment building projects. Therefore, most construction projects create dangerous conditions that can cause accidents and reduce their safety. Construction organizations must implement Precautionary measures and launch a safety management system to reduce accidents.

2. OBJECTIVES

The study's goals are to determine or look at numerous accident reasons on building construction sites and evaluate worker safety to provide strategies for decreasing site-specific accidents

3. LITERATURE REVIEW

Overview of construction industry in Pune.

The demand for high-rise building projects has fueled the construction industry in the Pune district,

which is the country's epicenter of IT sector growth. Pune's construction projects primarily fall within the public and private sectors. The Government authorities Public Works Department (PWD) and Construction Industry Development Council (CIDC) are two organizations in Pune that deal with public and private construction projects respectively. PWD works with public sector projects in Pune. The construction sector has significantly impacted the country's development during the past 20 years, contributing 3–5% of the GDP.

The majority of projects in Pune, however, are described as being behind schedule because poor time performance is so typical in the construction sector. As a result, the client and stakeholders are dealing with major problems like financial loss, quality compromises, and inconveniences from construction project delays. The country's economy is impacted on both the micro and macro levels by construction project delays. The macro-level is concerned with the nation's negative rate of national growth, while the micro-level is concerned with cost overruns and project abandonment.

4. RESEARCH METHODOLOGY

Like many other researchers, critical safety variables were determined from a literature review and then modified through a pilot study. A pilot study was directed to develop critical safety elements suitable for further research. To this end, 20 questionnaires were sent to industry and academic professionals, representing academia (five), entrepreneurs (five), customers (five) and consultants (five). The ten-group, sixty-two-item survey questionnaire was modified in response to their comments. The questionnaire was designed to achieve the research objectives of this study, which included identifying the main safety factors that caused accidents in high-rise construction projects.

Root cause of Accidents in Pune Construction Industry

Types of Accidents in Construction	Year	
	2021	2022
Fall from height	10626	12560
Explosion (Boiler, Gas cylinder, etc)	481	555
Fire	1401	1432
Electrocutions	8987	8839
Fall into Pit/ Manhole, etc	2638	2840
Suffocations	3298	3548
Collapse	3254	3410
Total	30685	33184

Source : Accidents, deaths in India 2021-2022

- Mishaps aren't something that just happens; they are things that are caused and risky behavior or harmful surroundings are to blame for 99 percent of mishaps. Various accident models are being created nowadays so that the causes of accidents can be understood and appropriate action can be done.
- The site conditions, building height measures, lacuna in safety measures, lacuna in safety signs, poor management systems, unplanned safety policies, a lack awareness in safety education, less personal protective equipment, a lack of personal protective equipment, and the type of working environment all contributed to the incidents.
- Additionally, bad manufacturing practices, such as the use of faulty scaffolding or negligent workmanship, contribute to accidents. Because workers are unaware of the possible risk, inadequate training is a major factor in the development of accidents.

Four factors of accident causality in construction namely

- Working conditions,
- Management failure,
- Unsafe acts of workers and
- Non-human related events.

Drops from a height

Accident fatalities are primarily caused by following; These frequently take place as a result of:

- Lack of edge protection,
- Exposed building openings,
- Roof work without edge protection,
- Dangerous destruction work and improper use of ladders and hoists are all risks.

Crush wounds

These take place in dangerous excavations frequently result in tragic accidents or severe injuries. They happen when trench walls are not adequately supported, especially after rain, or when vehicles are driven too closely to the edge. Walls and buildings that have weak supporting structures are susceptible to collapse. This situation has the potential to be fatal. Absence of toe boards on scaffolding, a lack of tool belts for workers, and other factors may contribute to such falling objects. Operational actions, which account for over 29.8% of what causes accidents in the years 2019 to 2022, include not using the correct personal protective equipment, failing to follow instructions, complying with working standards, being reckless and overconfident, among others.

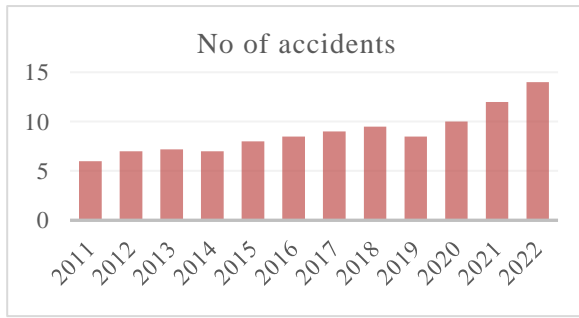


Fig 1: Number of fatal fall accidents in India 2011-2022

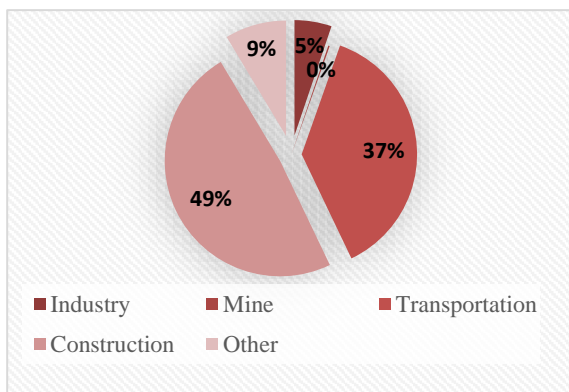


Fig 2: Number of fatal accidents in India (2011-2022)

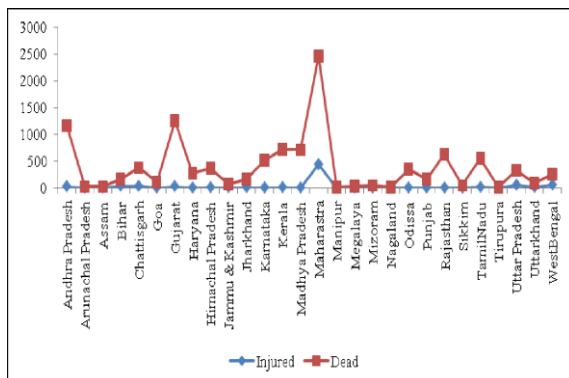


Fig 3: State wise fall accidents in India (2022)

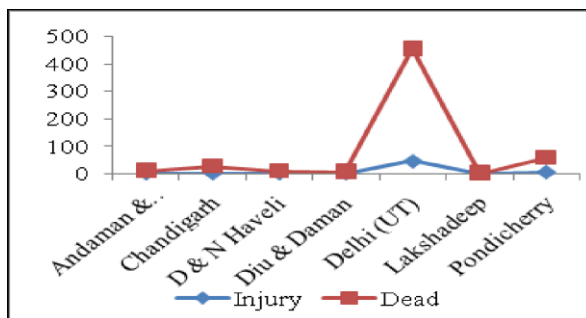


Fig 4: Territory wise fatal accidents in India

Index of relative importance (RII)

The Relative Important Index (RII) approach was used to assess the data gathered from the respondents after being entered into SPSS. Several academics have already employed the RII approach in factor analysis research. For the analysis of delay factors, Sambasivan & Soon [26] and Shah and Dixit [27] both employed the RII approach. Additionally, [28] also examined the productivity factor analysis using the RII approach.

$$Relative\ Importance\ Index\ (RII) = \sum W / (A \times N)$$

W stands for the respondents' weighting, which varies from 1 to 5.

A = greatest weight, which in this case would be 5.

N stands for the total number of responders.

5. DATA ANALYSIS

Reliability assessment

The reliability and validity tests provide evidence that the analysis in the research study satisfies its objectives. The balance of a measure and the likelihood of getting the same findings if the measure is repeated are both considered to be aspects of reliability [24]. The Cronbach's coefficient alpha is used to assess reliability. The range of Cronbach's alpha is 0 to +1, with a higher number indicating greater dependability. Validity establishes if a score or question accurately quantifies the intended concept [24]. A pilot survey and 20 expert interviews regarding high-rise building projects were already undertaken to ensure the validity and reliability of the questionnaire. The justification and dependability of data analysis were carried out using SPSS-19. Internal consistency was most frequently measured using Cronbach's coefficient alpha [25]. Cronbach's alpha in this study's analysis was 0.976. When the Cronbach's coefficient alpha value above 0.9, the data were trustworthy and appropriate for further investigation [24].

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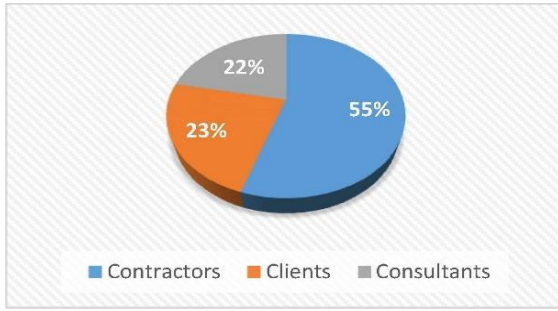


Fig. 5. Respondents' profile.

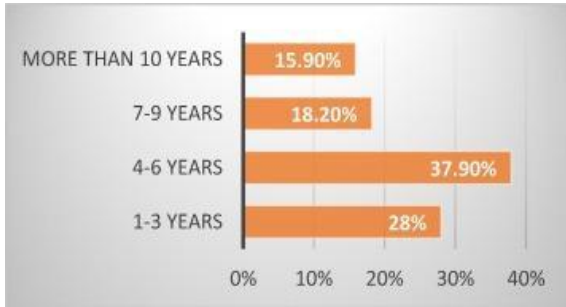


Fig. 6. Level of experience of respondents.

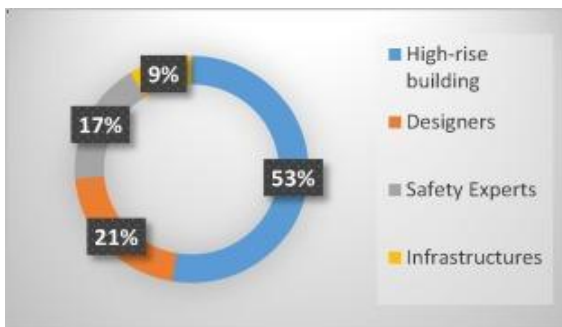


Fig. 7. Expertise of respondents.

6. RESULT AND ANALYSIS

The following further discussion is based on the group ranking of the important safety elements mentioned above:

(RII = 0.774) Safety indication

The respondents' input indicated that safety signs were the most important safety component in building projects in Pune. Because employees are unable to discern which areas are off-limits, a severe accident could result from a high-rise building project lacking safety signs and boards. Therefore, in building projects, safety indicators must be correctly installed in order to avoid the safety risks.

(RII = 0.757)

Personal protection equipment.

According to the respondents' comments, personal protective equipment (PPE), which had a RII value of 0.757, was the second most important safety aspect. Workers may suffer catastrophic consequences if they don't wear PPE at building sites [30]. Wearing PPE is occasionally neglected in favour of comfort. To minimise injuries, PPE must be worn before visiting construction sites, including hand gloves, hard safety hats, and safety boots [31].

a) Falling from ceilings or floors (RII = 0.745)

In accordance to the opinions of the respondents with a RII value of 0.745, falling from a roof or floor was considered as the third most important factor. Fall is characterised as a downward motion towards the ground. Additionally, the risk of falling causes a loss of body equilibrium, which ultimately results in an accident [32]. As a result, it's important to reduce injuries caused by people falling from rooftops or floors through safety awareness, workplace inspections, and fall protection measures [33]. When working at heights, safety belts should always be attached to avoid falls from rooftops or floors.

b) Failure of the scaffolding and ladder (RII = 0.696)

The malfunction of the scaffold and ladder, with a RII value of 0.696, was evaluated as the fourth most important safety factor. Poorly made scaffolding construction materials have also been blamed for accidents. Serious accidents in construction sites were also brought about by improper scaffolding erection. Before erecting the scaffolding, personnel must be trained in order to avoid failure. In addition, the quality of the scaffolding materials used for construction projects needs to be raised.

Safety inspection (RII = 0.690)

Because of the neglect in the safety design process, accidents have also occurred in construction projects. Building information modelling should be used throughout the design phase of the construction project to address the construction safety measures in order to reduce accidents in the working area.

c) Storage and transportation (RII = 0.664)

The respondents selected transportation and storage as the sixth most important safety element, with a RII of 0.664. Transport refers to moving building supplies from one location to another. Accidents have occurred as a result of building materials being handled incorrectly during transportation. By enhancing overall safety performance, good material transportation and storage can lower the rate of accidents.

d) The work environment (RII = 0.637)

7. SAFETY MANAGEMENT TECHNIQUES

Effective security arrangements for contractors, subcontractors and specialist contacts are critical. The management team also owns security because they are in charge of executing it. These line managers must be supported by occupational safety qualified those with knowledge of and responsibility for maintaining the workplace and any tools or equipment used in construction, such as ladders, scaffolding, and lifting equipment. As part of an ongoing programme, safety procedures and standards must be followed at all levels. The following is a list of some of these organizations to pinpoint problem areas and achieve improved manufacturing safety status:

- Contractors Safety surveillance and correction programme
- Area-wise Task Force to ensure construction site safety
- Only after completing Induction Safety training is there access to the job site.
- Safety Related Deficiency Management system
- Periodical Safety Audits

8. SAFETY TRAINING

It is impossible to exaggerate the value of training. Standardised training modules have developed throughout time. The contract and departmental personnel are also given Pre Job Briefing and PEP seminars to help them become more knowledgeable. But for training to be more effective, defined training modules and approaches that can ensure the necessary safety must be created. The effectiveness of training will rise with the use of contemporary educational teaching materials, such as audio-visuals and mobile training. There is scope for future development in our training approach.

As a result Interactive approaches must be used to structure and tailor training for such a large workforce. Rewards should be used to motivate employees who exhibit exemplary safety behavior and procedures. Our goal of achieving safety and desired safety culture will be strengthened by increased field visits by the line managers and engaging with the employees in an "each one teach one" manner.

TCSM, Or Total Construction Safety Management

The three steps of this approach are:

- (1) Planning and Preparation,
- (2) Identification and Assessment, and
- (3) Execution and Improvement.

Phase 1: planning and preparation

Construction companies must first launch the safety programme during this phase through a successful preplanning and resource creation procedure. Organisations must build a vision during this time, secure top management support, organise employee training, and ensure that all operational resources are available to support the programme change.

Phase 2: Identification and Assessment Phase:

In the course of this phase, safety goals and objectives are developed, management is trained, and tactical choices about safety management strategies are made that the programme modification will be accommodated by all operational resources.

Phase 3: Execution and Improvement:

The execution and improvement phase is the last stage of the TSM implementation paradigm. At this point, it is necessary to include the new culture into the mix, start employee training

9. RESEARCH CONTRIBUTION

- The improvement of safety issues, construction job productivity, and accident rates would be of interest to the construction industry. To that end, the industry would be concerned in analysing current safety management practises and recognizing which safety areas to enhance.
- Engineers, project managers, researchers, contractors, clients, consultants, and upper management can all benefit from the study's conclusions; since they highlight critical safety factors that necessitate extra care in order to ensure that safety implementation may be properly carried out.

10. CONCLUSION

Due to the complexity of the procedures, construction is more risky than ever. To reduce workplace risks and remain profitable in the still explosive sector, construction companies must carefully evaluate their safety management systems. Agencies in other countries, such as OSHA, have helped promote injury-free environments.

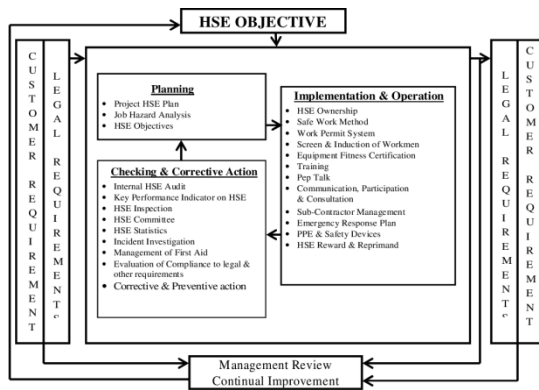


Fig 8. Total Safety Management Model

However, India lacks a sufficient construction safety management system. Additionally, The approach to proper safety execution isn't necessarily through strict rules and regulations, but rather through an effective total risk management initiative, supported first by senior management of an organisation, then integrated via specific safety management implementation tools/systems, and finally by ongoing monitoring. TQM efforts should serve as a foundation of encouragement for construction organizations interested in maximising safety and keenness. The guiding principles must be quality emphasis, entire devotion, and constant improvement. Only businesses that adopt a zealous safety management strategy can programmes, and rigorously monitor all safety performance in order to encourage continual development maintain profit margins and attain top-tier competitiveness. Top management for the contractor should implement plans and guidelines that promote a secure environment. The suggested TCSM acts as a motivator for maintaining a secure project. The ability of an organisation to translate, integrate, and ultimately institutionalise TCSM behaviours into common workplace practice is the single most crucial factor in determining the success of an organization's TCSM implementation, according to the experts.

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