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OCCUPATIONAL SAFETY MANAGEMENT DURING EXECUTION PHASES OF MID-RISE RESIDENTIAL PROJECTS

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ABSTRACT

The construction industry is critical to India's economy, but it also has the highest occupational fatality rate of any sector, emphasizing the importance of improved safety management. Workers, who play an important role in construction, are frequently involved in accidents caused by unsafe practices and inadequate safety measures. Occupational safety during the execution phase of mid-rise residential projects is critical for protecting workers and meeting project deadlines. Despite regulations such as the BOCW Act of 1996 and the Factories Act of 1948, gaps in implementation and enforcement continue to impede effective safety management practices.

This paper identifies the primary causes of site accidents, conducts a literature review to assess current occupational safety management practices on residential construction sites, and investigates barriers to their implementation. By bridging the gap between documented protocols and on-ground application, this study aims to foster safer working environments in construction. Survey results show that effective safety management reduces accidents and ensures site safety, positively impacting the industry.

Keywords: Construction Industry, Occupational Accidents, Occupational Safety, Safety Management, Safety Practices

1. INTRODUCTION

The construction industry continues to play an important role in the country's development, and it is more labour-intensive than in other developed areas of the world. The construction industry appears to have a widespread inability to manage workplace health and safety to an acceptable standard. Due to the high-risk nature of the construction industry, occupational safety management is of paramount importance. The construction sector's hazardous nature, characterized by high accident rates, has significant implications, including project delays and social and

economic costs. Nik Fadhilah Nik Him, et al. (2023) Juhari & Arifin, 2020. The International Labour Organization (ILO) estimates that 2.78 million work-related deaths and 374 million non-fatal injuries occur annually worldwide, costing 3.94% of global GDP. International Labour Organisation. (n.d.) India faces additional challenges due to its decentralized and diverse construction activities, ranging from small-scale projects with limited safety resources to large-scale developments with more structured safety systems. Therefore, it is crucial to establish an effective and strong safety management system to enhance productivity and ensure a safe working environment.

India's construction workers account for 7.5% of the total global labor force, but they face 16.4% of global occupational hazards. Patel & Jha (2016) Accidents affected 62.8% of construction workers on small construction sites and 47.4% on large construction sites. Kanchana et al. (2015) Four major factors that contribute to occupational accidents and illnesses have been identified: human, worksite, management, and external. Jaafar et al. (2017) Despite regulations such as the Building and Other Construction Workers (BOCW) Act of 1996, enforcement remains weak. Inadequate training, insufficient safety supervision, and a lack of awareness exacerbate the situation. Nik Fadhilah Nik Him, et al. (2023) A poor safety culture, attributed to contractor attitudes and a lack of promotion of safety practices, continues to put workers at risk. Nik Fadhilah Nik Him, et al. (2023) Workers are an integral part of construction. The high rate of accidents in India highlights the critical need for effective occupational safety management. Ensuring worker safety requires addressing hazards, identifying barriers, and improving current practices.

Research on safety management in mid-rise residential projects can provide valuable insights to enhance safety protocols, promote a strong safety culture, and reduce risks, ultimately protecting workers and improving industry standards.

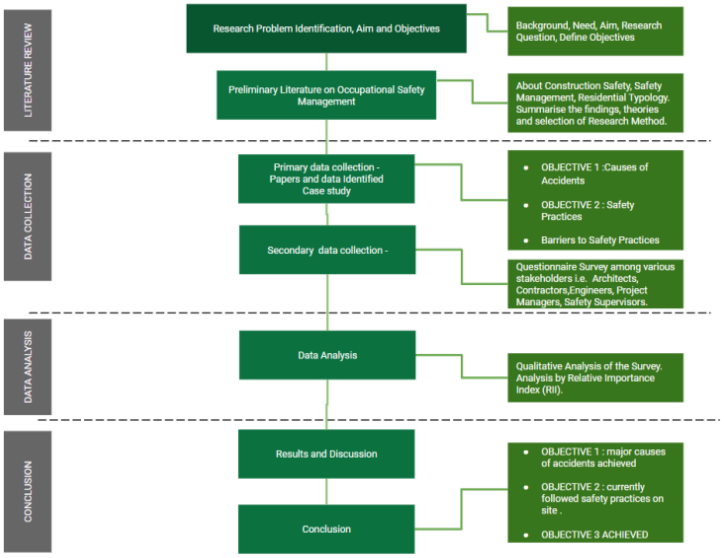
Accordingly, this research aims to understand the effectiveness of occupational safety management in the Indian construction industry, focusing on residential buildings.

1.1. OBJECTIVES TO REACH THE AIM AND FILL THE RESEARCH GAP ARE

1) Identify and categorize the most prevalent causes of accidents on residential construction sites in India.
2) Identify and analyse the existing occupational safety management practices in residential construction projects.
3) Identify the barriers to implementing the safety management practices in the residential construction projects.

2. MATERIAL AND METHODS

The methodology adopted for this study is represented through the flowchart below:



2.1. STUDY AREA

This research focuses on the overall Indian construction industry, a sector playing a pivotal role in building India's economy, focusing on residential projects. The construction industry operates on a national scale in India. Conducting the research across the entire country allows us to identify common factors and challenges faced by the industry as a whole. This approach ensures a comprehensive understanding of safety practices within the Indian construction sector as a whole.

2.1.1. DESCRIPTION OF STUDY

The present study was conducted to describe the effectiveness of occupational safety management in the Indian construction industry, focusing on residential buildings. This is done to obtain firsthand information, which is critical for understanding the safety issues that arise in the construction industry.

2.1.2. SPECIFIC SUBJECT

The survey consulted stakeholders from various sectors of India's construction industry, such as project managers, safety managers, architects, engineers, and contractors. The target subjects are people who are currently employed or actively involved in construction projects in India. Participants' years of construction experience may vary, influencing their perspectives on safety management practices. Some participants have less than five years of experience, while others have six to ten years, eleven to fifteen years, or more than fifteen years.

2.1.3. RESEARCH METHODOLOGY

The method that has been used for this research is a literature review followed by data collection using questionnaire surveys. This survey aims to gather data and evaluate the contributing causes to occupational accidents and the effectiveness of safety practices on site within India's construction industry. The survey methodology offers a strategic advantage in collecting data. This approach allows

the collection of data from a large and geographically dispersed population within the Indian Construction sector. This method ensures the collection of comprehensive data and the ability to achieve results, all within a defined research time frame. Using the ranking method, which involves calculating the relative importance index and applying the Likert scale, the survey data is examined.

1) Scope and Limitations

This research paper focuses specifically on the Indian construction industry, examining occupational safety management and the primary causes of accidents in residential building projects. It investigates safety management practices within this sector while excluding other construction types, such as commercial and infrastructure projects. The study is limited to the perspectives and experiences of stakeholders within India's construction industry, meaning the findings cannot be generalized to other countries or industries. Additionally, as the research relies on self-reported data collected through a questionnaire, response bias may influence the accuracy of the results. By concentrating solely on residential projects, the study does not address the unique safety challenges present in other construction sectors, where safety management practices may vary due to differences in project typology, complexity, and regulatory requirements.

2) Literature Review

A thorough literature review was conducted to identify existing causes of accidents on construction sites. Relevant academic databases and journals were systematically searched to collect a diverse range of perspectives and findings. Along with this, a case study in the Asia Pacific was conducted, and data was collected on safety practices being implemented on sites and barriers to safety practices.

3) Causes of Accidents:

Table 1

Table 1 Causes of Accidents

Category	Causes of Accidents	References
	lack of awareness and experience of worker	Abukhashabah et al (2020);Samanta & Gochhayat (2021); Sulthana & Kumar (2020); Golaviya et al (2018); Thanaraj & Priya (2019); Rakul & Ramadhasan (2020); Saeed (2017)
	lack of training	Abukhashabah et al (2020); Sulthana & Kumar (2020); Golaviya et al (2018); Saeed (2017); Saeed (2017); Saeed (2017)
	lack of safety supervisors	Abukhashabah et al (2020);Samanta & Gochhayat (2021); Sulthana & Kumar (2020)
	pressure from clients	Kunodzia et al (2024)
	lack of decision making	Abukhashabah et al (2020); Samanta & Gochhayat (2021); Kaur et al. (2023)
	physical strain	Kaur et al. (2023); Samanta & Gochhayat (2021); Sulthana & Kumar (2020); Saeed (2017)
Human Factors	lack of communication	(2001) SP-70 HANDBOOK ON CONSTRUCTION SAFETY PRACTICES; Samanta & Gochhayat (2021); Rajendran & Karthigaipriya (2019): Rakul & Ramadhasan (2020)

Work Environment Factors	**unsafe environment**	Abukhashabah et al (2020); Sulthana & Kumar (2020); Golaviya et al (2018); Thanaraj & Priya (2019); Rajendran & Karthigaipriya (2019); Rakul & Ramadhasan (2020); Saeed (2017)
	lack of PPE kit	Abukhashabah et al (2020); Samanta & Gochhayat (2021); Golaviya et al (2018); Thanaraj & Priya (2019); Rajendran & Karthigaipriya (2019)
	Slip, trip and falls	Kaur et al. (2023); Sulthana & Kumar (2020); Thanaraj & Priya (2019); Rakul & Ramadhasan (2020); Kishore & Suman (2021)
	electric shocks	Abukhashabah et al (2020); Sulthana & Kumar (2020); Thanaraj & Priya (2019); Rajendran & Karthigaipriya (2019); Rakul & Ramadhasan (2020); Saeed (2017); Kishore & Suman (2021)
	exposure to hazardous materials	Abukhashabah et al (2020); Kaur et al. (2023); Rakul & Ramadhasan (2020)
	fall from heights	Abukhashabah et al (2020); Sulthana & Kumar (2020); Thanaraj & Priya (2019); Rajendran & Karthigaipriya (2019);Kishore & Suman (2021)
	contact with objects	Kaur et al. (2023); Sulthana & Kumar (2020); Golaviya et al (2018) Thanaraj & Priya (2019) Saeed (2017); Rajendran & Karthigaipriya (2019); Kishore & Suman (2021)
	unfenced trenches	(2001) SP-70 HANDBOOK ON CONSTRUCTION SAFETY PRACTICES; Sulthana & Kumar (2020)
Equipment and Transportation Failure	**defective machinery**	Abukhashabah et al (2020); Sulthana & Kumar (2020); Golaviya et al (2018)Rakul & Ramadhasan (2020), Kishore & Suman (2021)
	falling of equipements	Abukhashabah et al (2020); Sulthana & Kumar (2020); Saeed (2017); Kishore & Suman (2021)

4) Safety Practices followed:

Table 2

Table 2 Safety Practices

Safety practices	References
Safety policy	Sulthana & Kumar (2020)
Education and training	Sulthana & Kumar (2020); Saeed (2017)
Site safety inspections	Sulthana & Kumar (2020); Thanaraj & Priya (2019); Patel & (2021)
Safety auditing	Sulthana & Kumar (2020)
Safety meeting	Sulthana & Kumar (2020)
Site safety organization	
Personal protective equipment	Sulthana & Kumar (2020); Thanaraj & Priya (2019)Rakul & Ramadhasan (2020)
Emergency support and safety & measuring devices	Thanaraj & Priya (2019)
Fall protection systems	Sulthana & Kumar (2020)
Safety Signages	Keng & Razak
safety access	Keng & Razak

5) Barriers to Safety Practices followed:

Table 3

Table 3 Barriers to Safety Practices	
Reasons for not following Safety practices	**References**
Ignorance of workers on work procedures	Sulthana & Kumar (2020)
Carelessness of workers in performing their tasks	Sulthana & Kumar (2020)
Lack of financial allocation for safety management	Golaviya et al (2018)
The training for safety officer is costly	Golaviya et al (2018)
Lack of experience of workers on safety matters	Golaviya et al (2018)
Lack of awareness among workers	Sulthana & Kumar (2020); Priyanka & Bhavya (2020)
Language barriers between supervisors and workers	Keng & Razak
The workers use defective equipment or tools	Golaviya et al (2018); Priyanka & Bhavya (2020)
Lack of staff for safety department	Sulthana & Kumar (2020)
Lack of promotion on safety matters	Golaviya et al (2018); Priyanka & Bhavya (2020)
Poor management commitment	Priyanka & Bhavya (2020)
Incompleteness of the content in the training programme	Sulthana & Kumar (2020); Golaviya et al (2018) Priyanka & Bhavya (2020)
lack of enforcement by the authority	Sulthana & Kumar (2020)

3. DATA ANALYSIS

The data gathered from the questionnaires will be analyzed and summarized to obtain meaningful insights for describing the importance of safety management practices in India's construction industry. Data analysis serves as a method for breaking down and interpreting the collected information. The survey results will be assessed using the Relative Importance Index (RII), which helps determine the relative significance of various factors. The RII is calculated using the formula:

$$RII = \sum w / (A \times N)$$

where w represents the weight assigned to each factor by respondents on a scale of 1 to 5, A is the highest possible weight (5 in this study), and N is the total number of responses.

3.1. QUESTIONNAIRE SURVEY

The survey was done among 47 numbers of stakeholders from diverse sectors of the construction industry in India. It was found that 38.3% of the respondents were project managers, 12.8% were safety managers, 29.8% were architects and the rest were contractors and engineers.

The survey reveals varied experience levels among participants in the construction industry:

- **Less than 5 years**: 59.6%

- **6-10 years**: 23.4%
- **11-15 years**: 12.8%
- **More than 15 years**: Minimal representation

Regarding project involvement:

- **Residential projects**: 95.7%, reflecting rapid urban development.
- **Commercial projects**: 76.6%
- **Other sectors (Industrial, Institutional, etc.)**: 30-40%

Safety is recognized as a critical aspect, with 56.8% emphasizing its importance. However, 66% of respondents have encountered safety-related issues on construction sites, underscoring the need for improved safety management practices.

3.2. OBSERVATIONS

The Second Part of the Questionnaire Survey asked for the respondents' views and perceptions regarding the factors accounting for major causes of accidents, most followed safety practices and barriers to safety practices.

The collected data was analyzed based on the four experience slabs of stakeholders and the findings are summarised below.

Figure 1

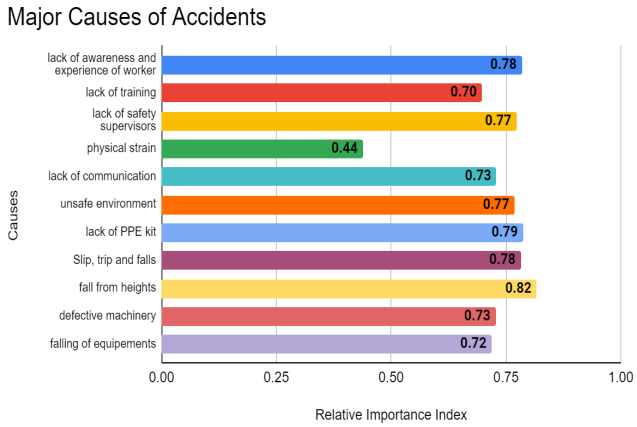


Figure 1 Causes of Accidents

Figure 2

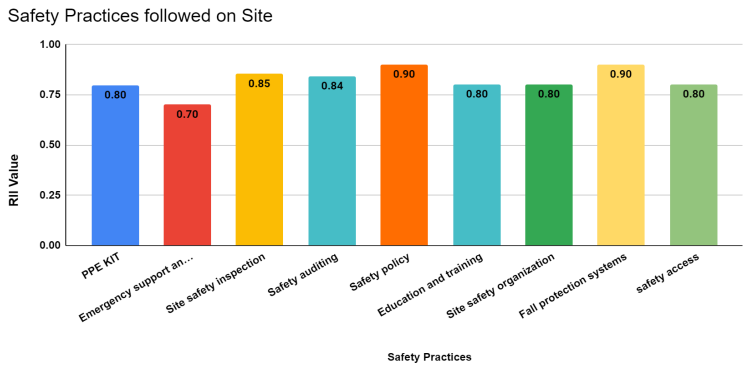


Figure 2 Safety Practices

Figure 3

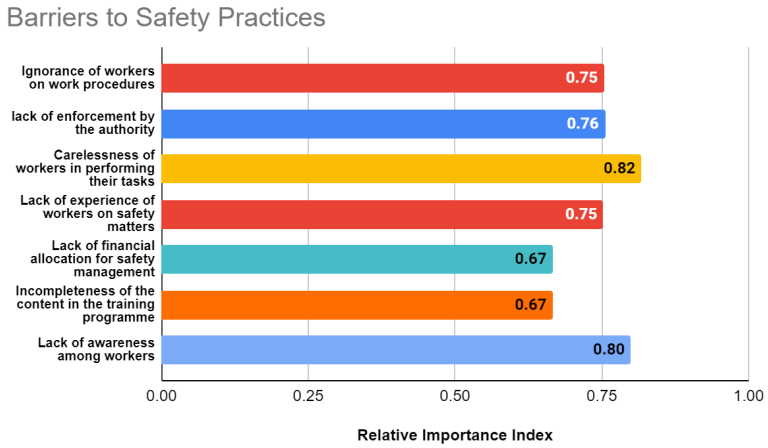


Figure 3 Barriers

4. DISCUSSIONS

The questionnaire survey conducted throughout India provides a deeper understanding of stakeholder perspectives of Occupational safety Management in the construction Industry. The questionnaire consists of three sections, General Information, Major Causes of Accidents, Most followed Safety Practices and Barriers to the Construction Industry in India.

4.1. CAUSES OF ACCIDENTS

The survey's findings highlight how crucial safety is on building sites. The majority of respondents (89.4%) said that human factors were the main cause of accidents, with work environment factors coming in second (53.2%) and machinery failures coming in third (20%).

Responses varied based on experience levels

0-5 years: Lack of safety supervisors (32.14%) and falls from heights (50%) were identified as major causes.

6-10 years: Lack of worker awareness (36.36%) was most significant, with falls from heights (45%) and defective machinery (45%) also noted.

11-15 years: Lack of training and supervision (16.6%), falls from heights lack of PPE kits (66.6%), and defective machinery (50%) were key concerns.

15+ years: All respondents emphasized the role of safety supervision and unsafe environments in causing accidents.

The findings underscore the need to prioritize safety training, supervision, awareness programs, proper PPE kits, safer work environments, and machinery maintenance to enhance site safety, worker productivity, and regulatory compliance.

4.2. SAFETY PRACTICES

The survey highlights significant gaps in the enforcement and prioritization of safety regulations on construction sites in India. Nearly half (48.6%) of respondents believe safety standards are not adequately enforced, and only 31.9% strongly prioritize safety practices on-site.

Among safety practices, the use of PPE kits emerged as a common measure, though adherence varies by experience level:

- **0-5 years**: Only 35% follow PPE kits.
- **6-10 years**: 54.5% identified site safety inspections as the most followed practice, with PPE kits as the next.
- **11-15 years**: 66.6% consider PPE kits the most adhered-to safety practice.
- **15+ years**: 50% recognized PPE kits as a key practice, alongside safety policies, site safety inspections, and fall protection systems.

The findings underscore the importance of implementing PPE kits universally and improving enforcement of safety practices to reduce accidents, prevent delays, and ensure worker safety.

4.3. BARRIERS

The survey reveals that 76.6% of respondents identify barriers to implementing safety management practices, underscoring the need for effective measures to address these challenges. The most critical barrier across experience levels is the lack of enforcement by authorities, with varying perceptions:

- **0-5 years**: 21.4% cite lack of enforcement as the main barrier.
- **6-10 years**: 27.7% highlight worker ignorance of procedures and carelessness as key barriers.
- **11-15 years**: 33.3% identify lack of enforcement as the primary challenge.
- **15+ years**: 50% emphasize lack of enforcement as the most significant barrier.

Other barriers, such as poor management commitment and inadequate promotion of safety matters, are considered less critical. Overall, improving

enforcement by authorities is vital to overcoming these obstacles and ensuring safety on construction sites.

5. CONCLUSION

- The study investigated occupational safety management in the Indian construction industry using literature, data analysis, and stakeholder surveys to determine accident causes, current practices, and safety barriers.
- Key findings: Human factors were identified as the most common causes of accidents, followed by work conditions and machinery failure. Lack of safety supervisors, insufficient worker training, falls from heights, and defective machinery were all identified as major contributors.
- Experience-Based Perspectives: Respondents with varying levels of experience held differing views on accident causes, reflecting the variety of challenges encountered on construction sites.
- Safety Regulation Enforcement: More than half of respondents thought safety regulations and standards were poorly enforced, indicating the need for stricter implementation.
- Barriers to Safety: Key barriers include a lack of worker experience, carelessness, and insufficient regulatory enforcement, emphasizing the importance of developing a strong safety culture.
- Framework Proposal: A comprehensive safety management framework could be proposed, which addresses accident causes and barriers to safe practices. This would improve safety, productivity, and reputation while lowering costs and risks in India's construction industry.

CONFLICT OF INTERESTS

None.

ACKNOWLEDGMENTS

None.

REFERENCES

Abukhashabah, E., Summan, A., & Balkhyour, M. (2020). Occupational Accidents and Injuries in Construction Industry in Jeddah City. Saudi Journal of Biological Sciences. https://doi.org/10.1016/j.sjbs.2020.06.033

Bhatuk, S. A., & Patel, A. S. (2021). Effective Safety Management in Construction.

Bureau of Indian Standards. (2001). SP-70: Handbook on Construction Safety Practices. Retrieved from

Golaviya, D., Bhingradiya, J., Chabhadiya, K., Anghan, D., & Ram, A. (2018). Health and Safety Management Analysis in Construction Site. Retrieved from https://www.ijets.in/Downloads/Published/E0202407016.pdf

International Labour Organisation. (n.d.). Safety and Health at Work. Retrieved from https://www.ilo.org/topics-and-sectors/safety-and-health-work

Jaafar, M. H., et al. (2017). Occupational Safety And Health (OSH) Management in Construction Industry: A Review. American Journal of Industrial Medicine. https://doi.org/10.1080/10803548.2017.1366129

Kanchana, S., Sivaprakash, P., & Joseph, S. (2015). Studies on Labour Safety in Construction Sites. The Scientific World Journal. https://doi.org/10.1155/2015/590810

Kaur, H., et al. (2023). Occupational Injuries Among Construction Workers by Age and Related Economic Loss: Findings from Ohio Workers' Compensation, USA: 2007-2017. Safety and Health at Work. https://doi.org/10.1016/j.shaw.2023.10.003

Keng, T. C., & Razak, N. A. (n.d.). Case studies on the Safety Management at Construction Site. Retrieved from https://www.researchgate.net/publication/283242992_Case_Studies_on_the_Safety_Management_at_Construction_Site

Kishore, A. N., & Suman, A. V. (2021). Accidents at Construction Sites: A Legal Perspective. Retrieved from https://www.irjmets.com/uploadedfiles/paper/volume3/issue_6_june_2021/13202/1628083517.pdf

Kunodzia, R., Bikitsha, L. S., & Haldenwang, R. (2024). Perceived Factors Affecting the Implementation of Occupational Health and Safety Management Systems in the South African Construction Industry. MDPI. https://doi.org/10.3390/safety10010005

Nik Fadhilah Nik Him, et al. (2023). Assessment of Safety Management Attitude Practices Toward the Safety Culture of the Construction Sector. Pertanika Journal. https://doi.org/10.21837/pm.v21i25.1220

Patel, D. A., & Jha, N.K. (2016). An Estimate of Fatal Accidents in Indian Construction. Retrieved from https://www.researchgate.net/publication/308155592

Patel, U., Pitroda, J., & Raichura, C. S. (2021). Construction Safety Management in Construction Project. Retrieved from https://www.researchgate.net/publication/354061168_CONSTRUCTION_SAFETY_MANAGEMENT_IN_CONSTRUCTION_PROJECT

Priyanka, M. K., & Bhavya, K. (2020). Safety Analysis in Construction Industry. Retrieved from https://www.irjet.net/archives/V7/i6/IRJET-V7I61226.pdf

Rajendran, P., & Karthigaipriya. (2019). Safety Management in Construction Sites: Fall from Height. Retrieved from https://www.researchgate.net/publication/332548202_Safety_Management_in_Construction_Sites_-Fall_from_Height

Rakul, P., & Ramadhasan, T. D. (2020). Safety and Quality Issues in Construction Industry. Retrieved from https://www.ijert.org/advancements-and-challenges-in-safety-management-in-building-construction-a-comprehensive-review

Saeed, Y. S. (2017). Safety Management in Construction Projects. Retrieved from https://www.researchgate.net/publication/319215798_SAFETY_MANAGEMENT_IN_CONSTRUCTION_PROJECTS

Samanta, S., & Gochhayat, J. (2021). Critique on Occupational Safety and Health in Construction Sector: An Indian Perspective. Materials Today: Proceedings. https://doi.org/10.1016/j.matpr.2021.05.707

Sulthana, R., & Kumar, N. (2020). Safety Management in Construction Project Management. Retrieved from https://www.irjet.net/archives/V7/i12/IRJET-V7I12122.pdf

Thanaraj, M. S., & Priya, M. (2019). Effective Safety Management in Construction. Retrieved from https://www.irjet.net/archives/V6/i4/IRJET-V6I4182.pdf