The Asian Review of Civil Engineering
ISSN: 2249-6203 (P) Vol.11 No.2, 2022, pp.10-14

DOI: https://doi.org/10.51983/tarce-2022.11.2.3455

Statistically Analyzing Fatal Accidents Pattern of Construction Activities in India

Saket Patni
PG Student, Department of Architecture, School of Planning and Architecture, Vijayawada, Andhra Pradesh, India
E-mail: 1210900056@spav.edu.in

Abstract - **In construction activities, fatal accidents occur frequently due to inherently dangerous nature which accounts for around 38 fatal accidents every day as reported by leading news articles. The aim of the paper was to investigate the pattern of fatal accidents in India's construction works by utilizing a statistical method known as frequency analysis. The methodology includes the collection of data on accidents published by government departments, private bodies, and journals related to this topic. The results were achieved by assessing the year, month, and state factors. The findings reveal that there are noticeable trends in fatal mishaps. These data can be used to offer guidance for corrective or preventive measures for occupational injuries. The pattern identified in this paper can be useful to guide the development of accident-preventative measures.**
Keywords: **Accident Analysis, Accident Prevention, Construction Activities, Fatal Accident Patterns, Statistical Analysis**

I. INTRODUCTION

With India's inevitable economic development, the construction industry's Gross Domestic Product (GDP) has risen dramatically, accounting for about 23.5% of GDP annually, which is nearly equal to the global average. In recent years, the construction industry has contributed a considerable portion of India's GDP, laying a firm foundation for urbanization. The movement of people from the countryside to urban centers is a major feature of urbanization [4]. The construction industry, as a major source of employment, has sped up the transfer by employing a large majority of countryside excess workmen. With the accelerated growth of the urban population, a major number of construction projects (for example, commercial buildings, multi-family residences, single-family or duplex dwellings) are necessary to withstand the growing needs of people's lives, particularly the residential need. Furthermore, due to the increasing age of buildings, certain developed cities must maintain an increasing number of development projects [7].

Unfortunately, in developing nations like India, the construction business has a bad reputation for being dangerous. Construction accidents are notorious for causing an abundance of negative repercussions, including absenteeism, project delays, and lifelong. Fatal mishaps, in particular, not only result in a high number of casualties, but also significant human, societal, and financial losses. Every day, roughly 38 workers die in tragic incidents, according to various news articles. As a result, there is a pressing need to do research into the prevention of fatal construction accidents.

To begin with, because construction activities are congested with numerous workforce types (e.g., supervisors, foremen, steelworkers, scaffold workers, and machinery operators) as a result of the use of labor-intensive methods, carrying out connected construction works within a limited work area is prone to fatal mishaps [14]. As a result, construction works are consistently carried out outside, exposing on-site personnel to unknown threats such as abnormal climatic change, falling objects, falling people, and running machinery [6], [13]. Furthermore, the momentary and transitory character of construction workplaces and projects contributes to a dynamic workforce, requiring construction companies to engage new workers regularly, many of whom lack experience and training, making them vulnerable to construction mishaps [8], [11] [13]. Last but not least, multi-story or high-rise structures continue to be popular in construction projects, and there are several risks associated with working at height, vertical transit, and heavy gear [6].

II. LITERATURE REVIEW

The lack of accident statistics is a barrier to doing construction safety studies in India [16]. In India, the construction industry employs 67.5 million people (Indian Labor Statistics 2021), and there is a skilled labor shortage. Natural depreciation and the requirement for contemporary trades skills mean that the construction sector still requires at least six million people each year (Construction Industry Development Council report 2020-21). This demonstrates the significance and worth of workers in the construction business and serves as motivation to examine the existing accident data in the Indian construction industry.

Contractors are generally reluctant to report accidents to the appropriate authorities. As a result, analyzing the accident trend and evaluating the construction industry's safety performance at the state and national levels becomes challenging. As a result, comparing India's safety performance to that of other countries becomes increasingly problematic. Nonetheless, the data on fatal and non-fatal mine, factory, and railway accidents are included in Indian

Labor Statistics (2020-2021). However, an analysis of estimates of fatal and non-fatal construction accidents is not included. As a result, analyzing the fatal accident pattern of construction in India is critical.

III. MATERIALS AND METHODS

A. Data Collection

The accident information was gathered from a variety of feasible sources. These resources were discovered through previous research and discussions with experts and professionals. Some were part of a direct approach, while others were indirect. The data was gathered from a total of five different sources. These are briefly outlined in the section on data collecting below.

1. National and International Journals
2. Websites of Government Departments and Private Bodies
3. Leading newspapers
4. Online search engines
5. Non-Government Organizations (NGO)

1. Review of the Collected Accident Data: The accident numbers in Indian construction cited in international and national journals have no sound basis. Similarly, the accessible government (such as concerned departments and ministries) and NGO records have limitations because they only capture data for incidents that are recorded. Not all accidents are covered by all major media and online search engines.

B. Data Arrangement

Although there are standard templates for statistical reliability (SR), the components of raw reports can differ because the manner in which accident information is described differs from person to person [15], [21]. Key fatality data, such as 'year' and 'month' from 'date' and 'state' from 'accident location', was obtained from the original data to provide uniform data which are well suited for accident analysis. As a result, essential statistical parameters and their possible states are below, and each fatal accident can be simply summarised using the key accident data.

Year: 2017, 2018, 2019, 2020, or 2021
Month: A month from January to December
State: A province from 28 provinces

C. Data Analysis Method

Accident patterns are always studied using statistical analysis and having a strong understanding of particular accident patterns is beneficial for accident prevention [26]. The frequency analysis method was used in this study to first extract usable information from the frequency of fatal incidents for the key components like the year, month, and state. Various statistical charts depicted the statistical characteristics of fatal mishaps, and some accident patterns were investigated based on them. Furthermore, the fatal accident Excel format database organized in Section B has been uploaded into SPSS19.0, which has been used to run the above-mentioned statistical analysis.

IV. RESULTS AND DISCUSSION

A. Frequency Analysis

The frequency analysis is primarily concerned with the statistical description of fatal mishaps by year, month, and state.

1. Year

Fig. 1 depicts the number of fatal mishaps that decreased somewhat from 2018 to 2020 but increased dramatically in 2021. The figure for 2021 is 28.7% higher than the average for the previous four years and 47.2% higher than the figure for 2020. Because of the nature of outdoor construction operations, the accident rate is frequently linked to the weather. Construction workers can be more likely to be exposed to unforeseen job hazards as a result of abnormal climate change. On the other hand, reporting fatal accidents under tight audit procedures is further evidence of a radical shift in personnel mentality. Construction companies have been gradually developing on-site emergency plans in latest years, and adequate on-site first-aid procedures can be the driving force behind such a pattern. However, it's also worth noting that some deadly incidents can go unreported.

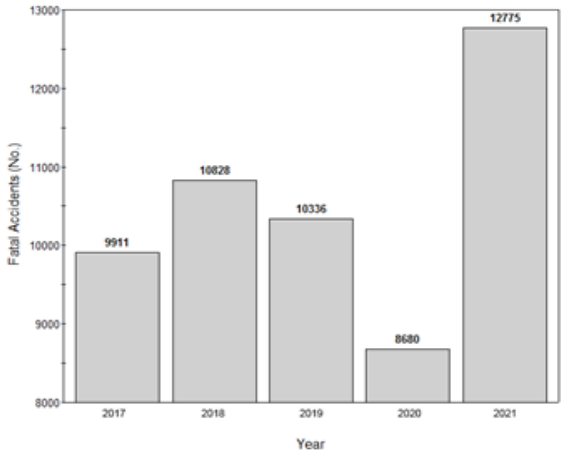

Fig. 1 Division of fatal mishaps by year

2. Month

With the exception of April and May, the monthly accident rate remains fairly consistent throughout the remaining months. These two months have the highest fatality rate of any month, making up for 22.2 percent and 21.7 percent of all months, respectively. Summer in India lasts from April to May, and more accidents occur during this time. Summer

heat, particularly above 40 degrees Celsius, is normally unbearable for humans, and workmen can be compelled to work hard hours to meet construction schedule requirements as the days lengthen. Workers are prone to exhaustion as a result of the heat and long hours of work, which is why fatalities are common in April and May.

In contrast, the count of fatal mishaps and deaths in January (winter month) is the lowest, partially as the cold makes specific construction works (e.g., reinforced concrete casting) difficult, which means that rigorous construction works are avoided on a typical operating day. Similarly, the preceding argument could be applied to explain the situation in December (winter month). Furthermore, the lower mishap rate in January could be attributed to the increased number of Indian vacations. There are fewer construction works to finish and fewer working days in January.

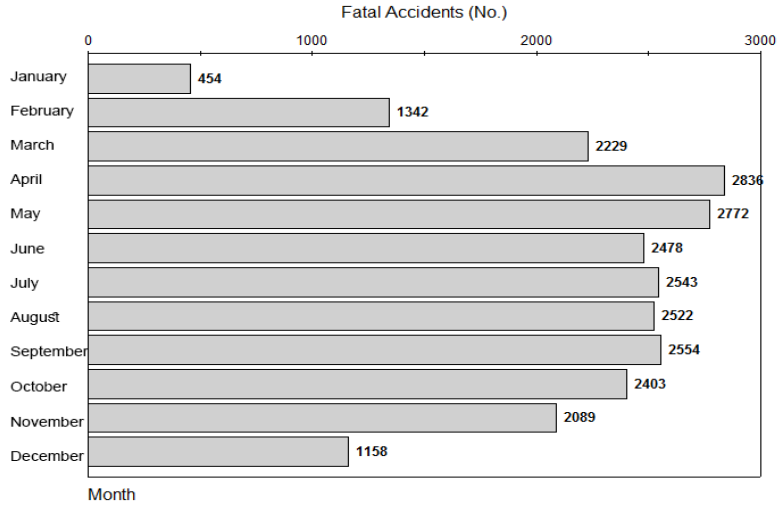

Fig. 2 Division of fatal mishaps by month

3. State

As shown in Fig. 3, the states in the north-eastern part of the country have a very smaller number of fatal accidents. Bihar has a very large number of fatal accidents which is almost 5 times the average of fatal accidents in all the states. Other states like Maharashtra, Tamil Nadu, and Uttar Pradesh are also contributing to a large number of fatal accidents when combined as a whole. The national capital, Delhi significantly shows a smaller number of fatal accidents as compared to most of the states and Union territories. States like Arunachal Pradesh, Manipur, Mizoram, Nagaland, and Tripura have less than 10 fatal accidents. This can be due to the fact that these states have a lesser number of construction activities as compared with other states in the country.

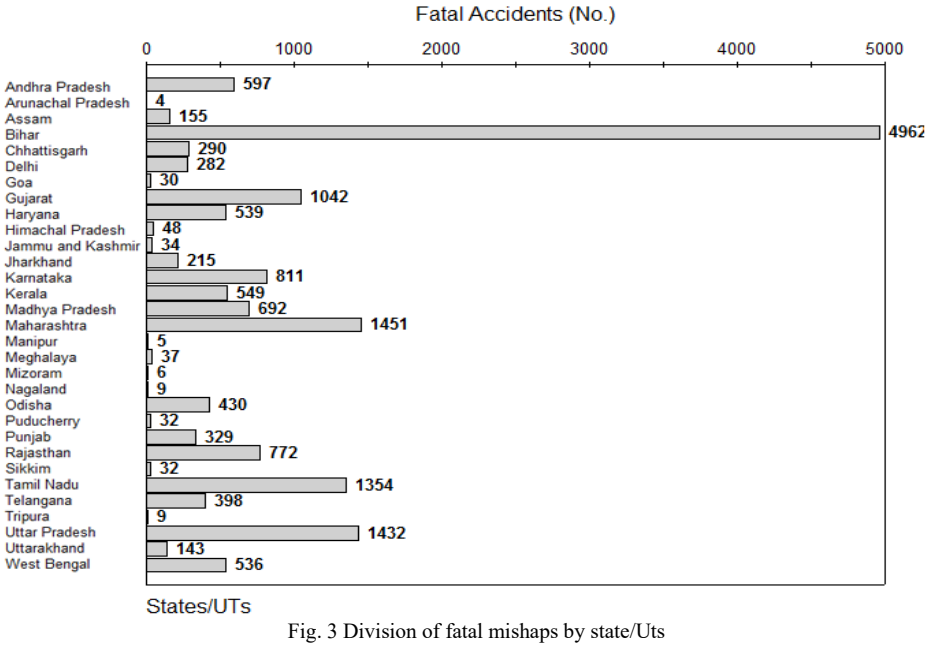

Fig. 3 Division of fatal mishaps by state/Uts

V. CONCLUSION AND RECOMMENDATIONS

Construction works have a large risk of mortality because of their inherent danger. The goal of this research is to look into fatal accidents that have occurred in India's construction industry and to look into fatal accident patterns. The findings reveal that there are evident trends in fatal incidents. Based on these data, recommendations for preventing fatal accidents in construction operations are made. As a result, the trends identified in this article can serve as a useful reference for both regulators and construction companies looking to improve the industry's safety.

The incidence of fatal accidents increased dramatically in 2021. To minimize the fatal accident rate, more effective prevention techniques are urgently needed. In summer, especially in April and May, there are more fatal incidents. As a result, it's critical to maintain suitable working hours and provide workers with sufficient personal protection equipment. Workers should also not be allocated to excessive daily construction activities when the temperature is over the human working temperature.

The importance of construction safety must be highlighted by construction companies. Furthermore, onsite safety management employees should devote appropriate attention to construction activities as well as accident emergency rescue. Workers, particularly those without personal protection equipment or safety training, should be reminded of the importance of safety. Toolbox presentations can be used to teach employees how to create and maintain safer working environments, as well as urge identifies, avert, notify, and put the right workplace hazards.

VI. LIMITATIONS

The above study looked at fatal mishaps that occurred during India's construction activity and discussed fatal accident patterns. Most of the published sources only included the 'date', 'accident location', and 'number of casualties'. This is why the study's statistical analysis focused solely on parameters such as the year, month, and state. As a result, the current findings are limited in terms of apparent fatal accident patterns. Future research in India's construction operations will be conducted in order to obtain more accident data, which is an unavoidable necessity of accident prevention. Despite recent improvements in the obligatory audit system, omitted reporting, fake reporting, and hidden reporting of accidents can still persist. The results could not be more precise to some extent.

REFERENCES

[1] M. Amiri, A. Ardeshir and M. H. Fazel Zarandi, "Risk-based analysis of construction accidents in Iran during 2007-2011-meta analyze study," *Iran J. Pub. Health,* Vol. 43, pp. 507-522, 2014.

[2] M. Amiri, A. Ardeshir, M. H. Fazel Zarandi and E. Soltanaghaei, "Pattern extraction for high-risk accidents in the construction industry: a data-mining approach," *Int. J. Injury Control Safe. Promot*., Vol.23, pp. 264-276, 2016.

[3] R. M. Choudhry, D. P. Fang and H. Lingard, "Measuring safety climate of a construction company," *J. Constr. Eng. M Asce,* Vol. 135, pp. 890-899, 2009.

[4] J. L. Fan, Y. J. Zhang and B. Wang, "The impact of urbanization on residential energy consumption in China: an aggregated and disaggregated analysis," *Renew. Sust. Energ. Rev.,* Vol. 75, pp. 220-233, 2017.

[5] F. J. Forteza, J. M. Carretero-Gomez and A. Sese, "Occupational risks, accidents on sites and economic performance of construction firms," *Saf. Sci.,* Vol. 94, pp. 61-76, 2017.

[6] I. W. H, Fung, V. W. Y. Tam, T. Y. Lo and L. L. H. Lu, "Developing a risk assessment model for construction safety," *Int. J. Proj. Manag.,* Vol. 28, pp. 593-600, 2010.

[7] M. Gangolells, M. Casals, M. Forcada and M. Macarulla, "Predicting on-site environmental impacts of municipal engineering works," *Environ. Impact Assess. Rev.,* Vol. 44, pp. 43-57, 2014.

[8] J. Hinze and J. Gambatese, "Factors that influence safety performance of specialty contractors," *J. Constr. Eng. M Asce*, Vol. 129, pp. 159-164, 2003.

[9] K. Hu, H. Rahmandad, T. Smith-Jackson and W. Winchester, "Factors influencing the risk of falls in the construction industry: a review of the evidence," *Con. Manag. Eco.,* Vol. 29, pp. 397-416, 2011.

[10] H. J. Im, Y. J. Kwon, S. G. Kim, Y. K. Kim, Y. S. Ju and H. P. Lee, "The characteristics of fatal occupational injuries in Korea's construction industry," *Saf. Sci.,* Vol. 47, pp. 1159-1162, 2009.

[11] Y. Kang, S. Siddiqui, S. J. Suk, S. Chi and C. Kim, "Trends of fall accidents in the U.S. construction industry," *J. Constr. Eng. M Asce,* Vol. 143, 04017043, 2017.

[12] C. W. Liao, "Pattern Analysis of Seasonal Variation in Occupational Accidents in the Construction Industry," *2012 International Workshop on Information and Electronics Engineering,* Vol. 29, pp. 3240-3244, 2012.

[13] C. W. Liao and Y. H. Perng, "Data mining for occupational injuries in the Taiwan construction industry," *Saf. Sci.,* Vol. 46, pp. 1091-1102, 2008.

[14] I. Mohammadfam, A. Soltanzadeh, A. Moghimbeigi and M. Akbarzadeh, "Factors affecting occupational accidents in the construction industry (2009-2013)," *J. Occup. Health Epi.,* Vol. 3, pp. 88-95, 2014.

[15] H. Ohtani and M. Kobayashi, "Statistical analysis of dangerous goods accidents in Japan," *Saf. Sci. Vol. 43*, pp. 287-297, 2005.

[16] D. A. Patel, "Estimating the Number of Fatal Accidents and Investigating the Determinants of Safety Performance in Indian Construction, PhD thesis", *Indian Institute of Technology Delhi*, New Delhi, India, 2015.

[17] Dilip Patel and Kumar Jha, "An Estimate of Fatal Accidents in Indian Construction", 2016.

[18] Y. B. Peng, S. Zhang and P. Wu, "Factors influencing workplace accident costs of building projects," *Saf. Sci.,* Vol. 72, pp. 97-104, 2015.

[19] J. C. Rubio-Romero, M. C. R. Gamez and J. A. Carrillo-Castrillo, "Analysis of the safetyconditions of scaffolding on construction sites," *Saf. Sci.,* Vol. 55, pp. 160-164, 2013.

[20] J. Sa, D. C. Seo and S. D. Choi, "Comparison of risk factors for falls from height between commercial and residential roofers," *J. Saf. Res.* Vol. 40, pp. 1-6, 2009.

[21] F. Salguero-Caparros, M. Suarez-Cebador and J. C. Rubio-Romero, "Analysis of investigation reports on occupational accidents," *Saf. Sci.,* Vol. 72, pp. 329-336, 2015.

[22] D. C. Sang and K. Carlson, "Occupational safety issues in residential construction surveyed in Wisconsin", *United States Ind. Health,* Vol. 52, pp. 541, 2014.

[23] Bo Shao, Zhigen Hu, Quan Liu, Shu Chen and Wenqin He T., "Fatal accident patterns of building construction activities in China," *Safety Science*, [Online]. Available: 111.10.1016/j.ssci.2018.07.019, 2018.

[24] S. Unsar and N. Sut, "General assessment of the occupational accidents that occurred in Turkey between the years 2000 and 2005," *Saf. Sci.,* Vol. 47, pp. 614-619, 2009.

[25] L. Wang, Y. P. Cheng and H. Y. Liu, "An analysis of fatal gas accidents in Chinese coal mines," *Saf. Sci.,* Vol. 62, pp. 107-113, 2014.

[26] Y. P. Zheng, C. G. Feng, G. X. Jing, X. M. Qian, X. J. Li, Z. Y. Liu and P. Huang, "A statistical analysis of coal mine accidents caused by coal dust explosions in China," *J. Loss Prev. Process Indust.,* Vol. 22, pp. 528-532, 2009.

[27] Z. P. Zhou, Y. M. Goh and Q. M. Li, "Overview and analysis of safety management studies in the construction industry," *Saf. Sci.,* Vol. 72, pp. 337-350, 2015.