

Construction Site Accidents: Root Causes

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Abstract

The construction industry plays a significant role in driving a nation's economic development. In Malaysia, this sector continues to demonstrate substantial growth, contributing positively to the country's economic progress. However, alongside this expansion, the industry has also been identified as one of the sectors with the highest fatality rates. This is largely due to the inherently hazardous nature of construction work and the risks present on job sites. Construction site accidents are typically defined as unforeseen incidents that lead to injuries ranging from minor to fatal or result in damage to equipment, materials, structures, or machinery. The aim of this study is to identify the dominant root causes contributing the construction site accidents in Malaysia. Through a structured survey conducted among industry professionals and subsequent analysis using the Statistical Package for the Social Sciences (SPSS), several key contributing factors were identified. The leading cause was found to be Inadequate Knowledge of Handling. This was followed by incidents involving Electrical Shocks, the third major factors are Structural Failures, and the fourth most critical factor is Improper Use of Construction Machinery.

Key Words: *Root Causes; Construction Sites; Accidents.*

1.0 Introduction

The growth of the construction industry development can give a major contribution to country's economy improvement. Construction industry considered plays once of the significant role in contributing to the economic performance of country (Nadia et al.,2020). Indeed, the Malaysian construction industry continues to enhance the country's economy by displaying voluminous growth. However, in line with the growth of country economy, Malaysian construction industry was classified as amongst the major high rate of fatalities due to the nature of the industry and the hazards involved during the time of construction (Jaafar et al., 2017; DOSH 2022). Even though, various approaches have been implemented to prevent accidents, the construction workers are repeatedly exposed to various essential risks associated with working conditions on construction sites.

Site construction accidents are defined as unplanned events which result in minor or major injury and fatalities directly or indirectly to workers, and result in damage to materials, structures, tools, equipment, and machineries (Asan & Akasah.,2015). Based on findings by much previous research have disclosed that most of the accident doesn't happen by pure chance and co-accidents (Qing & Zerong.,2023). Construction site accidents possibly will emerge because of two main causes either by unsafe conditions or unsafe acts or both. Unsafe condition- is a condition in which the physical layout of the work location or workplace, the status of material, equipment, and/or tools is in violation of current safety standards. Unsafe act - contrarywise, can take place despite of the initial conditions of the workplace - whether the condition is safe or unsafe (Amran & Zainal A.,2014).

The high rate of construction accidents can largely be attributed to the inherent complexity of the industry. Therefore, a thorough approach to identifying the root causes of construction site accidents is essential for understanding the underlying factors contributing to these incidents (Hamid et al., 2019). Hence, by correctly determining and understanding this root causes arose only can be determine effectively and appropriately preventive strategies. However, this process remains a challenging and complicated task. Only by correctly identifying the true causes can targeted and integrated safety programs be developed. These programs can then serve as a foundation for guidelines, legal frameworks, and on-site safety policies aimed at reducing accidents (Ruslan & Nooraini., 2022).

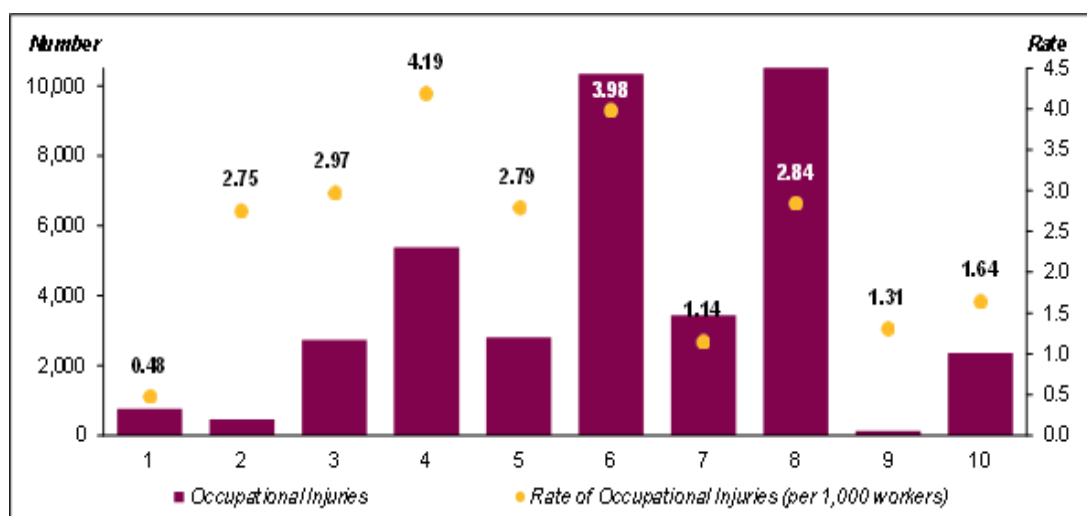
This study specifically aims to identify the most dominant root causes of construction site accidents in the Malaysian context. By gaining a deeper understanding of these contributing factors within the local environment, the findings of this research can support industry stakeholders in enhancing safety standards, reducing accident rates, and fostering a safer construction work environment.

2.0 Literature Review

Previous local and international research has consistently highlighted the persistent challenges in implementing, improving, and sustaining effective safety management practices within the construction industry (Hamid et al., 2017). Despite ongoing efforts, the complexity of construction environments continues to pose significant obstacles. Over the years, various regulatory bodies have been established, and multiple legislative measures have been introduced to develop a more comprehensive legal framework aimed at safeguarding the health and safety of construction workers (Mohammad et al., 2015). However, the effectiveness of these safety measures is often influenced by a multitude of factors. These include the geographical and topographical characteristics of project sites, the scale and complexity of developments (such as high-rise versus low-rise projects), regional climatic conditions, the availability of labour and material resources, the types of machinery deployed, the nature of project designs, and the construction methods employed. Furthermore, the level of expertise among both workers and domain professionals, along with the adoption of emerging technologies and ICT tools, significantly affects the actual implementation of safety protocols on-site (Adel et al., 2022).

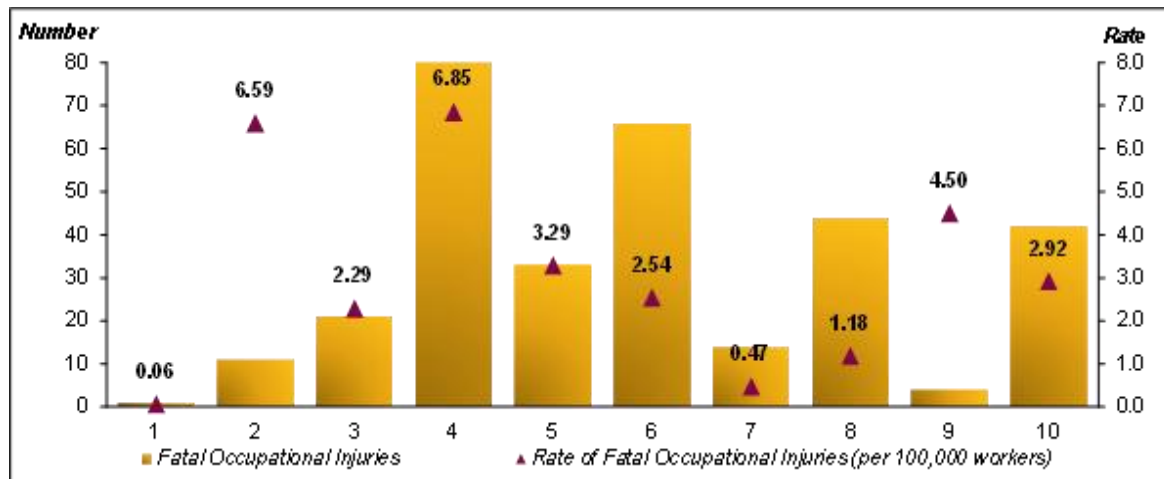
Recent data from the Social Security Organisation (SOCSO., 2024) has indicated that in 2023, a total of 9,338 construction workers were involved in workplace accidents. This marks a significant increase of 27.26% compared to 7,338 reported cases in 2016. The reported incidents represent approximately 4.19% of the total construction workforce in Malaysia, highlighting a persistent concern regarding site safety. In addition, the Department of Occupational Safety and Health (DOSH., 2024) had recorded that 173 construction site accident cases during the same year, this has given a clear indication that further emphasizing the urgent need for improvement of safety and health measures in Malaysia's site construction industry.

Figure 1: Occupational Injuries in Malaysian Industry (OSHA., 2023)



Note chart 1 & 2

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|---|--------------------------------------|
| 1 Hotels and Restaurants | 6 Manufacturing |
| 2 Utilities | 7 Wholesale and Retail Trades |
| 3 Finance, Insurance, Real Estate and Business Services | 8 Services |
| 4 Construction | 9 Mining and Quarrying |
| 5 Transport, Storage and Communication | 10 Agriculture, Forestry and Fishing |

Figure 2: Fatal Occupational Malaysian Injuries (DOSH.,2023)

At the same, recorded from the Department of Occupational Safety and Health (DOSH) stated that total numbers of 88 deaths were reported in the construction industry in 2023 compared with 72 cases in year's 2022 (DOSH & OSHA.,2024), an increasing of 22.22% in total. Based on these statistics and other researchers for construction site accidents occurred has shown that the accident rate in the construction industry for the country is still high especially by comparison to other sectors.

2.1 Root Cause of Construction Accident

In Malaysia, the construction industry undeniably plays a vital role in national development. However, safety-related issues on construction sites remain a persistent and pressing concern. Controlling and reducing the number of accidents in this sector has become increasingly difficult for the relevant authorities. As a proactive measure to mitigate such incidents, it is essential to first identify the key root causes of construction site accidents (Panassaya et al., 2015). Table 1 presents a list of 20 root cause factors identified from previous studies conducted in various countries. This preliminary analysis serves to assess whether these factors are also prevalent within the Malaysian construction industry context.

Table 1: List of root causes contributing to construction site accidents.

Root Cause	Reference
Structural failure	Nasser & Samer.,2014; Samuel et al.,2012; Lawrence et al.,2003.
Inadequate safety features	Seoka et at., 2012; rozanah et at,2008; Lilis.,2012
Fail to inspect the environment before work	Nunnally., 1978
Negligence	Adel et al.,2012; Ali et al., 2013
Unsuitable weather or climatic conditions	Sekaran.,2003; Chan et al.,2001
Use of inappropriate tools & equipment	Ching et al.,2010; Himadri et al.,2013
Incorrect use of PPE	Kajal et al.,2007; Patrick et al.,2010; Sariah.,2014
High place without use of safety facilities	Ching et al.,2012
No safety measure taken on the roof	Hashem.,2010
Unmonitored by supervisor	Zahra et al.,2012; Heinrich et al.,2011
Unauthorized operation of equipment	Seyyed et al.,2012
Equipment or tool failure	Akhmad et al.,2009; Jantaneet et al.,2013
Equipment without safety devices	Berend et al.,2010.
Exposed to electrical shock	Jimmie et al.,2011; Tariq et al.,2014
Failure to report breakdown of machinery	Hashem et al.,2014
Failure to use safety features	Abdelnaser et al.,2013; Mousa Muftah et al.,2011
Inadequate knowledge in handling machine	Patrick et al.,2014; Manu et al.,2013;Subashini.,2010
Failure to obey instructions	Kamal et al.,2013; Thanet et al.,2012
Improper handling of machineries	Bendixen et al., 2014; Nunnally et al, 2010
Stuck under falling object	Rahim.,2014;Pejman et al.,2013;Kiyanoosh.2012

3.0 Methodology

To understand and identify the most obvious of root cause an exploratory quantitative survey was conducted to the Malaysian construction industry players. The targeted population are from prominent professional of clients, consultants, developers and contractor's company. Project managers, contract managers, civil engineers, quantity surveyor, architect, site engineers, site supervisor, site safety supervisor with at least 5 years of experiences. The structured questionnaire was distributed in state of Selangor, Negeri Sembilan and Melaka by using the google form methods. The answers are based on a Likert bipolar scale; namely in 1–5 point scale, where 1 is 'not significant', 2 is 'slightly significant', 3 is 'moderately significant'. 4 is 'significant and 5 is 'very significant'. The scale was provided to gather the level of importance of each factor. 36 returned and valid samples were analysed using Statistical Package for Social Science (SPSS) - version 2.0. The reliability was measured using Cronbach's Alpha values, and a mean score (1-5) analysis was used to rank the factors in this research for differing level of significant factors among the variables.

4.0 Result and Discussion

From 65 distributions surveys to the practitioner's respondents, 36 return with complete answer was analyses and validated. The highest respondents are contractors at 56%, followed by developers (15%), civil engineering & structural consultants (14%), quantity surveyor's consultants (10%) and architectural consultants (5%). The numbers of years of respondents' experience in construction industry between 16 and above is 30%, followed by 40% with working experience in between 10 to 15 years and 30% with working experience ranging between 5 to 9 years. For the respondent's qualification the highest percentage of 67% are degree holders. 28 % are diploma holders and 5% are master holders.

4.1 Identifying Significant Root Causes

The data collected was analyzed by SPSS -version 2.0, to determine the reliability of Cronbach's Alpha value (reliability coefficient) and the test values of the instrument were 0.84 is greater than minima accepted values of 0.70, this result was indicated that data collected, and measurement process was sufficiently reliable. Then ranking analysis was run by the ranking key variables, where the mean score of root causes analysis, based on Mean Rank Score approach (Table 2) as below.

Table 2: List of Root causes, Mean rank value and Standard deviation

Variables	Mean	Std. Deviation	Rank
Inadequate knowledge of handling	4.69	.53273	1
Electrical shock	4.68	.53374	2
Structural failure	4.67	.54560	3
Improper handling of machineries	4.67	.56174	4
Failure to obey instructions	4.66	.59471	5
Inadequate safety features	4.65	.59471	6
Failing to inspect working environment	4.65	.59471	7
High place without use of safety facilities	4.64	.59710	8
Negligence	4.63	.59829	9
No safety personnel to monitor	4.62	.59930	10
Equipment failure	4.60	.60408	11
Unauthorized operation	4.59	.60369	12
Incorrect use of PPE	4.59	.61942	13
Failure to report breakdown	4.58	.61073	14
Without a safety device	4.57	.62988	15
Unsuitable climatic conditions	4.56	.62003	16
No safety on roof	4.56	.63514	17
Use of inappropriate equipment	4.54	.63201	18
Stuck under falling object	4.53	.63514	19
Failure to use safety feature	4.49	.63471	20

Based on the result, it was found that Inadequate knowledge of handling with mean 4.69 is the top significant factors. Furthermore, the second factors is Electrical shock with mean rank 4.68, meanwhile Structure failure is the third top major factors with rank mean 4.67 and Improper handling of machineries with mean 4.67 is the fourth significant root factors with mean 4. The top 4 significant factors will be discussed more as below:

4.1.1 Inadequate Knowledge of Handling

Inadequate Knowledge in Handling Machinery and Equipment was identified as the leading root cause of accidents within the Malaysian construction industry. This finding is consistent with previous international studies. For example, Patrick et al. (2014) in the United Kingdom, Manu et al. (2013) in Morocco, and Subashini (2010) in Taiwan all reported similar conclusions, highlighting a lack of proper handling skills as a major contributor to construction site accidents. Similarly, Adel et al. (2015) in Canada emphasized that numerous industrial incidents stem from insufficient knowledge in operating machinery. Supporting this, Himadri et al. (2014), in their research conducted on construction sites in India, also identified inadequate machinery handling skills among workers as a significant factor contributing to workplace accidents.

4.1.2 Electrical Shock

The second major root cause of construction site accidents is Electric Shock, which recorded a mean rank value of 4.68 in this study. This finding aligns with a wide range of international research highlighting that electric shock is a significant contributor to serious injuries and fatalities on construction sites. Tariq et al. (2014), in a study conducted in the United States, found that approximately 86% of construction-related accidents were linked to electrical apparatus or faulty wiring, identifying electrical hazards as a primary risk factor. Similarly, Jimmie et al. (2011) reported that in Australia, electric shock was among the most frequent and dangerous types of construction site accidents, often resulting in severe injuries and fatalities. In Indonesia, Yusuf et al. (2011) classified electrocution as one of the leading causes of fatal construction incidents. Supporting this, Nawawee et al. (2009) revealed that from 2005 to 2008, electrical shock was the predominant cause of construction accidents in Southern Africa. In the Malaysian context, Dayang and Gloria (2012) also highlighted structural failures and component breakdowns during construction activities as major contributors to site accidents, although not limited to electrical causes alone.

4.1.3 Structural Failure

Structural Failure was identified as the third leading root cause of construction site accidents, with a mean value of 4.67. Research by Nasser and Samer (2014) in Libya emphasized that the use of conventional in-situ construction methods—characterized by extensive manual labor—poses higher safety risks compared to off-site prefabrication techniques. Their study indicated that manual construction practices are more prone to hazards such as premature structural collapse, which negatively impacts both safety and quality. Similarly, Samuel et al. (2012) in South Africa reported that structural failure represents a major contributing factor to site accidents. In Taiwan, Ching et al. (2013) found that structural collapses accounted for a significant proportion of construction-related incidents. These findings collectively suggest that enhancing structural design practices, enforcing regular inspections, and adhering to safe construction procedures are critical steps toward creating a safer working environment for construction workers.

4.1.4 Improper Handling of Machineries

Improper Handling of Machinery ranks as the fourth most significant root cause of construction site accidents, with a mean rank value of 4.67. This finding is consistent with several international studies. Bendixen et al. (2014), in their research conducted in the Netherlands, highlighted improper machinery handling as a critical contributor to site-related incidents. Similarly, Nunnally et al. (2010) identified it as a key cause of accidents in the construction industry in Lebanon. Comparable conclusions were drawn by Suraji et al. (2011) in the United States and by Aksorn and Hadi (2015) in Thailand, both of whom emphasized the importance of proper machinery operation to ensure site safety. In the Malaysian context, Noorul et al. (2012) also recognized improper handling of machinery as one of the leading factors contributing to construction accidents. These consistent findings across different regions reinforce the need for adequate training and supervision in machinery operation to mitigate risks on construction sites.

5.0 Conclusion

Extensive research conducted globally has consistently identified a wide range of factors contributing to construction site accidents. These root causes have been examined across diverse geographical regions, climates, site topographies, construction techniques, and project types including residential buildings, commercial developments, office towers, malls, and infrastructure projects. Despite these variations, the construction industry continues to be recognized internationally as one of the sectors with the highest rates of workplace accidents, often resulting in serious injuries and fatalities. This study contributes to the ongoing effort to pinpoint the most critical root causes of construction site accidents within the Malaysian context. Based on both global literature and local findings, the four most significant contributing factors identified are: inadequate knowledge of handling, electric shock, structural failure, and improper handling of machinery.

To mitigate the risk of accidents and translate these findings into practical safety and health policies, it is imperative for all stakeholders in the construction industry to strengthen their understanding and implementation of effective safety management practices. Moreover, these insights should be integrated into comprehensive safety strategies, including increased safety awareness, the enforcement of preventive measures, the development of clear safety guidelines and policies, and the provision of targeted training programs. Such efforts will support improved worker performance and organizational management in addressing safety and health challenges on construction sites.

References

- Adel Rafieyan, H., Sarvari, H., & Chan, D. W. M. (2022). *Identifying and evaluating the essential factors affecting the incidence of site accidents caused by human errors in industrial parks construction projects*. International Journal of Environmental Research and Public Health, 19(16), 10209. <https://doi.org/10.3390/ijerph191610209>
- Asan, A., & Akasah, Z. A. (2015). *Developing an accident causation model for accident prevention at building construction sites*. In InCIEC 2014 (pp. 273–285). Springer, Singapore.
- Department of Statistics Malaysia (DOSM). (2015–2024). *Construction [Online]*. Retrieved from https://www.statistics.gov.my/dosm/uploads/files/3_Time%20Series/Malaysia_Time_Series_2015/2023/2024_18Pembinaan.pdf

- Department of Occupational Safety and Health Malaysia (DOSH). (2018–2024). *Fatal accident cases*. Retrieved December 23–24, 2022, from <http://www.dosh.gov.my/index.php/en/fatal-accidentcase>
- Hamid, A. R. A., Muhamad, N., Zakaria, R., Aminuddin, E., Alwee, A. A., & Tok, A. (2018). *The challenges of the ageing population on the Malaysian construction industry*. Journal of Physics: Conference Series, 1049(1), 012034. IOP Publishing.
- Hamid, A. R. A., Noor Azmi, M. R. A., Aminudin, E., Jaya, R. P., Zakaria, R., Zawawi, A. M. M., Yahya, K., Haron, Z., Yunus, R., & Saar, C. C. (2019). *Causes of fatal construction accidents in Malaysia*. In SEPKA-ISEED, IOP Conference Series: Earth and Environmental Science, 220(1), 012044. IOP Publishing. <https://doi.org/10.1088/1755-1315/220/1/012044>
- Jaafar, M. H., Arifin, K., Aiyub, K., Razman, M. R., Ishak, M. I. S., & Samsurijan, M. S. (2017). *Occupational safety and health management in the construction industry: A review*. International Journal of Occupational Safety and Ergonomics, 1–14.
- Jantane, D., Mostafa, S., Kamardeen, I., & Rameezdeen, R. (2013). *Factors associated with the severity of construction accidents: The case of South Australia*. Australasian Journal of Construction Economics and Building, 13(4), 32–49.
- Mohammadfam, I., Soltanzadeh, A., Moghimbeigi, A., & Akbarzadeh, M. (2014). *Factors affecting occupational accidents in the construction industry*. Journal of Occupational Health and Epidemiology, 3(2), Spring 2014.
- Nur Nadia Adila Abdul Halim, M. H., Jaafar, M. H., Kamaruddin, M. A., Kamaruzaman, N. A., & Singh, P. S. J. S. (2020). *The causes of Malaysian construction fatalities*. Journal of Sustainability Science and Management, 15(5), 236–256. <https://doi.org/10.46754/jssm.2020.07.017>
- Panassaya, P., Soponsakulrat, P., Adulyanukosol, C., Kaiyarit, P., & Chinda, T. (2015). *Identifying root causes of construction accidents: Non-human error factors*. International Journal of Computing, Communications & Instrumentation Engineering (IJCCIE), 2(1). ISSN 2349-1469 | EISSN 2349-1477.
- Ruslan, A. S., & Othman, N. (2022). *Overview of the causes of accidents in the construction industry: A comparative perspective*. International Journal of Academic Research in Economics & Management Sciences, 11(4). <https://doi.org/10.6007/IJAREMS/v11-i4/14253>
- Yusuf, L., Suraji, A., Nugroho, Y. S., & Arifuddin, R. (2011). *The nature of fall accidents in construction projects: A case of Indonesia*. International Journal of Civil & Environmental Engineering (IJCEE-IJENS), 11(5).