Vol. 13, No. 2, 165-177, https://doi.org/10.22712/susb.20220014

INTERNATIONAL JOURNAL OF
SUSTAINABLE Building Technology and Urban Development

pISSN : 2093-761X · eISSN 2093-7628

Preventive measures of struck-by accidents at the construction site: Perspectives from construction personnel in johor

Yap Wan Heong[1], Nor Haslinda Abas[2*], Muhamad Hanafi Rahmat[3] and Hairuddin Mohammad[4]

[1]Engineer, CRCG (M) Sdn. Bhd., Sunway Velocity, Kuala Lumpur, Malaysia

[2]Senior Lecturer, Jamilus Research Centre, Faculty of Civil Engineering and Built Environment, Universiti Tun Hussein Onn Malaysia, Batu Pahat, Johor, Malaysia

[3]Lecturer, Jamilus Research Centre, Faculty of Civil Engineering and Built Environment, Universiti Tun Hussein Onn Malaysia, Batu Pahat, Johor, Malaysia

[4]Senior Lecturer, Centre for Diploma Studies, Universiti Tun Hussein Onn Malaysia, Pagoh Higher Education Hub, Johor, Malaysia

***Corresponding author:** nhaslin@uthm.edu.my

Received: 7 March 2022
Accepted: 8 May 2022

A B S T R A C T

Struck-by accidents are among the main contributor to fatality number in the Malaysian construction industry. From the standpoint of construction safety professionals, this study explores the main preventive measures for struck-by accidents at the construction site. The data for this study was gathered through the questionnaire distributed to construction site safety workers in Johor, Malaysia, and about 116 answered questionnaires were received. Data were analyzed using the Relative Importance Index (RII) and Spearman's rank correlation. The main preventive measure factor identified was related to training. This study provides eye-opening findings in terms of the weak correlational relation between the views of safety personnel and the most effective preventive strategy. This research raises awareness of the problem, and more action should be made to lower the fatality rate in struck-by-object accidents.

Keywords: accident; struck-by; construction; preventive measures; correlational

Introduction

Since industrialization, automated machines and heavy equipment have been utilized by humans to enhance product demand and efficiency. Due to the demand to diversify the industry, several jobs had been created and this has led to an increase in the number of workers to increase industrial production. However, with the number of workers steadily increasing in terms of proportion, it poses the risk and threat to the workers which are industrial fatal accidents in workplaces [1].

As the incidence and expense of fatal workplace accidents increased, there was a shift in public opinion of workplace safety, and national programs to improve worker safety and avoid accidents were established [2]. To ensure the safety and lives of workers in industries in Japan, the "Occupational Accident Prevention Plan" was implemented. "Industrie 4.0" and "Arbeiten 4.0" had been promoted in Germany as ways to improve industrial

technology and the workplace environment. To protect employee safety and health, one of the occupational safety and health executives in the United Kingdom designed and implemented an annual "Health and Safety Executive Business Plan." [3].

Not only for the developed countries, but Malaysia also implemented the Occupational Safety and Health Act (OSHA) which is a law that establishes a legal framework to ensure the safety, health, and welfare of all Malaysian workers, as well as to protect others from hazards to their safety or health because of their work activities. However, the construction sector in Malaysia was still left behind the most other industries in terms of safety and health, as indicated by its vastly disproportionate rate of accidents [4, 5]. According to the statistic reported by the Department of Occupational Safety and Health, the construction industry had the largest number of fatal occupational deaths, which was 54.76% [6]. The nature of the job, weather conditions, and the diversity of hazards involved contributed to the high occurrence of incidents, injuries, and fatalities amongst construction personnel.

Among all types of accidents, fall from height was the highest contributing type of accident in Malaysia, followed by struck-by objects and crushed-by vehicles [7]. Most of the previous research focused on the causes of building accidents in general, for example, in the research study by Abdul Halim et al. [8], the causes of deaths in the Malaysian construction sector were studied by examining 145 fatalities investigated by DOSH over a five-year period (2013 to 2018), and it was discovered that the main incidents were caused by management element, worksite element, and the human element. Other studies related to the causes of construction accidents include Hamid et al. [9], Chong and Low [10], and Othman et al. [11]. Despite that, there had been also investigations into the causes of specific sorts of accidents. such as Zermane [12] and Hamid et al. [9], Abas et al. [13], Liy et al. [14] and Zaini et al. [15], who explored the fall from height accidents; Blazik-Borowa [16] and Abas et al. [17] who investigated accidents related to scaffolds. The current trend of this study is focusing on struck-by accidents as there were fewer studies conducted in this area. The previous study conducted was focusing on the contributing factors of the struck-by accident [18, 19], but fewer studies were focusing on attaining the safety professionals' insights on the preventive measures for struck-by accidents. It should be emphasized that victims of struck-by-objects accidents are not limited to construction workers; they might also include the wider populace [20].

Therefore, the purpose of this study is to seek significant preventive measures to lessen accidents caused by struck-by-objects. This study expands on an earlier study by Abas et al. [18], in which the nature and causes of struck-by accidents from the reported cases to DOSH were investigated; and further adopted in the present study to identify the preventive measures of struck-by accidents from the real cases reported. This study is narrowed down to the analysis of fatal cases that have occurred at construction sites in Johor with selected respondents who also work in Johor.

Literature Review

Accident Analyses in Construction Industry

Previous construction fatality research has centered on broad causes or causal linkages on the job site. It was

demonstrated that project characteristics and design choices had an impact on the multi-causal and complicated nature of construction accidents [21, 22]. In the research of Gurcanli and Mungen, the falls from height and struck-by-objects accidents were categorized as the first and second most frequent construction accidents in all regions of the country [23]. As falls from heights account for the vast majority of fatal construction sector accidents, these incidents had gotten a lot of attention in recent years. Falling from rooftops, slipping or tripping, scaffold safety, protective equipment, and modern preventative measures have all been studied by many practitioners and academicians [24, 25]. Despite the fact that accidents caused by being struck by or against falling objects and/or equipment rank second or third in total accidents, they were frequently studied in general studies aimed at understanding the causes of construction accidents as a whole [26]. Therefore, it is very important to study the preventive measure for struck-by accidents in detail.

Struck-by Accidents

According to Occupational Safety and Health Administration (2011), a struck-by-objects accident is defined as the injuries that are caused by the forcible contact or impact between the victims and an object or a piece of equipment. It can be categorized into 4 types which include struck-by flying object, struck-by falling object, struck-by swinging object, and struck-by rolling object [27]. In Malaysia, there were several struck-by accidents reported cases. According to New Straits Times dated 25 March 2021, two factory workers were killed, and three others were injured when the SUKE flyover collapsed. A road user was also seriously injured when a crane tipped over and crashed to the ground. This horrific accident that occurred at the Sungai Besi-Ulu Kelang Elevated Expressway (SUKE) project became the talk of the town and the effect of this struck-by-object accident continued to haunt those who heard the news because it endangered the safety of the public [28].

The Statistical Data of Struck-by Objects Accidents in Malaysia

The analysis of struck-by-objects accidents was concentrated at the Johor construction sites as Johor had recorded the second-highest rate of occurrence of struck-by-objects accidents [4]. As shown in Figure 1, Johor had

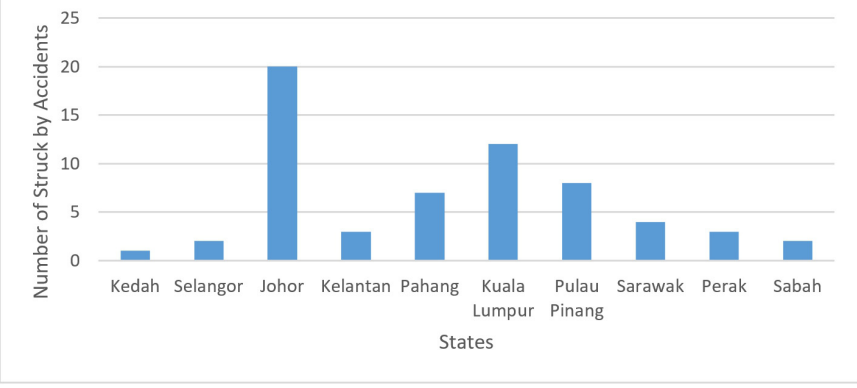

Figure 1. Proportion of struck-by accidents in Malaysia from the year 2010 to year 2018 [Adapted from: DOSH [4]].

the highest percentage of 32.26% of struck-by-objects accidents. It was then followed by the Malaysian capital, Kuala Lumpur with 12 reported cases.

To study in detail the types of accidents that occur at construction sites in Johor, the analysis of reported accident cases were analyzed from the DOSH website. It was found that the struck-by-objects was the second most critical accident that contributed to the accident in Johor. It had a total of 20 cases reported which was 19.42 percent of the total accidents that occurred at the Johor construction site as shown in Figure 2.

Causes of Struck-by Accidents

Several factors were the cause of the struck-by accidents at construction sites. According to Goh et al. [20], workers who lack guidance on safety matters have resulted in them being involved in accidents at construction sites. Untrained workers would not realize that their actions would endanger their lives especially when they were forced to operate certain machines and work tools without expert supervision or proper training. Besides that, workers often suffer injuries when working or walking near tall structures that could possibly cause objects to fall when they are moved upwards and while holding or shifting heavy loads [29]. In addition, machine tools and practices that create flying items could also jeopardize employee safety.

Bad weather conditions can cause unwanted accidents to occur. According to Safety and Branch [30], one case reported that a site agent had been struck by a falling object that was hit by a typhoon. In such situations, all construction activities were advised to be temporarily postponed during adverse weather conditions. Fass et al. [19] pointed out that unsafe supervision was also one of the causes of the occurrence of struck-by-objects accidents. Supervisory violations, failure to rectify recognized problems, insufficient supervision planning, and insufficient operations planning are all examples of unsafe supervision. The use of malfunctioning equipment, operations carried out without authorization, or harsh working conditions are all examples of supervisory violations. Unsafe supervision highlights the fact that supervisors or senior managers should demonstrate their responsibility in providing

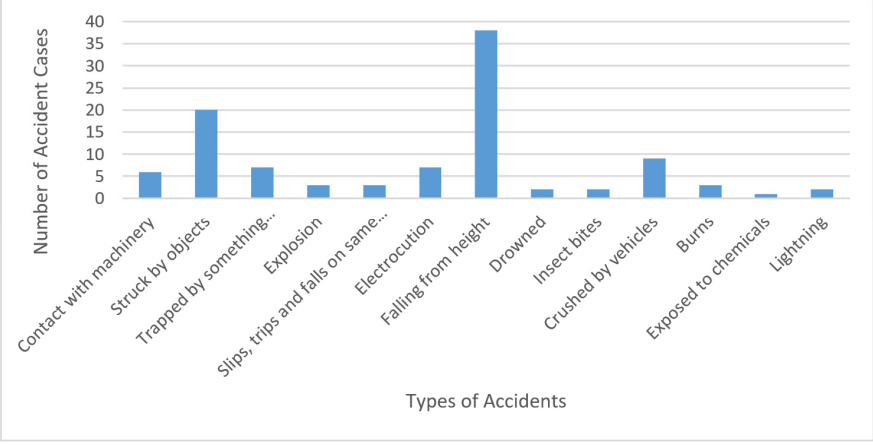

Figure 2. Number of construction deaths based on accident cases in Johor state from the year 2010 to the year 2018 [Adapted from: DOSH [4]].

adequate training for competent operators and adequate rest for workers to perform their duties optimally.

Each construction site must be thoroughly inspected to ensure that workers' safety is not jeopardized [31]. Different inspection processes are required for different working environments. There must be periodic inspections at the worksite to ensure safe working conditions for employees. Cheng et al. [32] stated that improper operation can result in struck-by-objects accidents. Proper operation is required to ensure safety in the workplace. Some operations carried out without careful planning and layout that prioritize the safety of workers, will be life-threatening, especially for those working under cranes, hoists, and scaffolding. Workers should avoid working with hoisted loads and should never operate under hanging loads.

Preventive Measures for Struck-by Accidents

Preventive measures to prevent struck-by-accidents from happening were obtained through online journals and articles. The first preventive measure identified was related to the frequency of staff training conducted among staff [8, 33]. The training was not only limited to general employees but also requires the involvement of management and the supervisory team. Next was the use of warning signs and barricades. This applies when there was a risk of objects falling in the area, 'no entry' signs, or installing barricades around the area as an 'isolation' zone could prevent workers from entering the area [34]. Meanwhile, Dong et al. [29] emphasized that all equipment should be inspected before use. This is to ensure that damaged equipment does not pose a threat to the safety of workers such as being hit by damaged equipment or heavy machinery. In addition, the hand-over process, post-over procedure, and after repair or modification work all necessitate a thorough inspection by a qualified individual [35].

When workers engage or use any equipment that poses a risk of falling objects, such equipment shall be equipped with a falling object protective structure. In addition, IHSA.ca [36] highlighted employees to ensure a balanced and safe load while lifting. This is due to load shifting or wind that could possibly cause objects to fall. Another preventive measure identified from the literature was compliance with manufacturer specifications including procedures for proper use of equipment [27]. Proper procedures would reduce the risk of struck-by-objects-accidents. Ensuring good housekeeping was also a key factor in preventing struck-by-accidents. For hazardous activities that expose workers to struck-by-objects-accidents such as demolition work, adequate protection must be provided to ensure the safety of the construction workers or others in adjacent areas including public walkways, roads, and residential yards, or other buildings from any falling objects [37].

Methods

The methodology of this study were analyzing the fatality cases due to struck-by-accidents from the DOSH website (secondary data analysis) and questionnaires survey to safety personnel working at construction sites in Johor. Analyzing these data were essential to establish and examine the significant contributing factor to this type of construction accident and its respective effective preventive measure to be taken to reduce this type of accident.

First, actual cases of struck-by accidents in Johor were extracted from the DOSH Website, and each case was thoroughly studied to determine contributing causes and preventive actions. Keywords like “construction,” “Johor,” and “Struck-by” were used to sort the results in order to find particular information on fatal cases at construction sites in Johor from 2010 to 2018. Twenty struck-by-objects accidents cases were selected from 103 construction accident cases in Johor to determine the key contributing factors in the cases. Based on the factors identified in the DOSH database and the literature review, a set of questionnaires was designed.

Questionnaire Survey Procedure

Questionnaire surveys were distributed to the respondents responsible for occupational safety and health in the workplace to understand their perceptions on the struck-by-object-accident preventive measures. It consisted of 2 parts, namely: i) Part 1 − Demographics of respondents; and ii) Part 2 − Significant preventive measures for struck-by object accident. On a 5-point Likert scale ranging from 1 (extremely insignificant) to 5 (highly significant), respondents were asked to rate the significance level of the preventative measure variables indicated. The survey instrument’s reliability and validity were tested in a pilot study. The results from content validity and Cronbach’s Alpha reliability were positive, suggesting that no changes were required in the questionnaire instrument. The pilot data were excluded from the study results.

The questionnaire was then distributed via open online surveys tools known as Google form to the targeted respondents which were the Site Safety Supervisor, Safety and Health Officer, and Safety Manager with a minimum of 3 years of working experience. According to the researchers Aithal et al. [38], the minimum sample required for this study was 100 for 10 items questionnaire. There was a total of 116 responses from the respondents for this study which achieved the requirement of the minimum samples.

Measures for Data Analysis

Relative Importance Index

In this study, the Relative Importance Index (RII) has been used to rate the preventive measures for struck-by-objects-accidents by their relative importance [39, 40]. The following formula was used to determine the RII of each criterion:

$$\mathrm{RII} = \frac{\Sigma W}{(A \ X \ N)} \tag{1}$$

where, RII = Relative Importance Index, W = Weighting given to each factor by respondents that is ranging from 1 to 5, A = Highest weight and N = the total number of respondents. The ranking of each preventive measure for the struck-by-object accidents by the respondents was then used to investigate the relationship with the actual case, as described in the next section.

Correlational Relationship between Respondents' Perceptions on Preventive Measures to Struck-by Object Accidents and the Real Cases Extracted from DOSH Website

The correlation between respondents' assessments of preventive measures against struck-by-object accidents and findings from actual instances taken from the DOSH website was examined using Spearman's rank correlation. The symbol for it is r s, and the formula is stated below [41]:

$$r_s = 1 - \frac{6(\sum d_i^2)}{n(n^2-1)} \tag{2}$$

where d_i is the rank difference assigned to the two variable values for each item of the data. The absolute index value of r_s can be used as a guide to describe the strength of the correlation which is shown in Table 1.

Results and Discussion

The study was divided into two parts: an examination of real fatal accident case data from secondary data analysis (DOSH website) and safety professionals questionnaire surveys. According to Abas et al. [18] findings, the authors' views and assumptions in evaluating the contributing factors of the struck-by-accidents were based on their opinions and assumptions in analyzing the actual cases from secondary data. This was due to the fact that the accident incidents on the website were qualitative data, and the cause of each accident indicated was not the accident's fundamental cause. The writers had to examine the data from each accident case in order to find the best techniques for avoiding accidents in each situation.

Preventive Practice to Struck-by Objects Accidents Based on DOSH Website

Table 2 shows the preventive measures that need to be taken to prevent actual cases of struck-by-accidents from DOSH data. It was found that the most effective preventive measure to deal with struck-by-accidents was equipment inspection as it was the highest in comparison to other factors (5 cases, 25%). The second highest was preventive measures such as the use of personal protective equipment, regular training, the use of protective equipment structures from falling objects, and proper demolition procedures. These preventive measures contribute 15 percent to minimizing the accident rate of struck-by-objects accidents. Preventive measures such as the use of warning

Table 1. Index of r_s for level of strength

Index of r_s	Level of Strength
$0.00 \leq r_s \leq 0.19$	Very Weak
$0.20 \leq r_s \leq 0.39$	Weak
$0.40 \leq r_s \leq 0.59$	Moderate
$0.60 \leq r_s \leq 0.79$	Strong
$0.80 \leq r_s \leq 1.00$	Very Strong

Table 2. Frequency of recommended preventing measures of struck-by object accident identified from secondary data (DOSH Website)

No.	Preventing Measures to Struck by Objects Accidents	Frequency	Ranking based on frequency
1	Regular training	3	2
2	Use of warning signs or barricades	1	5
3	Equipment inspection	5	1
4	Use of falling object protective structure on equipment	3	2
5	Securing the loads	1	5
6	Comply with the manufacturer's specification	1	5
7	Good housekeeping	-	8
8	Proper demolition procedures	3	2

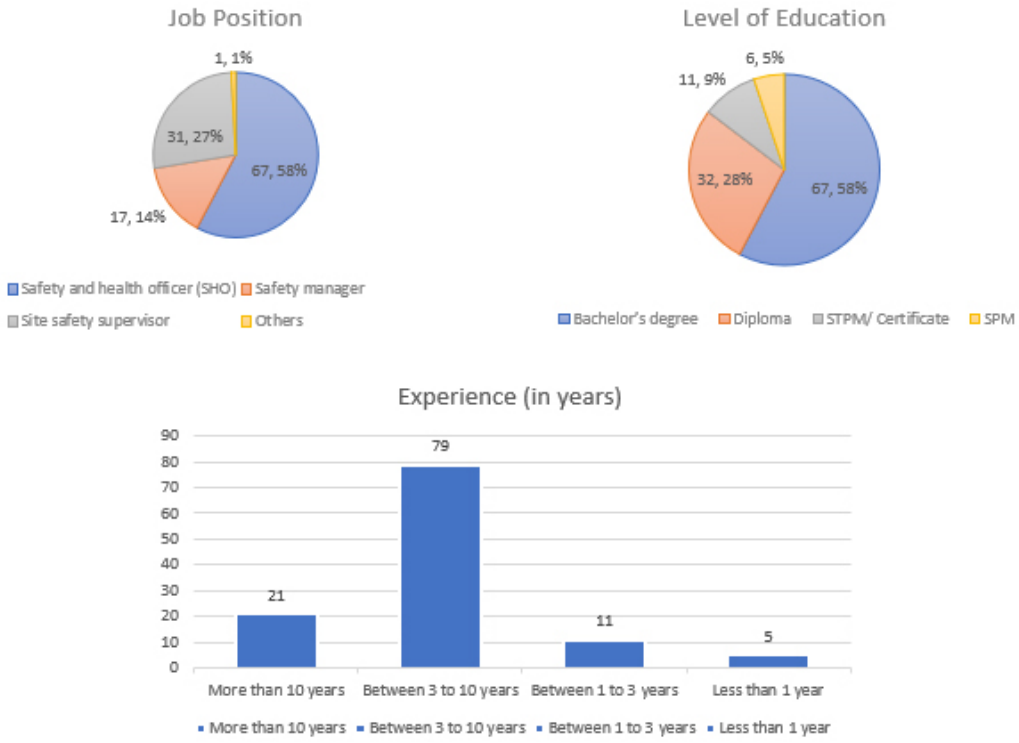

Figure 3. Background of respondents.

signs or barricades, securing the loads, and adhering to manufacturer specifications were placed at the third position showing 5 percent in preventing struck-by-objects accidents. However, the use of a proper tethering system tool and good housekeeping did not show any effectiveness in preventing the actual case of struck-by-objects accidents in Johor.

Analysis of Questionnaire Survey Form

Background of Respondents and Reliability Analysis

The respondents' backgrounds were examined, and the information was summarized as shown in Figure 3.

Cronbach's Alpha was 07.49, which was used to determine the general consistency of the measures throughout the full survey. The scale's internal consistency was found to be adequate, and all measurements were found to be accurate [41].

Respondents' Perceptions on the Significant Preventing Measure Factors to Struck-by Object Accidents

Table 3 indicates how participants agreed about the significant preventative measures factor for struck-by-objects accidents, with an overall mean index of 4.11 and a significant level of the factor. Important contributing factors to struck-by-objects accidents were identified using rankings based on the Relative Importance Index (RII).

Table 3's findings appear to contradict those of the secondary data analysis, i.e., the actual incidents of struck-by fatal accidents at the Johor construction site. For example, respondents considered 'equipment inspection' as the second-lowest preventive measure for struck-by-accident, but this measure was identified as the most recommended preventive measure from the secondary data analysis.

Respondents concluded that the most important preventive measure for struck-by-object accidents was the regular exercise which had an RII value of 0.843. It was then followed by the manufacturer's specification and procedure compliance factor (RII = 0.829) and securing the load (RII = 0.826). The lowest perceived preventive measure factor was the use of warning signs (RII = 0.809). The training was seen to be a low-cost but necessary approach to decreasing accidents, and it should be provided to all construction employees because they are exposed to a variety of hazards on the job [42]. This was also supported by other authors such as Brace et al. [43]. Some authors also emphasized inadequate training as a major cause of accidents [17, 19].

Complying with manufacturer specifications fell as the second-highest significant preventive measure for struck-by-object accidents by respondents because workers were expected to be familiar and aware of the attached specifications and could use the equipment in a safe condition. Proper procedures would reduce the risk of struck-by-object accidents [27].

IHSA.ca [36] emphasized that workers needed to ensure a balanced and safe load while lifting. This was due to load shifting or wind that could cause objects to fall. Not only that, the work area must have properly built guardrails before placing the load on the scaffolding or platform. This preventive measure had been considered by

Table 3. Summary of respondents' opinions on the most important variables in preventing struck-by object accidents

No.	Preventing Measures to Struck by Objects Accidents	RII	Ranking based on RII
1	Regular training	0.843	1
2	Use of warning signs or barricades	0.809	8
3	Equipment inspection	0.812	7
4	Use of falling object protective structure on equipment	0.814	6
5	Securing the loads	0.826	3
6	Comply with the manufacturer's specification	0.829	2
7	Good housekeeping	0.817	5
8	Proper demolition procedures	0.822	4

the respondents as the third most significant preventive measure to deal with struck-by-object accidents. Proper demolition procedures had been identified as the fourth significant preventive measure for struck-by accidents. It was supported by Hinze et al. [37] who stated that for any demolition work carried out, adequate safety for workers especially from objects falling into the work area or adjacent areas including public walkways, roads, residential courtyards, or other buildings must be provided.

Good housekeeping at a construction site is important because untidy work areas causing the space to appear confined can cause additional problems to workers that can lead to struck-by accidents [36]. The workers who used equipment that poses a risk of falling objects, such equipment should be equipped with a protective structure of falling objects to ensure that it does not pose a threat to the lives of workers [44]. Both of these preventive measures have RIIs of 0.817 and 0.814, respectively.

The least significant preventive measures are the inspection of equipment and the use of warning signs and barricades. They had the lowest RIIs of 0.812 and 0.809, respectively. Equipment inspection reduced the risk of construction workers being struck-by damaged equipment or heavy machinery [29]. The use of 'no entry' signs or the use of barricades to designate the place as an 'isolation' zone can prevent workers from entering the dangerous area [34].

It is interesting to note that most of the important preventive measures perceived by respondents were of the administrative risk control type. Higher risk control positions such as the use of protective structures on equipment and securing loads were considered less important than administrative risk controls. This was consistent with Lingard and Holmes's [45] finding that most personnel tend to emphasize individual risk control rather than technological control for OHS risk.

Correlational Relationship of Safety Personnel's' Perceptions on Preventive Measures to Struck by Objects Accidents with Real Cases

The connection between security personnel's opinions of preventive measures against struck-by-object accidents and secondary data analysis of actual fatal accident cases reported to DOSH was investigated using Spearman rank correlation (as collected from the DOSH website). The absolute index value produced from the formula stated in (2) was 0.05, which was extremely low. This indicates that respondents have varying perspectives on what is going on.

Through the analysis, it was discovered that respondents have varying perspectives on what is going on. Safety personnel had a perception that regular training was essential to deal with these accidents. While actual case statistics showed equipment inspection was the most effective preventive measure to reduce accidents.

Given the role of safety specialists who also act as counselors to employers and decision-makers on the precautions to be taken for hazards and risks in the workplace, discrepancies should be taken into account. The inconsistency of perceived accident causes can also result in similar incidents recurring in the future.

Conclusion

This study has identified several struck-by fatal accidents prevention measures at construction sites. Among the most significant preventive measures identified include regular training, compliance with manufacturer specifications, and securing the load. This study provides eye-opening findings to researchers and construction practitioners due to the weak correlation index obtained from the perceptions of security personnel to actual cases from DOSH. This study highlights the increasing awareness of this problem, and more efforts are needed to reduce the death rate due to struck-by object accidents. The study had some drawbacks, such as a limited population, which only focused on groups of security personnel and its population covers the state of Johor only. Future studies attempt to extend the study to other respondents such as engineers, management staff, architects, or consultants and cover respondents from other states in Malaysia. It is also recommended to investigate and compare perceptions between different groups of respondents as they have their respective roles in the construction industry. A detailed study can be performed to evaluate the relationship of different categories of respondents to preventive measures for struck-by objects accidents.

References

[1] S.Y. Kang, S. Min, W.S. Kim, J.H. Won, Y.J. Kang, and S. Kim, *Types and Characteristics of Fatal Accidents Caused by Multiple Processess in a Workplace: Based on Actual Cases in South Korea.* International Journal of Environmental Research and Public Health. 19(2047) (2022).

[2] P. Hamalainen, K. Leena Saarela, and J. Takala, *Global trend according to estimated number of occupational accidents and fatal work-related diseases at region and country level.* Journal of Safety Research. 40(2) (2009), pp. 125-139.

[3] H.J. Kim, *A Study on the Establishment of Mid & Long Term Strategies for Prevention of Occupational Accident Plan.* Occupational Safety and Health Research Institute: Ulsan, Korea, 2019.

[4] Occupational Accidents Statistics by Sector Until Jun 2018 (Investigated) [Online], 2018. Available at: http://www.dosh.gov.my/index.php/fatal-accident-case-1 [Accessed 31/12/2018].

[5] N.H. Abas, N. Blismas, and H. Lingard, *Development of Risk Assessment Tool Using Damaging Energy and Argumentation Theory for Evaluating Construction Occupational Safety and Health Risks.* Engineering, Construction and Architectural Management. 28(10) (2021), pp. 2967-2993.

[6] Fatal Accident Case [Online], 2021. Available at: http://www.dosh.gov.my/index.php/fatal-accident-case-1 [Accessed 10/01/2022].

[7] Woman killed after building crane falls on car [Online], 2016. Available at: https://www.thestar.com.my/news/nation/2016/08/25/woman-killed-by-building-crane/ [Accessed 01/01/2019].

[8] N.N.A. Abdul Halim, M.H. Jaafar, M.A. Kamaruddin, N.A. Kamaruzaman, and P.S. Jamir Singh, *The causes of Malaysian Construction Fatalities.* Journal of Sustainability Science and Management. 15(5) (2020), pp. 236-256.

[9] A.R.A. Hamid, M.R.A. Noor Azmi, E. Aminudin, R. P. Jaya, R. Zakaria, A.M.M. Zawawi, K. Yahya, Z. Haron, R. Yunus and C.C. Saar, *Causes of fatal construction accidents in Malaysia.* IOP Conference Series: Earth and Environmental Science. 220 (2019), 012044.

[10] H.Y. Chong and T.S. Low, *Accidents in Malaysian Construction Industry: Statistical Data and Court Cases.* International Journal of Occupational Safety and Ergonomics. 20(3) (2014), pp. 503-513.

[11] I. Othman, R. Majid, H. Mohamad, N. Shafiq, and M. Napiah, *Variety of Accident Causes in Construction Industry.* MATEC Web of Conferences. 203 (2018), 02006.

[12] A. Zermane, M.Z. Mohd Tohir, M.R. Baharudin, and H.M. Yusoff, *Analysis of the Contributing Factors for Fatal Accidents due to Falls from Heights in Malaysia and the USA.* Pertanika Journal Science and Technology. 28(2020), pp. 15-36.

[13] N. Kariya, N.H. Abas, E.K. Luju, and Y.G. Tong, *Causes of Fatal Accidents Due to Fall of Persons in Malaysian Construction Industry.* Sustainable Construction and Building Technology. (2017), pp. 1-17.

[14] H.L. Chong, S.H. Ibrahim, R. Affandi, N.A. Rosli, and M.N.M. Nawi, *Causes of Fall Hazards in Construction Site Management.* International Review of Management and Marketing. 6(8) (2016), pp. 257-263.

[15] N.Z. Muhamad Zaini, M.A. Mat Salleh, M. F. Hasmori, and N.H. Abas, *Effect of Accident Due to Fall From Height at Construction Sites in Malaysia.* IOP Conf. Series: Earth and Environmental Science. 498(1)(2020), 012106.

[16] E. Blazik-Borowa and J. Szer, *The analysis of the stages of scaffolding "life" with regard to the decrease in the hazard at building works.* Archives of Civil and Mechanical Engineering. 15(2) (2015), pp. 516-524.

[17] N.H. Abas, M.R. Noridan, M.H. Rahmat, N.A. Abas, and N.Q. Ibrahim, *Causes of Accidents Involving Scaffolding at Construction Sites.* Journal oF Technology Management and Business. 7(1) (2020), pp. 075-086.

[18] N.H. Abas, *The Analysis of Struck-By Accidents at Construction Sites in Johor.* International Journal of Integrated Engineering. 12(4)(2020), pp. 266-275.

[19] S. Fass, R. Yousef, D. Liginlal, and P.Vyas, *Understanding causes of fall and struck-by incidents: What differentiates construction safety in the Arabian Gulf region?* Applied Ergonomics. 58 (2017), pp. 515-526.

[20] K.C. Goh, H.H. Goh, M.F. Omar, T.C. Toh, and A.A. Mohd Zin, *Accidents Preventive Practice for High-Rise Construction.* MATEC Web of Conference. 47 (2016), pp. 1-6.

[21] P.A. Manu, N.A. Ankrah, D.G. Proverbs, and S. Suresh, *Investigating the multi-causal and complex nature of the accident causal influence of construction project feature.* Accid Anal Prev. 48 (2012), pp. 126-133.

[22] J.A. Gambatese, M. Behm, and S. Rajendran, *Design's role in Construction Accidents Causality and Prevention: Perspectives from an Expert Panel.* Saf Sci. 46 (2008), pp. 675-691.

[23] G. Emre Gürcanli and Uğur Müngen, *Analysis of Construction Accidents in Turkey and Responsible Parties.* National Institute of Occupational Safety and Health. 51 (2013), pp. 581-595.

[24] X.S. Dong, S.D. Choi, J.G. Borchardt, X. Wang, A. Julie, and J.A. Largay, *Fatal Falls from Roof among U.S. Construction Workers.* Journal of Safety Research. 44 (2013), pp. 17-24.

[25] K. Ohdo, Y. Hino, S. Takanashi, H. Takahashi, and Y. Toyosawa, *Study on Fall Protection from Scaffolds by Scaffold Sheeting during Construction.* Procedia Eng. 14 (2011), pp. 2179-2186.

[26] H.J. Lipscomb, A.L. Schoenfisch, and K.S. Shishlov, *Non-fatal contact injuries among workers in the construction industry treated in U.S. emergency departments.* Journal of Safety Research. 41 (2010), pp. 191-195.

[27] Occupational Safety and Health Administration, *Construction Focus Four: Struck-By Hazards*, OSHA Training Institute, 2011.

[28] SUKE flyover collapse: 2 factory workers killed, 3 others injured [Online], 2021. Available at: https://www.nst.com.my/news/nation/2021/03/670793/suke-flyover-collapse-2-factory-workers-killed-3-others-injured [Accessed 12/02/2022].

[29] X.S. Dong, X. Wang, R. Katz, G. West, and J. Bunting, *Fall Injuries and Prevention in the Construction Industry*, CPWR Quarterly Data Report (Silver Spring: CPWR − The Center for Construction Research and Training), 2017, pp. 1-21.

[30] Occupational Safety and Health Branch, *An Analysis on Occupational Fatalities Casebook Volume 1*, Department of Labour of Peninsular Malaysia, 2003.

[31] M. Mattila, M. Hyttinen, and E. Rantanen, *Effective supervisory behaviour and safety at the building site.* International Journal of Industrial Ergonomics. 13(2) (1994), pp. 85-93.

[32] C.W. Cheng, S.S. Leu, C.C. Lin, and C. Fan, *Characteristic analysis of occupational accidents at small construction enterprises.* Safety Science. 48(6) (2010), pp. 698-707.

[33] T. Nowobilski and B. Hola, *The qualitative and quantitative structure of the causes of occupational accidents on construction scaffolding.* Archives of Civil Engineering. 65(2) (2019), pp. 121-131.

[34] Falling Objects Fact Sheet [Online], 2012. Available at: https://www.safeworkaustralia.gov.au/system/files/documents/1702/falling_objects_fact_sheet.pdf [Accessed 10/01/2022].

[35] A. Enshassi and S. Shakalaih, *Construction Workers Fall Accidents from Scaffolding in Gaza Strip.* The 6th International Conference on Construction Engineering and Project Management (ICCEPM 2015), 2015, pp. 1-5.

[36] Scaffolds [Online], 2016. Available at: https://www.ihsa.ca/rtf/health_safety_manual/pdfs/equipment/Scaffolds.pdf [Accessed 2/2022].

[37] J. Hinze, X. Huang, and L. Terry, *The Nature of Struck-by Accidents.* Journal of Construction Engineering and Management. 131(2) (2005), pp. 262-268.

[38] A. Aithal and P.S. Aithal, *Development and Validation of Survey Questionnaire & Experimental Data − A Systematical Review-based Statistical Approach*, Munich Personal RePEc Archive, [Online], 2020. Available at: https://mpra.ub.uni-muenchen.de/103996/ [Assessed 10/4/2022].

[39] R.R.R.M. Rooshdia, M.Z.A. Majid, S.R. Sahamir, and N.A.A. Ismail, *Relative Importance Index of sustainable design and construction activities criteria for green highway.* Chemical Engineering Transactions. 63 (2018), pp. 151-156.

[40] M. Gündüz, Y. Nielsen, and M. Özdemir, *Quantification of delay factors using the Relative Importance Index method for construction projects in Turkey.* Journal of Management in Engineering. 29 (2012), pp. 133-139.

[41] *Spearman' s correlation* [Online], 2015. Available at: http://www.statstutor.ac.uk/resources/uploaded/spearmans.pdf [Accessed 10/01/2022].

[42] B. Benny and D. Jaishree, *Construction Safety Management and Accident Control Measures.* International Journal of Civil Engineering and Technology. 8 (2017), pp. 611-617.

[43] C.L. Brace, A.G. Gibb, M. Pendlebury, and P.D. Bust, *How can we prevent construction accidents? Outcomes from a stakeholder consultation: societal and industry-wide influences.* Procs. of the Institute of Ergonomics and Human Factors Annual Conference. (2010), pp. 107-115.

[44] Secondary Injury Prevention: Caught-in, Caught-between, or Struck-by Objects Caught-in or Between Accidents Struck-by Accidents [Online], 2018. Available at: https://ohioline.osu.edu/factsheet/AEX-981.2 [Accessed 10/01/2022].

[45] H. Lingard and N. Holmes, *Understandings of occupational health and safety risk control in small business construction firms: barriers to implementing technological controls.* Contsr. Mgmt. and Econ. 19 (2010), pp. 217-226.