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Hazard Investigation for Formwork Installation at High Rise Building Construction

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Abstract: Construction is now acknowledged as a key economic force in Malaysia. It's also one of the riskiest industries. The failure of a project is caused by accidents and injuries on construction sites. According to the Department of Occupational Safety and Health (DOSH) in construction, 6,686 incidents occurred in 2021. To mitigate the probability of accidents occurring on construction sites, risks in high-rise building construction sites must be identified, as well as protective measures. The purpose of this research is to determine the significant hazard for installation formwork. Second objective is to identify the significant preventive for installation aluminium formwork and third objective is to analyze the structural relationship of hazard and preventive for installation aluminium formwork. Every element of data collected in this study was obtained from media articles, journals, and websites. The quantitative research approach was used in this study, and data were acquired via a questionnaire survey. The distribution of questionnaires to the designated parties is a method of data gathering used to meet the study's objectives, namely the construction site staff and workers in high rise building within the Kuala Lumpur state. 62 respondents in total were required for this investigation. According to the study's findings, mechanical hazards with a mean of 3.77 aspect have the most occurrence in formwork installation at building sites. The study found that the preventive measure in the physical aspect with the highest mean of 3.77 is the most emphasized in formwork building installation. Identifying these hazards can raise employees' and contractors' awareness of potential risks in formwork installation when conducting construction projects.

Keywords: Safety Hazard, Accident, Formwork, High Rise Building,

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1. Introduction

As the demand for high-rise building projects develops, increases the number of construction accidents and fatalities. Accidents are unintended and unexpected incidents that cause harm or injury. As a result, accidents are increasingly recognized as a global problem that can be reduced by following safety regulations [1]. The framework of accident prevention is a detailed understanding of the components that contribute to causation. The Malaysian construction industry is critical for the nation's domestic economy since it increases demand for building activities. The industry is notorious for its hazardous physical working conditions, which result in a high number of accidents and fatalities [2]. According to the Department of Occupational Safety and Health (DOSH) in construction, 6,686 accidents were recorded in 2021 [3]. However, some companies are not responsible for not reporting incidents to DOSH. This problem frequently arises when employers wish to preserve Key Performance Indicators (KPIs), which means they do not want to keep a record of Lost Time Injury (LTI). This has a number of detrimental effects on the job environment in terms of employee wellbeing being neglected.

Formwork, also known as a die or a mould that includes all supporting elements, is used to shape and support concrete until it is good enough to hold itself. Aside from its own weight, it should be able to support any imposed dead and live loads. Since the commencement of concrete construction, formwork has been used. Formwork is made of modern materials like steel, plastic, fibre glass, and aluminium. Design, manufacture, erection, and takedown of formwork as a temporary structure are being given more consideration. The concrete-contacting surface and other required auxiliary structures are included in the form work. Despite its importance, [4] considering its special, dynamic, and transient nature, construction is one of the most hazardous industries. Project after project and day by day, safety challenges are confronted in this dynamic and creative business. Accidents are a significant issue in many businesses as well as daily life. [5] mentioned that relative to other industries, the construction industry has poor workplace conditions, a complicated scenario, a high labour turnover rate, a lack of safety management, low educational requirements, and poorly qualified personnel.

1.1 Background study

Considering this context, the purpose of the study is to identify dangers in the aluminium formwork system at building sites in the Kuala Lumpur state of Taman OUG, Bukit Jalil, as well as to offer control and preventative measures. The concept is to leverage the identification of dangers at a building site using the aluminium formwork system to prevent problems at future construction sites using the same technology.

1.2 Problem statement

Hazard arise during high-rise building construction as a result of poor or incomplete formwork design, frame and bracing erection, bearing and joist erection, and deck and beam formwork placement. Formwork operations are hazardous, and personnel are regularly subjected to hazardous working conditions. Failure of concrete formwork, whether partial or complete, is a major cause of fatalities, injuries, and property damage in the construction industry. Another significant hazard occurs during formwork stripping when loose formwork elements fall on employees beneath the concrete slab being stripped [6].

The problem statement that arises to continue this study is that employees perform poorly because they lack passion for their jobs, have inadequate discipline, and exhibit a negative attitude about their work. This has a detrimental influence on the organization's ability to install aluminium formwork in a safe manner.

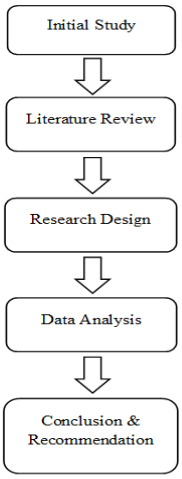
1.3 Significance of the study

This research will focus on the local projects at Bukit Jalil by company that are using aluminium formwork system. The study is limited to high-rise residential building construction. There are several hazard when operating the installation of formwork. The important thing is that these risks are recognised and controlled in order to reduce the likelihood of an accident or harm. Hazard identification is a method of determining whether or not a certain environment or activity has the potential to cause harm to a person. Furthermore, reducing identified hazards can help the organisation increase efficiency and production by reducing the number of employees who are absent from work due to illness or injury.

2. Methodology

The composition of the regular research should be carried out at this stage that the goal of the investigation is not missed much and achieve the objectives. This chapter will explain the following aspect:

Figure 1: Data Collection Procedures



2.1 Research instrument

The quantitative survey form was sent to qualified respondents, employees, and workers on the high rise building construction site as the research instrument used in this study. The goal of this study is to gather 62 respondents. Many individuals are involved in the construction of a building, including architects, designers, engineers, contractors, and subcontractors. In general, this research required quantitative data analysis and acquisition. There are three parts. Part A: Socio-demographic background, Part B: Occupational information, Part C: Identifying hazard and Part D: Identifying of preventive control. SPSS software will be used to analyse the survey data. Because it is designed specifically for research analysis, this software produces accurate and timely results. Respondents require to tick answer that best describes their response to each of the following statements.

2.2 Data analysis method

Table 1: Likert Scale

Scale	Score
Never	1
Very Rarely	2
Rarely	3

Very Frequently	4
Always	5

At this stage, the data gathered will be organised, checked, processed, and evaluated. In general, this research required quantitative data analysis and acquisition. As a result, frequency distribution and percentage will be used for data analysis in this study. The collected data is then assessed and analysed for usage in accordance with the specified objectives and scope of the study need. The survey information will be processed using SPSS software. Because they are designed to specialise in research analysis, this software produced accurate and timely results.

2.3 Data analysis based on the mean range for frequency level.

The results of the 5 level Likert Scale are being analyzed utilizing the mean approach to produce clearer results in the study.

Figure 2: Calculation range

$$\text{Range} = \frac{\text{Highest score value} - \text{Lowest score value}}{\text{Number of range}}$$

$$= \frac{5 - 1}{3}$$

$$= 1.33$$

Table 2: Mean range for frequency level

Mean scale	Occurrence level
3.68 - 5.00	High
2.34 - 3.67	Moderate
1.00 - 2.33	Low

2.4 Sample size population

The term "sample" refers to a specimen or part of a population that is drawn to demonstrate how the remainder of the population looks [7]. The target demographic for this study was contracting firms that were registered with the Construction Industry Development Board in the Selangor region in the following fields: high rise building. Three research suggested that respondents consisting of 40 to 50 people who are working in the field are considered as an acceptable sample size, as shown in Table 3.

Table 3: Average sample size from previous study

No	Reference	Sample size	Average
1	Gogtay NJ (2010)	50	44
2	Chu, A. H. Y., & Moy, F. M. (2015)	44	
3	Tipili & Yakubu (2016)	40	

Following the generally accepted rule, statistical analysis could still be performed although the sample size is not large because the central limit theorem holds when the sample size is minimum 44 [8]. This is regarded large enough to use the central limit theorem to model the sample mean, and the average index method/mean is appropriate for the analysis [9]. Therefore, the sample size for this study was 62 staff and workers from the Kuala Lumpur/Selangor region, according to the average sample size from previous research. Further discussions on the survey will be elaborated on Chapter 4.

3. Results and Discussion

The results and discussion section presents data and analysis of the study. During the data collection process, 62 respondents were collected in the Selangor and Kuala Lumpur areas. The poll was completed by qualified respondents who are safety officers, site staff, and formwork installers with experience addressing safety issues in high-rise building construction projects.

3.1 Demographic

Table 4: Respondent's Profile

Classification		Frequency	Percentage %
Age	20 - 25 years old	21	34
	26 - 30 years old	30	48
	31 - 35 years old	11	18
	Above 40 years old	0	0
Gender	Male	41	67
	Female	20	33
Marital Status	Single	34	55
	Marriage	27	43
	Divorce	1	2
Education Level	Secondary School	0	0
	Diploma	26	42
	Bachelor/Master/PHD	36	58
Race	Malay	38	61
	Chinese	24	39
	Indian	0	0

Table 4 shows the frequencies and percentages of respondents' profiles, where there are four classifications which are age, gender, marital status, race, and education level of the respondent. As the table shows, there were more male respondents than female respondents. The number of male respondents consist of 41 (67%), while the female respondents consist of 20 (33%). Next, there are more than half of the survey respondents are from the age of 20-25 years' old which is 21 (31%), followed by respondents age 26-30 years is 30 (48%), 31-35 years consists of 11 (18%) and no respondent 0 (0%) from 40 years of age or above. For Marital status, there are more respondents from single people over the married and divorce which is 1 (2%) and followed by single 34 (55%) and lastly from married 27 (43%). Furthermore, for respondents' education level, more than half is from bachelor/Master/PHD which is 36 (58%) and followed by secondary school 0 (0%), meanwhile for the Diploma is consist 26 (42%). Lastly for the race of respondent is more than half consist from malay 38 (61%) and followed by chinese 24 (39%).Meanwhile, no respondent from indian 0 (0%).

3.2 Occupational info

Table 5: Occupational Information

Classification	Scale	Frequency	Percentage %
Working Experience	1 - 3 Years	30	49
	3 -5 Years	25	40
	5 Years Above	7	11
Working Duration	0 -8 Hour	9	15
	8 – 12 Hour	42	63
	12 Hour Above	11	18

Table 5 shows the frequencies and percentage of respondent social occupational information where there are two classifications which are working experience and working duration, As the table showed, 1-3 years of working experience are the most 30 (49%) and are followed by 3-5 years, which are 25 (40%) and 7 (11%) for 5 years above working experience. Moving to the next point which is the working duration. From the table, it shows that the majority of respondents are working from 8-12 hours with a frequency of 42 (63%). Meanwhile, the rest of 9 (15%) of respondents are classified in 0-8 hours. The differences between working hours 0-8 hours and 12 hours above are only 11 (18%). Experience of staff and workers in construction site are important for them to study and observe the safety aspect and hazard arise in construction site.

3.3 Identifying hazard

This section shows the survey of identification hazard occurrence. (Physical hazard)

Table 6: Descriptive Statistics of Physical hazard

Classification	Mean
Falls from height	2.63
Exposed to noise when dismantling formwork	3.31
Flying pin and wedges orobjects	3.39
Slips and trips	3.05
Sharp edges on metal decks	3.32

Table 6 shows the hazards that occurred in terms of physical hazards. According to the data presented above, the majority of the moderate physical dangers occurred during the installation of aluminium formwork on the building site. The major physical threat is flying pins and wedges or debris, with the highest mean of 3.39. This happens when installing or dismantling a formwork that is vulnerable to falling objects. Sharp edges on metal decks are the second highest in terms of physical hazard, but they are nevertheless common in formwork construction, with a mean of 3.32. Educate and instruct all employees and workers on the proper usage of any tool and working environment. The third highest mean in terms of physical hazard is When disassembling formwork, I was exposed to noise. Workers make noise when they knock on steel formwork or shift material wrongly. Slips and trips come in fourth place. This hazard is caused by any restriction to access and inadequate housekeeping. However, the table indicates the lowest mean where the hazards in construction happened substantially less frequently.

Figure 2: Physical hazard

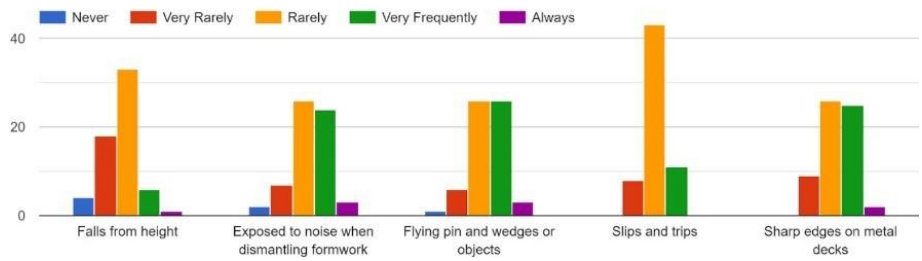


Table7: Fall from height

Scale	Frequency	Percent (%)
Never	4	6.5
Very Rarely	23	37.1
Rarely	28	45.2
Very frequently	6	9.7
Always	1	1.6
Total	62	100

Figure 2 and Table 7 shows the hazards occurred in aspect of physical hazards. A fall from height is one of the most serious safety concerns facing construction sites and many other workplaces. From the data shown above Rarely and Very Rarely has occurred frequently among workers with frequency value 28 (45.2%) and 23 (37.1%) respectively. After that, third highest frequency are Very Frequently with 6 (9.7%) and follow by the lowest frequency Always with 1 (1.6%) than Never 4 (6.5).

Table 8: Descriptive Statistics of Mechanical hazard

Classification	Mean	Std. Deviation
Unprotected moving machine parts	3.77	.777
Improper lifting arrangement/ tools	3.16	.658
Improper sequence of materialstacking	3.26	.723
Incorrect or careless use of handtools, faulty or damaged tools	3.45	.670
Improper working platform	3.06	.721

Table 8 displays the mechanical dangers that occurred. According to the statistics shown above, the majority of mechanical dangers occurred moderately during the installation of aluminium formwork on the building site. The major mechanical hazard is unprotected moving machine parts, which has the highest mean of 3.77. This happens when employees change power tools and remove machine guarding. With a mean of 3.45, incorrect or reckless use of hand tools, malfunctioning or broken tools is the second most common mechanical hazard in formwork building. Educate and instruct all employees and workers on the proper usage of any tool and working environment. The inappropriate sequence of material stacking has the third highest mean in mechanical hazard, with a mean of 3.26. Following that, the fourth highest mean is 3.16 incorrect lifting arrangement/tool. However, the chart shows that the

lowest mean is unsuitable working platform with a mean of 3.06, indicating that construction dangers are very rare.

Figure 3: Mechanical Hazard

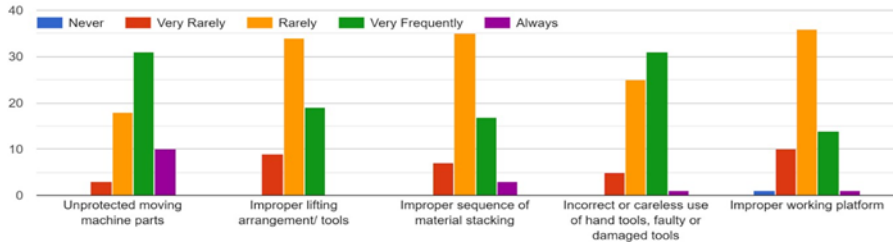


Table 9: Unprotected moving machine parts

Scale	Frequency	Percent (%)
Never	0	0
Very Rarely	3	4.8
Rarely	18	29.0
Very frequently	31	50.0
Always	10	16.1
Total	62	100

Table 9 depict the mechanical dangers that occurred on the construction site. According to the facts presented above, moving machinery can cause injuries in a variety of ways, including individuals being struck and harmed by moving parts of machinery or ejected material. The respondent's highest frequency is Very Frequently 31 (50%). The second highest is Rarely 18 (29.0%), followed by Always 10 (10%). (16.1). However, the respondent with the lowest frequency is Very Rarely 3 (4.8%).

4. Conclusion and recommendation

The first goal is to identify the important danger for installation formwork. The second goal is to identify the significant preventive installation formwork. The third goal is to build the structural relationship of hazard and preventive for installation aluminium formwork. The data analysis in the preceding chapter achieved all of the objectives. The aluminium formwork system has seen extensive use. Recognizing the dangers involved with each stage is crucial. This study aimed to identify these risks in order to assist construction workers who will utilize this method. The system's many risks were outlined. When only the activities of the aluminium formwork system are considered, each stage has numerous related dangers, and the worker may be exposed to several hazards in the same activity. The high risk hazard from data collection in previous chapter are unprotected moving machine parts. Moving machine parts can cause serious industrial injuries like crushed fingers or hands, amputations, burns, or blindness. Workers must be protected from these avoidable injuries with safeguards. Any machine part, function, or process that has the potential to cause injury must be protected. When a machine's functioning or inadvertent contact injures the operator or anyone nearby, the hazards must be minimized or regulated. To avoid this problem, only qualified and competent people should operate machinery. Install warning signs to alert staff about potential machine hazards. Ensure that all machines are appropriately secured. This hazards and the preventive solutions mentioned might be utilized as a data collection for other construction projects. They may be used to confirm the presence of these and other threats, as well as to ensure that constructors and other professionals are taking the appropriate precautions. Different preventative and control methods are offered in the proposed measures, including proposed measures for accident control and prevention.

Lastly, following are some recommendations for future research based on the findings and conclusions was to identification of hazards in other high-rise building construction, such as aluminium formwork and method used to identify hazard on the construction site of a high-rise building.

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