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RISK ANALYSIS ON HAZARD IN HIGH-RISE CONSTRUCTION PROJECT IN PULAU PINANG

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Abstract:
Falls from height, being hit by moving construction vehicles, hit by moving object, fall into bore hole and injuries from manual handling operations are some of hazards for high rise construction project. A study on the occupational safety for high rise construction projects was conducted which to identify the task of construction works in relation of safety, to determine the hazard that involves with high rise construction works, and to measure the level of risk for high-rise construction. So, the aim for this final project is to explore hazard and risk for high rise construction project. Around 50 sets of online questionnaires survey have been distributed through online because of pandemic covid-19. From that number, a total of 31 responds were collected. The process of data collection was done through the quantitative data collection method which is close ended questionnaire. The data were then analyzed by using excel to compose average index descriptive analysis where needed to calculate the risk assessment. The result concluded that the high risk accident is mostly occurred in falls from height and falling object. Based on the feedback from respondents, responsibility of the employer is more important which the employer must provide safety training to all workers during tool box talk. Otherwise, employer must also supply the information on hazard and risk for high rise construction project. Nevertheless, workers must comply the construction activity for high rise according to instruction and standard operation procedure.

Keywords: *Hazard, Risk, Construction Work, High Rise project, Risk Assessment.*

1.0 INTRODUCTION / RESEARCH BACKGROUND

According to Butnaru and Nicuţă (2017), construction sector is accompanied by wide diversity of risk as it is related with a complex succession of the operation. According to statistics, construction sector has associated with a large number of risks corresponding to the working activity and also with professional. Wang and Razavi (2019) stated that, according to U.S. Bureau of Labor Statistics (BLS, 2017) data, construction sector had the highest number of fatal work injuries among all investigated sector sectors for years 2012 to 2016. Risk is involved in every business, and the construction sector is no exception.

Construction for high rise building will exposed their workers to accidents with higher risk, thus risk assessments are needed to be identify the risk level for different type of hazard. The successful of construction projects is depends on the effectiveness implementation of risk assessment. To achieve the project objectives, the risk management must play their roles in doing the hazard identification, risk assessment, and risk control (HIRARC) (Chileshe *et al*., 2016).

1.1 Problem statement

Gao *et al.* (2018) stated that the workplace accidents in construction sector continue to dominate among occupational fatalities, which is around 36% of total workplace fatal injuries. It is because there are many hazard that could occurred during construction of high rise project, such as falls from height, being hit by plant and machinery, hit by moving object, fall into bore hole, injuries from manual handling operations and others. This is supported by Mirhadi Fard *et al.* (2017), construction sector is one of the dangerous in term of safety, it had the highest number of fatal work related to injuries. Workplace safety and health reports and statistic show that around 66 fatal injuries in 2016 that happen in Singapore, 24 people are from construction sector that remains as top contributor in workplace fatal injuries (OSHD, 2016).

Statistic from the Department of Occupational Safety and Health (DOSH) show that a total of 3749 people that involved in occupational accident for all sector in Malaysia. 33 numbers of death occurred from a total of 118 people in construction sector. While in 2018, the total accident for construction sector was 232 people and approximately 118 numbers of death occurred.
Risk management practices among construction organization still remains very low. According to Mwangi and Waiganjo (2017), there have been lack of safety and health measure at workplace which have left the workers exposed to dangerous. It is because lack of interest in implementing risk management is the main issues that will contribute to problems in the future.

In terms of level of safety awareness among construction workers during working, safety health officer has responsible to make sure workers on site use their Personal Protective Equipment (PPE). According to Md Ulang *et al.*, (2014), PPE is one of the important things to protect the wearer from hazards in the workplace. Gebremeskel and Yimer (2019) stated that negligence of the workers and lack of awareness were factors significantly associated with occupational injury.

Therefore, risk management such as hazard identification, risk assessment, and risk control (HIRARC) must be done for every project to control or eliminate the risk.

1.2 Aim

The aim of this study is to determine the hazard and risk of construction sector especially in construction of high-rise building.

1.3 Research objective

i. To identify the task of construction works in relation of hazard.
ii. To determine the hazard that involves with high rise construction works.
iii. To measure the level of risk of hazard for high-rise construction.

1.4 Research question

i. What is the task of construction works in relation of hazard.
ii. What is hazard that involves with high rise construction works.
iii. What is the level of risk of hazard for high-rise construction.

1.5 Scope of research

This study is focus on the high rise construction in Pulau Pinang which are through questionnaire to the contactor and safety and health officer. Questionnaire will be distributed to 50 contractors, safety health officer, or site supervisor. The reason for choosing this location is because of the possibility in the collection of data is high as there are an abundance of construction works that are carried out throughout this area of research.

2.0 LITERATURE REVIEW

2.1 Hazard of high rise construction

CIDB (2018), Ahmed Jannadi and Almishari (2003), MIHIĆ (2019) defined hazards as a source or situation with a potential for harm in terms of human injury or ill health, damage to the environment or a combination of these. Gebremeskel and Yimer (2019) stated that hundreds millions of people are working in unsafe conditions, hazards faced by construction workers in developing countries is 10 to 20 times higher than those in industrialized countries. Construction workers are frequently exposed to various types of injury-inducing hazards, especially falling from heights (Van Der Molen, Den Herder, Warning, & Frings-Dresen, 2016). Workplace accident rates in construction industry are very high compared to other sectors (Mohd Kamar & Che Ahmad, 2016).

2.2 Risk analysis

Risk has been considered as the chance that someone or something that is valuated will be adversely affected by the hazard. Moreover, risk has been defined as a measure under uncertainty of the severity of a hazard or a measure of the probability and severity of adverse effects (Marhavilas et al., 2011).

Risk can be measure by using numerical for likelihood of occurrence and severity of its effect (Subramanyan et al., 2008). Risk analysis is the process of evaluating the risk to safety and health arising from hazards at workplace (Cidb, 2018). Risk analysis is a process of converting the impact of risk on a project into numerical terms by doing the analysis on the severity and the likelihood/probability of the risk (Issa et al., 2019).

Table 1: Schedule of risk analysis/assessment matrix level

Likelihood / Severity	Most frequent (1)	Frequent (2)	Moderate frequent (3)	Less frequent (4)	Not frequent(5)
Very critical (5)	5	10	15	20	25
Critical (4)	4	8	12	16	20
Moderate (3)	3	6	9	12	15
Low critical (2)	2	4	6	8	10
Not critical (1)	1	2	3	4	5

Risk Level Legend	
Low: ≤ 2	
Medium: > 2 to 6	
High: > 6 to 12	
Extreme: > 12 to 15	

Risk = Average of likelihood x Average of severity

2.3 List of construction activity and hazard that involved in high rise construction project (by OSHA)

Construction activity for high rise project

1. Site clearance
2. Diaphragm wall as retaining wall
3. Piling
4. Work below lowest floor finish
5. Frame
6. Upper floor
7. Staircase
8. External wall
9. Internal wall
10. Roof
11. Window and door
12. Finishes

Hazard that involves in high rise construction

1. Hit by tree
2. Hit by plant and machinery
3. Hit by other object
4. Hit by moving object
5. Falls from height
6. Falls from slope
7. Falls into excavation
8. Falls into bore hole
9. Falling object
10. Noise
11. Hand arm vibration syndrome
12. Sharp edge of material
13. Hazardous material

3.0 METHODOLOGY

This research is using quantitative method, which is the data obtained was numerical and these also as to get the empirical finding. Besides that, this method was used as to get the numerical form of data from the questions that were clear-cut and the finding were from the participation of respondents in answering the distributed questions. This method is use to achieve the research objective and to find the answer of the research questions. The tools used to collect the data are through questionnaires.

This questionnaire is distributed to professional and people that have knowledge on safety in construction or have knowledge on construction hazard and risk such as safety health officer, safety site supervisor, engineer, architect and other. These questionnaires are distributed through emails and online platform as it helped in obtaining the feedbacks from the respondents during this pandemic (COVID 19). Approximately, there are safety health officer, safety site supervisor and site supervisor in each sites for high rise construction. A sum of 31 respondents will be needed to get a valid data for this research.

4.0 ANALYSIS AND FINDING

4.1 Construction activity and hazard for high-rise project.

Table 2: construction activity and hazard.

ACTIVITY	HAZARD	ACTIVITY	HAZARD
1.Site clearance	1. Hit by tree. 2. Hit by other object. 3. Falls from slope. 4. Hit by plant and machinery.	7. Staircase	1. Falls on single level. 2. Sharp edge of the material. 3. Falling object. 4. Hit by moving object.
2.Diaphragm wall as retaining wall	1. Noise. 2. Falls into excavation. 3. Hit by plant and machinery. 4. Hit by moving object.	8.External wall	1. Falls from height. 2. Falling object. 3. Hit by moving object. 4. Hit by plant and machinery.
3.Piling	1. Noise. 2. Hit by plant and machinery. 3. Fall into bore hole. 4. Hand arm vibration syndrome. 5. Hit by moving object.	9.Internal wall	1. Falls on single level. 2. Falling object. 3. Hit by moving object. 4. Hit by plant and machinery.
4.Work below lowest floor finish	1. Sharp edge of the material. 2. Hit by plant and machinery. 3. Hand arm vibration syndrome. 4. Material & manual handling.	10. Roof	1. Falls from height. 2. Sharp edge of material. 3. Falling object. 4. Hit by moving object.
5.Frame	1. Falls from height. 2. Falling object. 3. Hit by moving object. 4. Hit by plant and machinery.	11. Window and door	1. Material & manual handling 2. Sharp edge of the material. 3. Hit by moving object.
6.Upper floor	1. Falls from height. 2. Falling object. 3. Hit by plant and machinery. 4. Hit by moving object.	12. Finishes	1. Falls from height. 2. Hazardous material. 3. Falling object.

4.2 Compilation of hazard that in high-risk status.

Table 3: Summary of hazard in high risk status.

Construction activity	Type of hazard	Risk assessment matrix
External wall	Falls from height	8.93
Upper floor	Falls from height	7.43
Roof construction	Falls from height	7.29
Frame construction	Falling object	6.91
Upper floor	Falling object	6.9
Frame construction	Falls from height	6.72

According to table 3, all the hazard falls from height and falling object are in high risk status. Hazard falls from height during external wall construction is the highest risk with the assessment matrix 8.93. While the second highest risk with assessment matrix 7.43 is falls from height in upper floor construction. Next, the third ranking will be hazard falls from height during roof construction with risk assessment matrix 7.29. Other than that, hazard falling object during frame construction with risk assessment matrix 6.91 will be in the fourth ranking for hazard in high risk status. Besides that, the fifth ranking for high risk status will be hazard falling object during upper floor construction with assessment matrix 6.9. Lastly, hazard falls from height during frame construction will be the lowest for high risk hazard with assessment matrix 6.72.

Gao et al. (2018) stated that, falls, hit by moving objects, being caught in or between objects, and hit by falling objects are four common incident types in construction which accounted for 70% of all workplace fatal injuries in 2016. Besides, Molen *et al.* (2016) stated that construction workers are frequently exposed to various types of hazards, especially falls from height. A systematic controlling procedure for predicted risk to be faced in a construction project could be done to overcome the risk. By using the personal protective equipment such as safety harness and safety helmet and provide safety training procedure, it can reduce the probability of that hazard.

5.0 CONCLUSION

Hazard and risk in high rise project can be compacted simply by keying out the base cases of hazards, which is possible by accidents investigation techniques such as theories of accident causation and human mistakes. The hazard has been classified for each of construction activity for high rise project. So based on data analysis, the level of risk can be measure and hazard that have high level of risk should be control to ensure safety of workers on construction site.

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