

SAFETY SCAFFOLDING IN THE CONSTRUCTION SITE

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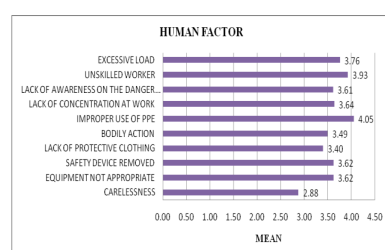
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Graphical abstract



Abstract

Statistics have shown that the construction industry is one of those sectors that have a high rate of deaths and injuries compared with to the other sectors. Scaffolding is a hazard that contributes to the large number of deaths and injuries in the construction industry. The aim of this study is to investigate the factors that influence the scaffolding related accidents at the construction site. The study was conducted using a questionnaire to obtain the maximum information and precise results. The questionnaire was prepared and distributed to listed contractors in grade G7 and G6 that are actively involved in carrying out construction work. The results of this study indicate that the higher factors influencing scaffolding related accidents at construction site are caused by technical factors.

Keywords: Construction industry, scaffolding, safety, risk assessment

Abstrak

Statistik telah menunjukkan bahawa industri pembinaan merupakan salah satu sektor yang mempunyai kadar kematian dan kecederaan yang tinggi berbanding dengan sektor-sektor lain. Perancah adalah bahaya yang menyumbang kepada bilangan besar kematian dan kecederaan dalam industri pembinaan. Tujuan kajian ini adalah untuk mengkaji faktor-faktor yang mempengaruhi kemalangan perancah di tapak pembinaan. Kajian ini dijalankan dengan menggunakan borang soal selidik untuk mendapatkan maklumat yang maksimum dan keputusan yang tepat. Soal selidik telah disediakan dan diedarkan kepada kontraktor yang disenaraikan dalam G7 gred dan G6 yang terlibat secara aktif dalam menjalankan kerja-kerja pembinaan. Keputusan kajian ini menunjukkan bahawa faktor tertinggi yang mempengaruhi kemalangan perancah di tapak pembinaan adalah disebabkan oleh faktor teknikal.

Kata kunci: Industri pembinaan, perancah, keselamatan, penilaian risiko

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1.0 OVERVIEW

The construction industry plays an important role in the development of Malaysia's economy and it is one of its major industries. However, the construction industry is also one of the most hazardous [1]. Based on the Social Security Organization (SOCISO) report in 2000[2], the accident rate in the construction industry in Malaysia was 3 times higher in comparison to other workplaces. It is further strengthened that there are at least 60,000 fatal accidents recorded in the

construction industry annually around the world [3]. It is also found that accident numbers are very high and frequent. Accidents at the construction site have led to the loss of life, property, workers, money and time.

In the construction site, there are certain parties that want to gain more profit rather than provide the best infrastructure. This type of problem often leads to some aspects to be overlooked by certain parties during construction. Such aspects include occupational safety and workers' health issues on

the construction site. The increasing number of accidents and deaths involving workers at the construction site is a serious concern. The effect is not only felt by the victims (workers and employers) but it becomes more worse when it involves other aspects such as economic costs as well as legal action which may burden both sides. Such problems will lead to the consequences such as the loss of the public's trust and confidence as well as giving a bad reputation to a developing country.

Scaffolding is an important tool used on construction sites. According to the Occupational Safety and Health (OSHA) [4], an estimate of over 2 million or 65 percent of construction sites use scaffolding. Based on Blazik [5], the main role of scaffolding is to support the building construction work at heights and places with poor access. According to the same study, scaffolding is widely used in not only in construction sites but also other fields such as renovation works of processing lines, in shipyards, as a supporting construction of billboards, a stage, a hall and also as decoration element. Herber [6] states that scaffolding provides facilities for workers with both a place to work and the means to reach areas that they could not access on their own. Workers can easily access their work stations using scaffolding (scaffolding here refers to any platform or ramp which makes it easier to move building materials and equipment) [7]. Beside the important role of scaffolding as a temporary structure, accidents involving scaffolding accounts for a large number of injuries and deaths on the construction site.

Nowadays, accidents involving scaffolding on construction sites has become a hot issue in most of Malaysia's local newspapers [7]. Such accidents account for thousands of injuries and deaths at the construction sites every year. On October 6, 2013, a warehouse door fell onto scaffolding and causing the death of a worker. On April 10, 2014, a construction scaffold collapsed between levels 27 and level 22 causing the death of a worker. On December 25, 2014, the formwork and scaffolding collapsed during concreting of a deck slab causing a fatality [8]. The above are examples of accidents involving scaffolding. Contractors are required to conduct construction within a limited construction site. These sites are either a closed or an open area. This is to establish the safety of workers and the public. It is a well-known fact, that scaffolding accidents involving the public do not have a high percentage in comparison to those occurring involving contractors and workers.

1.1 Common Hazards that Occur involving Scaffolding in Construction

In the construction process, it is important to identify hazards that might occur due to the usage of scaffolding so it can be prevented [9]. The main hazard is workers falling down or objects falling down from the scaffolding as the scaffold itself functions as

a working platform as well as an equipment or material supporting prop [7]. Based on Halperin and McCann [10], there are two ways for scaffolding accidents to occur. They are either due to scaffold collapse or due to falling from a scaffold. Hence, it shows that scaffold is a major contributor to accident occurrence on the construction site [7].

1.2 Factors Influencing the Scaffolding Accident in Construction

Factors influencing accidents on the construction site vary from time to time and they are not easy to identify. During the period of 1997 until 2000 scaffolding accidents are due to construction errors, lack of protective equipment, improper foundation, the poor technical condition of the scaffolding and to the excessive load placed on the scaffold [11]. Ismail and Ab. Ghani [7] state that the main factor contributing to accidents involving scaffolding is the lack of complying scaffolds, body action, insufficient capacities, and the improper use of Personal Protective Equipment (PPE).

This is also in line with Chia et.al [12] which found that the main factor of fall scaffolding accidents were due to bodily action such as climbing, walking and leaning against, distraction, insufficient capacities, improper use of Personal Protective Equipment (PPE), lack of complying scaffolding and coming in contact with falling objects.

Other factors leading to accidents involving scaffolding can be categorized as technical factors, environmental factors and the human factor. Technical factors can be listed as no lifeline, structure break, no guardrail, unsecure planking, tipping, overhead danger and poor footing. The environmental factors include working surface, falling objects, material handling and changes of weather. The human factor includes carelessness, no appropriate equipment, removed safety device and lack of protecting clothing [13]. This study aims to investigate the type of hazards commonly occur on scaffolding in the construction site and to identify the factors that influence accidents related to scaffolding on the construction site.

2.0 METHODOLOGY

The main objective of the questionnaire is to examine the types of hazards involving scaffolding and the factors that influence the scaffolding accidents on the construction sites. A total of 180 questionnaires were distributed to contractors of grade G7 and G6 located in Kedah and Pulau Pinang. Only 160 complete questionnaires were received out of the 180 questionnaires distributed. The questionnaire consists of several parts of questions that are classified to achieve the objectives of this research. The questionnaire is designed and classified into four categories with reference to technical factors, environmental factors, human factor and

organizational factors. Section A consists of a demographic question regarding the respondent's background, grade of contractor under CIDB and working experience. Section B is formed in multiple choices related to the type of hazard that commonly occurs involving scaffolding, and the last section is based on a quantitative judgment method for the purpose of identifying factors that influence the scaffolding accident on the construction site. The last section's evaluation is based on the priority using the scale from 1 (strongly disagree) to 5 (strongly agree). The data collected from the questionnaire were analyzed using the average index and frequency analysis.

3.0 RESULTS AND DISCUSSION

3.1 Profile of Responded

In this study, a total of 160 respondents participated from which 84.4% were male and 15.6% were female. This is because the majority of the respondents involved in the construction site were male; hence, the higher male percentage in comparison to that of female participants.

The results in Figure 1 show that the number of contractors of grade G7 with 71.3% represented by 114 respondents were higher than the contractors of grade G6 with 28.8% of the represented (46 respondents). This is reasoned to the fact that grade G7 contractors usually manage construction projects for high-rise buildings which involves using scaffolding in construction.

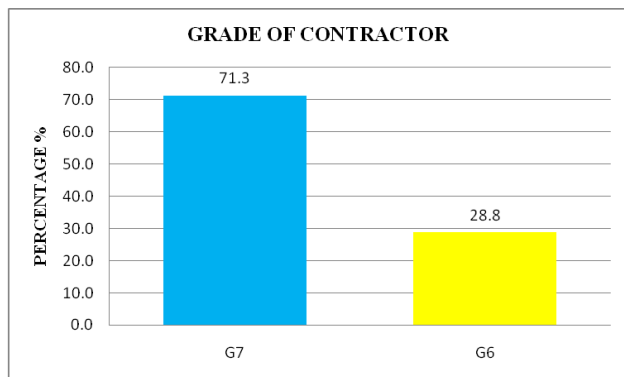


Figure 1 Grade of contractor

In Figure 2, 30.6% of the respondents have an experience of more than 15 years – less than 20 years. The contractors with over 15 years of experience are knowledgeable in using scaffolding in the construction and the answers provided by them were appropriate. The second highest respondents with 29.4% are contractors that have over 20 years of experience. The third highest respondents based on years of experience in construction have 10 years – less than 15 years of

experience coming at 20.0%. Those were followed by 5 years-less than 10 years of experience at 15.0%. Respondents having less than 5 years of experience came in last representing 5.0% of the total respondents.

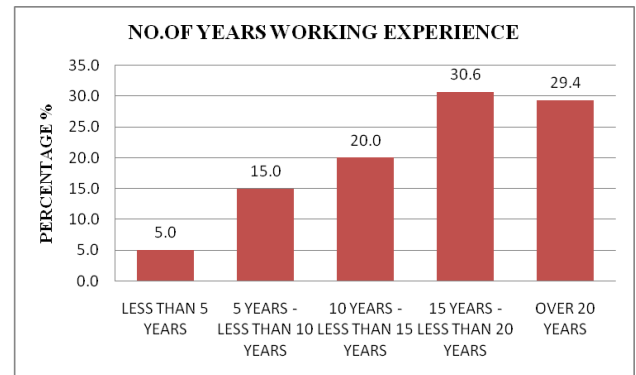


Figure 2 No of years working experiences in construction site

3.2 Hazards that Commonly Occur in Construction

Based on Figure 3, scaffolding collapse is the highest occurring hazard occurring on the construction site at a percentage of 4.38. The second highest at a percentage of 4.31 is falling objects, followed by workers falling from an elevated position of the scaffolding which came at a percentage of 4.30. These are followed by using the wrong setup of scaffold with a mean of 4.05, moving scaffold components 4.03, being struck by a suspended material at 3.88, scaffold failure related to damaged component at 3.83, loss of the load with mean a of 3.76 and finally is electrocution with a mean of 3.74. This results agree with the findings of Whitaker *et al.* [11], which proves that scaffold collapse or bad planking giving away are the highest hazards that commonly occur involving scaffolding on the construction site.

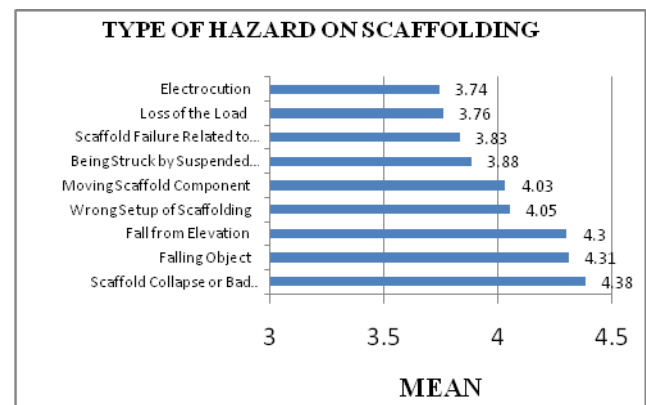


Figure 3 Types of hazard that commonly occur on scaffolding

3.3 Factors Influencing Scaffolding Accidents in Construction

The factors influencing scaffolding accidents are divided into four categories and they are technical factors, environmental factors, human factors and organizational factors. These factors have been identified and ranked accordingly. All factor rankings are based on the mean reading.

3.3.1 Technical Factor

Based on Figure 4, the data shows that the highest scaffolding accident was no guardrail with a mean of 4.12 and no lifeline was the second highest with mean of 4.03, where both factors were classified as the most influential factors. On the other hand, overhead danger of scaffolding accidents are the lowest with a mean of 3.13 and classified as the least influential factor. This result agrees with the findings of Whitaker et.al [11], which proves that no guardrail is the most common factor that leads to injury and death on the construction site.

The guardrails are required for worker's protection. Most of the workers are using scaffolding without guardrail because of their mindset; nothing will happen if they do not use the guardrail.

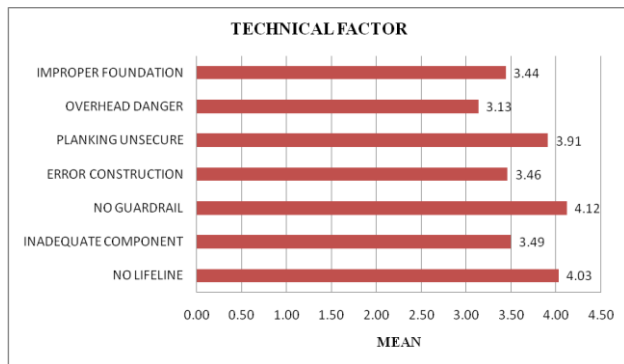


Figure 4 Technical factor influences the scaffolding accident

3.3.2 Environmental Factor

Figure 5 shows the environmental factor influencing scaffolding accidents. Working surface has the highest mean at 3.88, followed by falling objects with a mean of 3.67 and soil condition with a mean of 2.96. The reason behind the working surface being the highest factor is because of poor housekeeping. Poor housekeeping can frequently contribute to accidents by hiding hazards that cause injuries, such as slipping, being hit by falling objects, tripping over loose objects on floors and striking against projecting material.

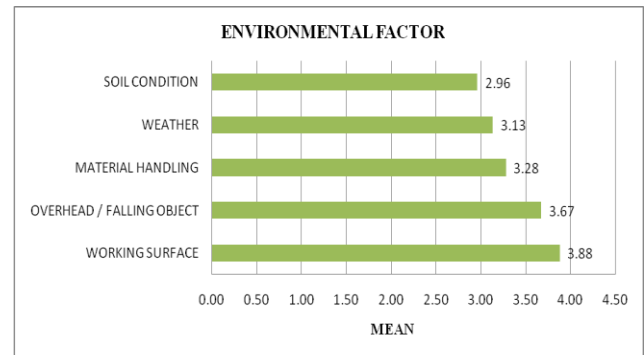


Figure 5 Environmental factor influences the scaffolding accident

3.3.3 Human Factor

Figure 6 shows the classification of factor influencing the human factor. Most of the respondents believe that the highest accident rate of scaffolding is due to the improper use of the Personal Protective Equipment (PPE) which came in at a mean 4.05, it was followed by unskilled workers with the a mean 3.93. Both of these factors were clarified as the factors influencing the scaffolding accidents on the construction site. The lowest influence factor mean with a 2.88 is carelessness.

Workers involved in the construction site should wear PPE such as safety helmets, face and eye protection, boots and hearing protection devices. The workers are provided with such equipment but most of them do not use them [14]. It is the responsibility of the worker to wear PPE provided to him before starting any construction work.

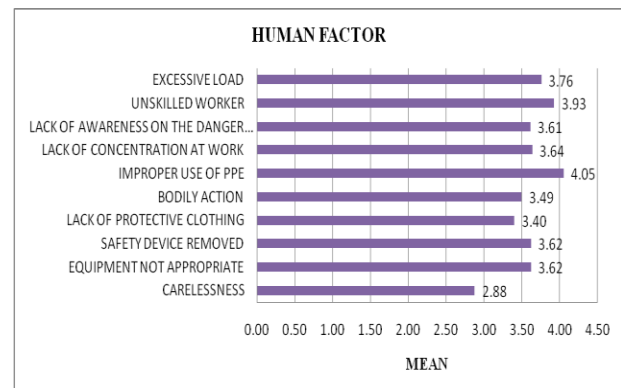


Figure 6 Human factor influences the scaffolding accident

3.3.4 Organizational Factor

Based on Figure 7, the data shows that the highest factor that influences scaffolding accidents is lack of proper training with a mean of 3.99. This is followed by lack of monitoring by the site supervisor with a mean of 3.92. Meanwhile, the absence of safe work procedures for using the scaffolding is the lowest

mean with 3.26. This result proves that workers with lack of proper training were the most common factors of injury on the construction site [10].

Lack of proper training is the major factors of scaffolding accident at the construction site. Where workers are not trained and lack the skills related to scaffolding will fail to perform at work involving scaffolding. Such a situation will cause unwanted accidents to occur. Therefore, the employer as a person who has the authority on the construction site should be responsible to expose and provide adequate training by a qualified person.

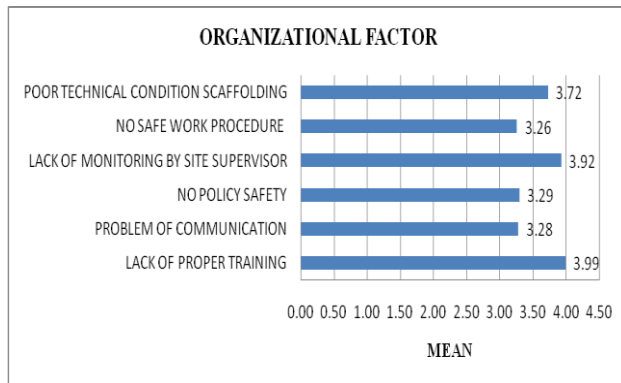


Figure 7 Organizational factor influences the scaffolding accident

3.3.5 Summary of Factors

Figure 8, shows the overall results obtained for the four factors studied. The highest score is obtained by the technical factor with a mean of 3.65, followed by the human factor with a mean of 3.60, organizational factor with the mean of 3.58 and finally the environmental factor with a mean of 3.38. This result agrees with previous studies which concluded that the technical factor is the largest contributor to accidents involving scaffolding [13].

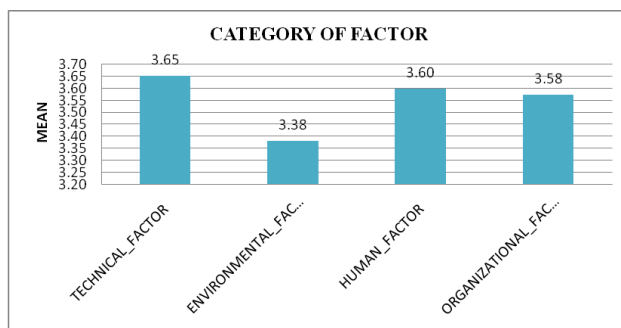


Figure 8 Category of factor

4.0 CONCLUSION

Analyzing the obtained data is important to understand the type of hazards involved when

scaffolding is used. In addition, the analysis will help in checking the highest ranking factor that leads to the most injuries and deaths on the construction site. This study shows that the type of hazards that occur involving scaffolding in the construction site come first, second and in third places. Scaffolding collapse or bad planking to give way, falling objects and falls from elevated positions are classified as types of hazards that often occur on the construction site involving scaffolding.

Through the four categories of factors that have been identified such as technical, environmental, human and organizational factors, this study has collected data to investigate the highest factor influencing accidents involving scaffolding. The highest technical factor influencing scaffold accidents is the absence of both guardrail and lifeline. In the case of the environmental factor, working surface and fall objects were found to be the most influential. Improper use of personal protective equipment, unskilled workers and excessive loading are the highest factors contributing to environmental factors influencing scaffolding accidents. In the case of organizational factors, the highest ranking factors were the lack of proper training and lack of monitoring by the site supervisor.

Overall, the technical factor is the highest among the studied factors which influences scaffolding accidents on construction site. The second highest influential factor is the human factor, then organizational and finally the environmental factor.

Implementing the following recommendations would help in reducing scaffolding accidents on the construction site. Employers and federal / state OSHA organizations should consider the following recommendations:

- i. Government agencies involved in the enforcement of occupational safety and health should increase the safety program to parties who are involved in the construction industry.
- ii. The contractors are also needed to attend special courses related to the safety and health legislation, especially related to scaffolding. This enables them to predict and identify the causes of accident on the construction site.
- iii. The safety management needs to obtain information from their employees who are directly involved in the site because they know the extent of the danger that might be faced by them while performing any work while using a scaffolding at a construction site.
- iv. All workers from various occupational levels should be involved in making the workplace a safe place by following the occupational safety and health policy. Therefore, consultation, cooperation and participation of workers and employers should take place in order to improve the level of safety and health on the construction site

References

- [1] Abdul Rahim Abdul Hamid, Wan Zulkifli Wan Yusof and Bachan Singh. 2003. Hazard at Construction Site. *Proceeding of the 5th Asia-Pacific Structural Engineering and Construction Conference 26-28 August 2003, Johor Bahru, Malaysia*.
- [2] Social Security Organization (SOSCO). 2000. *Annual Report for 2000*. Kuala Lumpur.
- [3] Oladiran, O. J. M. Sc (Construction Mgt.). *Accident on Building Sites: Rate of Occurrence and Causes*.
- [4] Occupational Safety and Health (OSHA). 2011. *Construction Focus Four :Fall Hazard*, OSHA Directorate of Training and Education April 2011 (Updated page ii and 12–September 2011).
- [5] E. Blazik-Borowa, J. Szer. 2015. 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: 516-524.
- [6] Herber, H., & Herber, J. 1993. *Teaching in Content Area with Reading, Writing and Reasoning*. Allyn & Bacon : Needham Height, M.A.
- [7] Herda Balqis Ismail and Kay Dora Ab Ghani. 2012. Potential Hazards at the Construction Workplace Due to Temporary Structure. *Social and Behavioral Science*. 49: 168-174.
- [8] Malaysia's Department of Occupational Safety and Health (DOSH).
- [9] Richard, J. C., Jimmie, H. H., Amarjit, S. 1999. Implementation of Safety and Health on Construction Site. *Proceeding of the Second International Conference of CIB Working Commission W99 (March 24-27), Honolulu, Hawaii*.
- [10] Kopl M.Halperin, Michael McCann. 2004. An Evaluation of Scaffold Safety at Construction Site. *Journal of Safety Research*. 35: 141-150.
- [11] Sean M, Whitaker, Rod J, Graves, Malcolm James, Paul McCann. 2003. Safety with Access Scaffold: Development of a Prototype Decision Aid Based on Accident Analysis. *Journal of Safety Research*. 34: 249-261.
- [12] Chia, F. C., Tin, C. C., & Hsin, I. T. 2004. Accident Pattern and Prevention Measure for Fatal Occupational Falls in Construction Industry. *Journal of Applied Ergonomic*. 36: 391-400.
- [13] John Vincent Heckmann, Jr. 1995. *Analysis of Accident Related to Scaffolding and Floor/Wall Opening*.
- [14] Toole, T. M. 2002. Construction Site Safety Roles. *Journal of Construction Engineering and Management*. 128(3): 203-210.