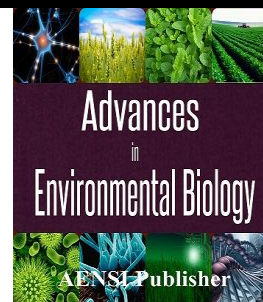




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Contributing Factors of Steel Formwork Usage in Malaysian Construction Industry: Housing Scheme

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ABSTRACT

Construction is one of an important industry in Malaysian economic towards the realization of developed and industrialised country. Urgent needs housing units for low-income groups is exacerbated by loss of interest in the local workforce to work because of the industry's 3-D syndrome namely difficult, dirty and dangerous. In line with this, Industrialised Building Systems has been given a new life to promote systematic construction housing process and to reduce the dependency of foreign workers. The objective of this paper is to identify the contributing factors of selecting concrete steel formwork system in housing construction industry. A quantitative research approach has been adopted for this study requiring the development of a questionnaire survey. From the result analysis, it confirmed that the most significant are speed of construction, available of company capital, building height, scale of project, building shape and type of building.

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INTRODUCTION

Construction is one of an important industry in Malaysian economic towards the realization of developed and industrialised country. In order to stay competitive in the global construction industry market, there must an increasing need for our local construction players to take an appropriate actions towards adopting new systems and technologies par excellence with other developed as well as developing countries. Urgent needs housing units for low-income groups is exacerbated by loss of interest in the local workforce to work because of the industry's 3-D syndrome namely difficult, dirty and dangerous. This circumstances has attracted huge number of foreign workers into this country. An excessive reliance on unskilled foreign workers has caused many problems in this country such as low quality works, delays, wastages, social problems and disease [1]. The activities of the industry are also vital to the achievement of national socio-economic development goals of providing shelter, infrastructure and employment.

In line with this, Industrialised Building Systems has been given a new life to promote systematic construction housing process and to reduce the dependency of foreign workers. Apart from that, it also offers minimal wastage, less site materials, cleaner and neater environment, controlled quality, shorter construction period and lower total construction costs [2]. The application of conventional approach, it takes average one worker one year to build a double storey house. It is clearly shown that the conventional approach is not able to meet the increasing demand for housing due to its slow pace of construction method. Therefore, it is important for the local industry players to play a vital role in adopting a concrete steel formwork technology towards eliminating these negative and destructive aspects. Then, complying international practices and standards, concern for health and safety in the job sites, sustain the environment and speed up the process of housing development.

Therefore, the objective of this paper is to identify the contributing factors of selecting concrete steel formwork system in housing construction industry. The outcome of this study is able to assess the importance factors to enhance the usage, efficiency and effectiveness of the said system. In facing the era of globalisation,

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the construction industry players need to be equipped with the technology and experiences related to the marketing of products and services both domestically and abroad. This study is confined to the contributing factors for above matter in Penang, Malaysia. This is explained by the fact that these is one of the active development state in providing houses in Malaysia.

Contributing Factors of Concrete Steel Formwork Usage:

There are various definition have been given to industrialised building system (IBS) who studied into this area previously. IBS is defined as an integrated manufacturing and construction process with well planned organisation for efficient management, preparation and control over resources used, activities and results supported by the used of highly developed components [3]. IBS is an effort to invest equipments, facilities and technologies with the objectives of maximizing production output, minimizing labour resources and improving quality while a building system is a set of interconnected element that joint together the designed performance of a building [4]. All the definition emphasized that IBS as a construction systems and in which components are manufactured in a controlled environment (on or off site) towards well implementing the production and acquiring quality output; at the same time minimizing the application of resources. There are four type of building systems in Malaysia namely conventional, cast in situ by using steel or aluminium formwork, prefabricated and composite building systems [3].

Concrete formwork development has paralleled the growth of concrete construction throughout the 20th century. The increasing acceptance level of concrete as a major construction material has created a new challenge to construction industry's players in developing an appropriate formwork technologies by using different materials and methods of construction. Therefore, an intensive study on the formwork in producing concrete structure is important in order to create a good formwork system. Formwork is very important in producing concrete structure, it allows contractors to cast the main parts of a building which are required to be strong and support the structure. Steel panel formwork systems use prefabricated moulds made from a metal frame. It can be divided into two main systems that are either large or small panel frame. Both of this formwork much cheaper and quicker to use in the long run than traditional formwork. The frames are extremely strong and rarely need replacing, reducing cost in terms of manpower. Besides that, it has very high reuse rates, more precise dimension, minimum construction waste, cleaner and safer jobsite, environmental friendly, reducing finishing coats and reducing overall foreign workers.

It has been developed a model to choose formwork system [5]; it can be divided into four sub activities namely: a) obtain all necessary information – all the necessary information has to collect at the beginning design stage to allow the management to make the correct decision; b) Identify changes – the consistency and integrity are reviewed and the necessary changes proposed to the selector; c) Evaluate alternatives – Different systems should be evaluated to avoid any expensive start-up and detailed design time pursuing; and d) Design formwork – After the final selection by the top management, the formwork elements are designed according to the applicable codes and standards. The choice of the system has been governed by several factors [5] namely: a) Project category – scale of project, size of company, available capital and type of buildings; b) Building design – slab type, lateral loads supporting system (building height) and building shape; c) Job specification – concrete finish and speed of construction; d) Local conditions – area practice and site characteristics; and e) Supporting organisation – hoisting equipment.

Methodology:

There are many techniques to define the research problems. In this study, the information from secondary and primary data gained from various sources that assist the researchers to do this study. A quantitative research approach has been adopted for this study requiring the development of a questionnaire survey. A likert scale has been utilised to measure the level of importance contributing factors of selection the concrete steel formwork system. When responding to a likert questionnaire item, participants specify their level of agreement to a statement. A likert item is simple which the participants were asked to evaluate according to any kind of subjective or objective criteria; generally the level of agreement or disagreement is measured. The five-point scale stating with 1 – Not Agreed; 2 – Slightly Agreed; 3 – Moderately Agreed; 4 – Very Agreed; and 5 – Extremely Agreed. A total of 10 set questionnaire has been distributed to participants for pilot test towards determining the reliability of the questionnaire. There are no problems being identified therefore no amendment needed to be done.

Before distributing the questionnaire, the stage has been gone through are: a) identify the target population – it gained from CIDB annual directory year book i.e. total number of contractors G7 firms (N = 238); b) Select a sampling size – all contractors were selected in this study (n = 238); and c) Conduct fieldwork – distributing questionnaire by faxed, emailed and hand delivered. An average response rate is 32 percent. Two types of statistical methods via Statistical Package for Sosial Science such as frequency and average index analysis has been used towards achieving the research objective. The average index analysis for each variable calculated by using the formula as below [6]: -

$$\text{Average Index (AI)} = \frac{\sum 1(X_1) + 2(X_2) + 3(X_3) + 4(X_4) + 5(X_5)}{\sum X_1 + X_2 + X_3 + X_4 + X_5} \quad (1)$$

Where,

X_1 – Number of participants for not agreed;

X_2 – Number of participants for slightly agreed;

X_3 – Number of participants for moderately agreed;

X_4 – Number of participants for very agreed;

X_5 – Number of participants for extremely agreed.

The overall level of agreement by the participants to the contributing factors which influence the significant of concrete steel formwork selection by the participants are summarised based on the classification of the rating scale. Then, the relative index analysis has been used to obtain the level of importance in evaluating the factors. The formula for the relative index analysis are as follows: -

$$\text{Relative Index (RI)} = \frac{\sum a_1 X_1}{\sum X_1} \quad (2)$$

Where,

a_1 – Number of participants for not agreed;

X_1 – Number of participants for slightly agreed;

Findings:

From the result analysis, it confirmed that scale of project and available company capital are among the most influence factors that lead the selection of concrete steel formwork selection compare to size of company and type of buildings. It shows that most of respondents with the value of AI = 4.47 and RI = 0.89 select the available company capital as their first priority selection, followed by scale of project with AI = 4.13 and RI = 0.83. Type of building and size of company with AI = 3.53 and 3.00 and RI = 0.71 and 0.60 respectively in the project influence factors selection.

Besides that, it shows that most of the participants with average index and relative value, AI = 4.31 and RI = 0.86 respectively select the building height as their first priority, followed by building shape (AI = 3.97; RI = 0.79), and slab type (AI = 3.09; RI = 0.62) in the building design influence selection factors. In the context of Job specification category, most participants valued for AI = 4.66 and RI = 0.93 agreeing that the speed of construction significantly influencing the concrete steel formwork selection. Concrete finish has followed behind with value of AI = 2.94 and RI = 0.59.

Through the result giving by participants, it clearly shown that area of practice and site characteristics is not significantly influence the concrete steel formwork selection with AI = 2.53 and 2.03 and RI = 0.51 and 0.41 respectively. Besides that, it is clearly shown that hoisting equipment is totally not significant influence the concrete steel formwork selection in supporting organisation element. The value of AI = 1.41 and RI = 0.28 level is the lowest in terms of the factors influencing the selection of concrete steel formwork usage.

It can be concluded that there are 3 levels of significant influence factors in the concrete steel formwork selection by contractor's organisations. Among the influence factors, the most significant are speed of construction, available of company capital, building height, scale of project, building shape and type of building. Slab type, size of company, concrete finish and area of practice are among the factors that under moderate significant influence factors. The site characteristics and hoisting equipments are among the contributing factors that not really influence during contractor's organisation decision level for housing scheme.

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