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ARCHITECTS' PRACTICES OF THE INTEGRATION OF CONSTRUCTION WORKER'S SAFETY FEATURES: A SURVEY

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Abstract

The construction industry is known to have some of the most hazardous activities in any country development. The hazards exposed to construction workers on site often place the contractor as the one to blame. Architects as the leader in the design team can play an effective role in minimizing the hazards. However, there is yet to be research that focuses on the architects' roles in hazard mitigation. This study investigates the possibility of integrating the construction workers' safety features into building designs in the Malaysian construction industry. The result could assist the clients in reducing related costs due to injuries and death on the construction site. A survey on the architecture consultant firms in Klang Valley Malaysia has found that the respondents do integrate construction workers' safety in their designs, yet the integration is insignificant because it is done through their own initiatives and on an informal basis. In addition, the integration is only considered during the third phase of the design review. The findings further indicate that certain designs have been taken into consideration such as providing warning and information about site conditions, designing and scheduling railings as part of the erection process, designing window sills and parapet wall 42 inches above the floor, designing permanent guardrails around skylights and providing warning in the plans and specification construction of floor openings during construction. The findings may be able to provide some new insights on the architect's involvement in integrating construction workers' safety features during the design process. Promoting and improving the integration of construction workers' safety features would be more promising to improve construction site hazards.

Keywords: Safety; construction workers safety; architect practices; design process; survey; Malaysia.

1. Introduction

Construction safety has become a primary concern, consistent with the rapid increase of Malaysian construction activities. Statistics has shown that the construction industry contributes the highest accident rates compared to agriculture, small-medium industry and small-medium enterprise (Abdul Rahman, 2007). Although a report by Tawad (2006) states that construction accidents in Malaysia have been reduced to 5.62 for every 1000 workers from 19.00 in the early implementation of OSHA 1994. However, when compared to the accident rates in developed countries which fall within 2.00 to 4.00 for every 1000 workers, this country seems to be in need of a lot of improvement to achieve the rates of the developed countries. In terms of potential hazards, the main contractors are the parties that are held responsible for the occurrences of accidents on site (OSHA 1994; JKR 203/203a, 2010; PAM, 2006; CIDB, 2006 & Mroszczyk, 2006).

Previous researches have addressed issues concerning accidents on site, but failed to look into the methods to make the construction process safer. According to Mroszcyk (2006), architects can contribute in eliminating the hazards by incorporating appropriate design features in their designs. Bluff (2003) and Lingard et. al (2005) emphasize that safety considerations are normally based on making choices about the design methods of construction and materials used and this should begin at the schematic drawing stage. The views of the above scholars are in line with the risk management theory, which pose that it is better to eliminate occupational health and safety risks at the source rather than to try to control them once they appear.

Smith et. al (2006) argues that designers of the construction projects, whether architects and engineers, have the opportunity to consider construction safety features in the project's design stage. Their designs transmit how a project will appear and how a particular project or its components will be assembled. The method of assembly is often not recognized by designers. In reality, designers influence many decisions about how construction tasks are undertaken. They are in a position to perform decision-making and influencing to help improve construction safety. He further describes that the safety of any operation is determined long before the people, procedures and equipment come together at the work site.

Research on integrating construction workers' safety features into building designs has been widely debated in the United States and the United Kingdom (Haslam et. al, 2005). However, very little research has been done in Malaysia on designers' role towards construction workers' safety during the design phase. Therefore, the purpose of this study is to investigate the integration of construction workers' safety features by Malaysian architects. More specifically, the study aims at achieving the following specific research objectives (a) to determine the criteria emphasized by Malaysian architects when designing a building, (b) to identify what construction workers' safety features that are incorporated into the building designs, (c) to identify the constraints of integrating construction workers' safety features when designing a building.

1.1. Methodology

The research proceeds with a review of relevant literature on construction safety published by the Academic Journals. This is followed by a pilot study questionnaire, which is designed and discussed with ten (10) professional Architects, obtained from personal contacts through conferences and seminars. A certain modification was made to the pilot study questionnaire and the final version was then sent to architecture consultant firms. The consultant firms were randomly selected from 107 companies listed in the Lembaga Arkitek Malaysia (LAM) as part of the survey. They were selected due to their past experiences on high-scale projects. Of the selected companies, 7 were unproductive as the companies had been untraceable during the time when the survey was conducted. The final sample comprising 100 companies were representative of the Malaysian architects on the integration of safety features for the construction workers. The surveys took place during the last quarter of 2011.

The questionnaires were mailed, faxed and e-mailed to 100 architecture companies identified earlier. The process of sending questionnaires took almost two (2) months to administer, including making phone calls to all of the companies to ensure that the questionnaire was safely delivered and that only appropriate personnel would answer the questionnaire of the survey and also responded to the follow-up phone calls. The respondents were limited to personnel with vast experiences on designing and working on-site. Within the time frame, the total responses were coming from 30 organizations. The survey data were gathered and analyzed using The Statistical Packaging for Social Science (SPSS) version 16.0. This software would be used to perform the data analysis for the questionnaire survey.

1.2. Results and Analysis

In the survey, the analysis was presented in the form of frequencies and mean. In this part of the survey, the priority of characteristics to be considered during the designing stage was carried out. According to Hecker, et. al. (2005), they discover that quality is the highest priority among their respondents followed by the end-users (which they use to refer to final occupants' safety), project cost, project schedule and aesthetic value of the building. In their survey, construction workers' safety features are shown to assume the lowest priority to be considered by their respondents.

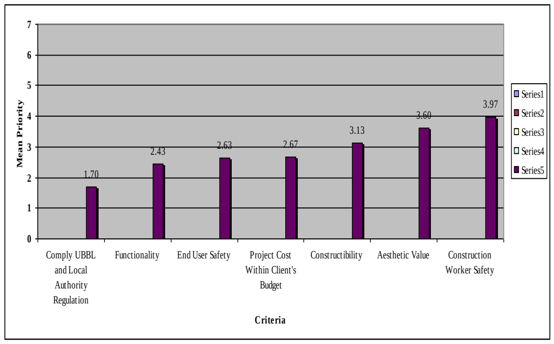

Fig. 1. Priority Characteristics When Designing

In this study, in order to determine criteria emphasized when designing a building, the respondents were asked to rank in order of 1 to 5; the lowest point indicates the highest priority. The result is shown in Figure 1, which depicts that being compliant to the UBBL and the Local Authority Regulation was the highest to be prioritized when designing (Hecker et. al., 2005) term this as "quality"). The second ranked was functionality and this is followed with the end-user safety. Project cost is the third priority being considered when designing a building. This criterion is to ensure that the architects' designs are not too overbearing, that the client's budget is affected. However, this depends on clients' need statements. Constructability and aesthetic value respectively ranked fourth and fifth as the criteria to be considered during the design process. It should also be noted here that, in line with findings of Hecker et. al. (2005), construction workers' safety features have appeared to be the last criterion being emphasized by the respondents. This reflects that the construction workers' safety features are not selected to be at the higher scale of priority by Malaysian architects during the designing process. This scenario is also consistent with Haslam et. al. (2005), revealing that many designers still fail to acknowledge their influences on the construction process safety. An analysis using the five-point Likert Scale was used in each of the three (3) design phases; the schematic phase (Figure 2), design development phase (Figure 3) and contract document phase (Figure 4) in order to determine whether or not the integration of the construction workers' safety features is emphasized during those three design phases. The lower figure shows lower emphasis of the criterion at the design stage.

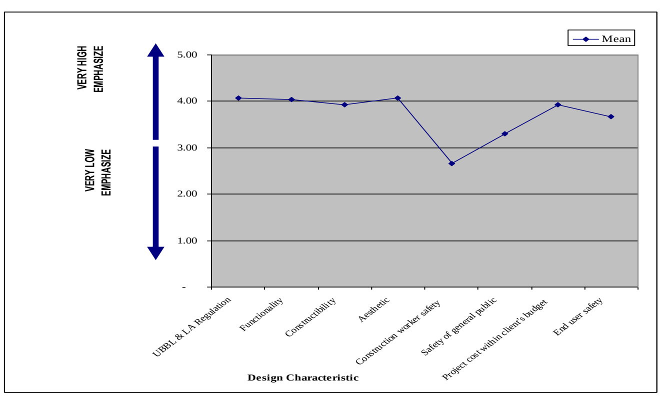

Fig. 2. Characteristic Emphasis during Design Review; Contract Schematic Phase

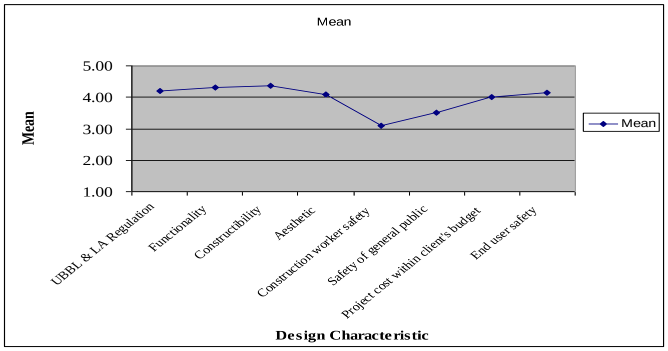

Fig. 3. Characteristic Consideration during the Design Development Phase

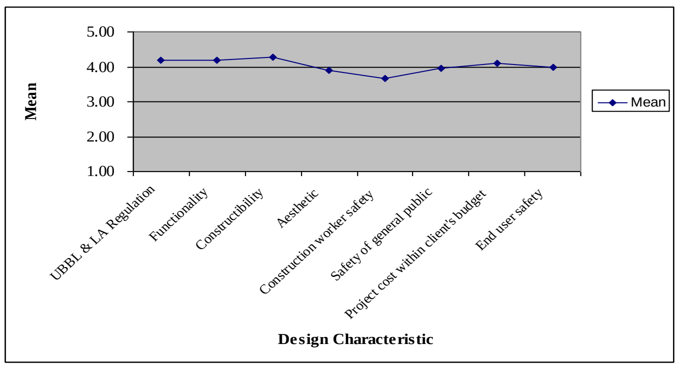

Fig.4. Characteristic Emphasis during Design Review; Contract Document Phase

From the survey, it has been revealed that the integration is ranked last in every design phase. In Fig 2 it shows that the integration of the construction workers' safety is given low emphasis during the schematic phase where the mean score is fewer than 3.00. During the design development phase, the integration of construction workers' safety still remains the lowest to be emphasised with the mean above 3.00 but it closes in to neutral response (See Fig 3). Meanwhile, in the contract document phase (Fig 4), the integration of the construction workers' safety remains to be the last emphasized. However, the mean score is noted to be above 3.00 which is close to the 'high emphasis' scale. Based on those three phases, it can be disclosed that the integration of the construction workers' safety is ranked lowest to be emphasized. It reveals that the integration is implemented insignificantly which is only highly emphasized during the third phase of the design; namely the contract documentation phase.

In order to identify the design basis which is coherent to the integration of the construction workers' safety features, the respondents were asked to answer based on a Five (5) Likert scale of 1-5. Scale 1 indicates very low emphasis and the scale increases in the level of significance where 5 denotes very high emphasis.

Table 1: Basic Design Consideration Based On The Mean Score

Mean Score Less Than 3.00		**Mean Score More Than 3.00**	
Description	**Mean Score**	**Description**	**Mean Score**
Fall Protection		***Fall Protection***	
Design permanent guardrail system for use by all contractors upon designing the ventilation system, trash chutes, elevator which cause floor openings to occur during construction.	2.67	Design handrails, guardrails, stair rails to be built as part of the erection process.	3.23
Design fall protection mechanism of the guardrail systems (permanent guardrails, anchor point) when designing the atrium of building.	2.93	Design window sills 42 inches above the floor.	3.50
Construct fall protection mechanism into the schedule to allow their use by construction workers when constructing the atrium.	2.80	Design permanent guardrails around skylights.	3.13
		Design 42 inches parapet wall.	3.37
		Provide warning in the plans of the construction of the ventilation system, trash chutes, elevator which causes floor openings during construction.	3.10
		Provide warning in the specific construction of the ventilation system, trash chutes, elevator which causes floor openings during construction.	3.07

The literature review suggests that this fundamental design consideration is used as a guideline or outline for the integration of the construction workers' safety features when designing a building, as collectively agreed by Gambatese and Hinze, (1999), Hecker et al, (2005), Lorent, (1999) in Bluff, L (2003) and Bluff, L (2003), Gambatese (1998), Behm (2006) and the Construction Industry Council CDM Guidance (2004). Table 1 depicts that the result of the basic design consideration is categorized into more or less than the mean score of 3.00. This effort is done to determine which categories on design consideration that the respondents had scored in the low scale. The result shows that there are six (6) design considerations under two (2) main headings which mean score is less than 3.00. As noticed, the mean score less than 3.00 shows that the basis of design consideration is lowly emphasised while the mean score more than 3.00 shows that the basis of design consideration is highly emphasized. A few basic designs belong to the latter, which are designing and scheduling handrails and guardrail which are to be built as part of the erection process, designing permanent guardrails around the skylight, designing 42 inches parapet wall, provide warning in the plans and specification for the construction of the ventilation systems, trash chutes, and the elevator which causes floor openings during the construction and determine the damaged conditions of the roof, trusses, purlins structure to evaluate how fall protection devices will be incorporated into such a structure. This result also describes that the implementation of other designs is insignificant among the respondents as only certain basic design considerations have been lowly emphasized, as tabulated in Table 1 in the column “mean score less than 3.00”.

1.3. Constraints In Integrating Construction Workers Safety

Table 2 presents the list of constraints faced for integrating construction safety during the design stage. The list of constraints has been ranked in accordance to the mean score. Scale 1 depicts strongly agree, 2, agree, 3 not sure, 4 disagree and 5, strongly agree. As shown in the table, the significant constraints agreed by the respondents in integrating construction workers’ safety during the design process are explained by the lack of education received on issues of construction workers’ safety and how to design for safety. The next rank, agreed by the respondents is the OSHA’s placement of safety responsibility on the contractors, followed by limited or absence of safety-in-design tools, guidelines and procedures. Finally, the lack of acceptance of integrating the approach, lack of motivation to implement the approach due to liability concern and weak or non-existing regulatory requirements to design for the safety of the construction workers have also been agreed as their constraints in implementing the approach. In contrast, the lack of knowledge on construction workers’ safety, limited pre-construction collaboration between the architect & contractor due to the traditional contracting structure of the construction industry and lack of knowledge on construction worker safety are shown in Table 2 as being above the mean score of 3.00, suggesting “not sure”. Instead of the constraints listed, the respondents also agreed that the client’s budget restricted them to implement the approach. The respondents also expressed that there was overlapping of roles incurred as the main contractor required an appointed safety officer to monitor site safety. This scenario may lead to conflicts of interest among the Architect and main contractor. Another constraint is due to the transient workforces in the industry whereby the majority originate from foreign countries. Commonly, they will move on to new sites which tend to offer higher salary, and thus, this makes it difficult to educate them on safety ethics.

Table 2: Constraints In Designing Construction Safety During The Design Stage

Constrains	**Mean**
Lack of education received on issues of construction worker safety & on how to design for safety	2.60
OSHA's placement of safety responsibility on the contractor	2.67
Limited, or the absence of safety-in-design tools, guidelines & procedures	2.83
Lack of acceptance of integrating such approach	2.87
Lack of motivation to implement the approach due to liability concern	2.87
Weak or absent regulatory requirements to design for the safety of the construction workers	2.87
Limited pre-construction collaboration between the architect & contractor due to the traditional contracting structure of the construction industry	3.03
Limited pre-construction collaboration between the architect & contractor due to the traditional contracting structure of the construction industry	3.03
Lack of knowledge on construction worker safety	3.20

N=30

Conclusion

This survey provides an important insight mainly on the fact that the respondents do integrate construction workers' safety in their design, yet the integration is insignificant because it is done through their own initiative and on an informal basis. In addition, the integration is only considered during the third phase of the design review. Certain basic design considerations which lead to the integration of construction workers' safety features have been taken into account during the contract documentation phase. Only a few basic designs have been stressed namely, designing and scheduling handrails and guardrails which are to be built as part of the erection process, designing permanent guardrails around skylights, designing 42 inches parapet wall, providing warning in the plans and specification for the construction of ventilation systems, trash chutes, and elevator which causes floor openings during construction and determining the damaged conditions of roof, trusses, purlins structure to evaluate how fall protection devices will be incorporated into the structure. The research suggests that designers should provide and take into consideration the best safety practices such as preparation of plans and specifications. Besides, the communication of risk regarding the design and utilization of specific safe designs can also be integrated to reduce hazards during the construction stage; hence, there is a need to generate some effective solutions that can be implemented and to come up with checklists to monitor the design in later stages.

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