

A Case for the Introduction of Designers' Safety Education (DSE) for Architects and Civil Engineers

Wan Faida Wan Azmi^{1, a} and Mohd Saidin Misnan^{2, b}

^{1, 2} Department of Quantity Surveying, Faculty of Built Environment, Universiti Teknologi Malaysia, Malaysia

^awfaida2@live.utm.my, ^bb-saidin@utm.my

Keywords : Safety Education, Design for safety, Designers

Abstract. The construction industry has been known as the most fatal industries worldwide. Accident affects varies parties involving direct and indirect costs to the contractor and clients as well. The construction safety measures in the current practice often begin during the construction phase rather than at the earliest stages possible. Design for Construction Safety (DfCS) is a process to reduce the hazards and risks during construction by focussing on design decision at the design phase. This concept implementation is new and has yet to be adapted worldwide. With every new culture comes with a set of list to overcome. The top barriers stated by past researchers are lack of knowledge and education followed by increased of liability and the nature of the industry. The initial step to be taken is to adapt this concept in the universities and college level during the designers' formal education. By mastering this subject, the designers will become more confidence with new found skills while their attitudes towards safety will have a huge impact on workforce safety by eliminating hazards on site.

1.0 INTRODUCTION

The construction industry is known as one of the most hazardous industries among others. This has been proven in Malaysia where this industry has been the third highest accidents statistics for the past five years after the manufacturing and agriculture industry [1]. When an accident occurs on site involving a construction workers, it affects varies parties such as the victim and his family, the construction company as well as the client of the project. It involves direct and indirect costs as to the iceberg theory. These costs may include compensation to the victim, the chance of liability suits and prosecutions for allowing employees to perform work in an unsafe condition [2]. The current culture of Malaysia's construction industry often puts the blame on the main contractor when an accident happens. However, besides the financial implication stated earlier, a temporarily site shutdown may occurs due to the investigation of the accidents, loss of workforce or replacement of damages plants and equipment. This situation gives major impact to the contractor as well as the client.

Therefore, researchers are finding ways and methods to reduce the accidents statistics to a minimum target in order to reduce the lost affected by all parties. They found that besides putting the site safety responsibilities solely to the contractor, the designers as well as clients have their own roles and responsibility to the safety of the workforces especially during the construction. This concept is known as Design for Construction Safety (DfCS) and has been widely implemented worldwide. It is however yet to be implemented to the Malaysia's construction industry due to the inadequate knowledge on safety by the Architects and Civil Engineers.

2.0 DESIGN FOR CONSTRUCTION SAFETY (DFCS)

Design for Construction Safety (DfCS) is a process influencing design decision to reduce the need of personal protective equipment such as fall protection both during construction phase and maintenance [3]. It is very crucial for a designer to be aware of their roles and responsibilities in the

context of enhancing the construction site safety [3,4]. The objectives are to reduce the project risk at the most minimum while increasing safety of the workforce by thoroughly reviewed the design during the design phase. This concept is new and has not been widely known in this country's construction industry culture.

However, this implementation has been performed in the United Kingdom a few years back. To show their support on this concept, they added the duties of designer in the Construction (Design and Management) Regulation (CDM) 2007 where it stated that the duty of the designer to ensure that any design prepared should avoid foreseeable risks to the construction workers. Similarly in South Africa, an additional clause is added to the Occupational Health and Safety Act (1993) stated that the designers shall modify the design where it necessitates the use of dangerous structural, procedures or materials that brings hazards to the health and safety. Guidelines were also made in order to fulfil this concept by Singapore and Australia.

The improvement of construction safety in the current practice often focusses during the construction phase. However, Figure 1 shows the comparisons between the level of safety influences and the project timeline. The level of influences is the highest during the earliest stage as it decreases towards the completion of a project. This proves that the conceptual phase is the most crucial than other stages. This also proves that the designers have an important role to play during designing a project and that the DfCS concept is proven to be valid and true.

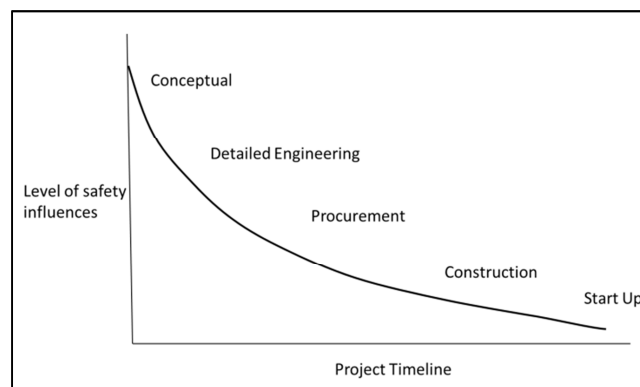


Figure 1 : Construction Safety vs Time Curve [3]

Moreover, past researcher has found that as high as thirty three per cent (33%) of construction accidents in Iran are related to design [5]. In another research, it was found that sixty three per cent (63%) of all fatalities occurs may be attributed to design decisions or lack of planning [6]. With these results, we can conclude that it is time to change the culture of this hazardous industry by focussing on the root of the project; the design stage rather than concentrating during the construct of the building or structure.

In the designer's defence, they stated that their main focus are on quality, time and costs whereas for the safety of site is not their concern [7]. They expected the construction managers to be fully responsible as to provide necessary and sufficient safety equipment for the safety of their own employees. Based on Torghabeh and Hosseini [8], the physical condition of the construction site or workplace is not necessarily providing hazardous situation but the design characteristics may create a hazardous condition which cannot be attributed to contractors. For an example, the usage of safety cables or lanyards would be useless if there is insufficient means of anchorage. This can only be overcome if the designer are aware of this situation and take into considerations during the designing by adding columns with holes above the floor level that can be used as an anchor point [4]. Therefore, even though sufficient safety equipment was used in a proper manner on construction site, personal protective equipment itself cannot fully eliminate the risk and hazards provided by the design made.

3.0 BARRIERS OF DESIGN FOR CONSTRUCTION SAFETY (DFCS)

With the implementation of a new concept into the current culture, there are always barriers and limitations that needed to overcome. Table 1 shows the barriers stated by past researchers on implementing design for safety. The lists includes increasing of liability, project cost and duration, lack of knowledge and education to practice the concept, lack of motivation and support, limitation on their creativity as a designers and the current culture of the industry that does not involve designer into the safety of the workforce.

Table 1 : Barriers in Implementing Design for Safety based on past researchers

No.	Researchers	Barriers in Implementing Design for Safety						
		1	2	3	4	5	6	7
		Increased Liability	Increased Project Cost	Increase Project Duration	Lack of Knowledge & Education	Lack of Motivation	Limitation on Creativity	Nature of the industry
1	Lena Almen <i>et al.</i> (2012)		X		X			
2	Nicholas Tymvios <i>et al.</i> (2012)	X	X					X
3	Yazici & Dulaimi (2012)	X	X	X	X		X	
4	Torghabeb & Hosseinian (2012)	X			X			X
5	Roosbeh & Mohammad (2011)				X			X
6	Zarges & Giles (2008)	X		X	X			X
7	Gambatese <i>et al.</i> (2005)				X	X		X
8	Gambatese & Hinze (1999)	X			X			
9	Hinze & Wiegand (1992)	X						
Total		6	3	2	7	1	1	5

Among these barriers, the top barriers found are lack of knowledge, education & training of the designers. This is followed closely by the fear of increasing of liability and the current nature of the industry. Most designers' are not exposed on design for safety during their formal education. They were not given the awareness of their role in providing a safe design to be constructed by the workforce. This explains why only 7 out of 23 respondents made design decision specifically with the intent of improving construction worker safety [9]. Based on Hinze & Wiegand (1992) research, it resulted that the majority of respondent did not address construction worker safety in their design. Although most of them agreed that design decisions made during construction can most help eliminate some construction workers' hazard, their fear of added liability is one of the barriers in implementing this concept [9, 10, 11].

4.0 DESIGNERS' SAFETY EDUCATION (DSE)

Common problems highlighted by the designers are mainly on their lack of trainings, skills and information regarding the concept. The other barriers can be easily overcome in time however their knowledge on design safety are the main factor that may distort the implementation process to be a success. Many of the designers are beginning to admit and ware that their designs may impact the safety performance on site. However, they could not proceed further as they are unable to

improve or mitigate their designs [2]. Although majority of the designers support this concept, there are a handful of designers who do not consider themselves in charge of providing and preserving safety on site. They believe that the contractors and site management are solely responsible for workplaces safety especially in the context of their employees whereas their roles are mainly on the safety of the end-product and end-users. This attitude and mind-set may result due to the culture of the construction industry as well as lack of safe design training and skills [5].

One of the ultimate steps to be taken in order for this concept to be widely implemented successfully is to increase the Designers' Safety Education (DSE). Designers' knowledge on design for safety should be instilled during their education process in the university [5, 12]. This can be done by improving the education curricular in the university and college in the Architecture and Civil Engineering programmes by including safety matters in their existing course and introducing a safety course as a primary subject. Majority of local and private universities in Malaysia did not include safety design in their curricular for both bachelor in Architectural and Civil Engineering [13-19]. Although they may include or squeeze in safety as subtopics, however safety should be a separate and primary subject to be mastered on especially in design context. With that, the designers will be taught that the only way to approach a design is by taking safety of the construction workers into considerations [12]. Therefore, hazards and risks on site affecting the workforce will be at the minimum while accidents on site can also be reduced at the same time.

Apart from curricular education, this effort should also be exposed to practicing architects and engineers throughout the country in order to eliminate the paradigm shift occur between the graduates and practicing professionals. Continuing education should be provided and act as a formal education for practicing designers' or project teams whom are no longer students [10]. This is in order to provide awareness to them on the latest design mitigation and decisions that can be altered or modified into their design during practice. Educational material on safety design should be prepared adequately for workshops, trainings and seminars to develop and increase designers' knowledge [11].

5.0 CONCLUSION

The mind-set of the designer must change in order to implement design for safety concept. The initial step to be taken is through their education level in order to improve the current culture and adapting the culture to this new and improved concept. The designers should consider safety implications of their design decisions made during the design phase by taking worker's safety into consideration. By mastering the safety design subjects, the designer will become more confident in safety design whereby they would understand that this concept would not limits their creativity of designing. It will however enhance their role and position in a project towards a safe project both during construction and end-project. In addition to that, the designers' attitudes towards safety will have a huge impact to take a responsibility that can save lives. In addition to that, this concept doesn't only provide a safe construction environment to the workforce, but it also benefits financially to all the parties involved.

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