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COMPACT INTERLOCKING PRECAST WALL PANEL

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ABSTRACT

This study focuses on decreasing on-site labour and increasing sustainability by utilising better products for campus projects. The issues of weight, dimension, storage and handling have led to transportation problem of precast wall panel. Transportation problem clearly causes delay and increases cost of a project. The aim of this study is to develop the current precast wall panel using an innovative idea to minimize the current problem and issues. The three objectives of this study are to review the current issues of precast wall panel, to propose a compact interlocking precast wall panel and to suggest the marketability of compact interlocking precast wall panels in the construction industry. Several research methodologies have been implemented to achieve the objectives of this study; first is a literature review to review the issues of precast wall panels, the second is a simulation to simulate the making process of the innovation product and the third is a desk study to study the marketability of the innovation idea. As a result, a Compact Interlocking Precast Wall Panel was developed to upgrade the current precast wall panel that benefits all issues related to transportation. Literature review, simulation and desk study were successfully done to show the effectiveness of the new idea. Thus, a small, lightweight, and an interlocking product is proposed to resolve the transportation problem. The product is simulated and explained from the materials used for the lightweight panel to the manufacturing of the interlocking and small-size panels.

Keyword: *transportation, interlocking, lightweight*

1. INTRODUCTION

Industrialised Building System (IBS) precast concrete is a building technology that aims to improve on the traditional construction process (Khairul et al., n.d.). Engineers and architects are increasingly interested in precast concrete building (Rossley et al., 2014). Precast concrete offers benefits over in situ cast concrete in that it is more sustainable, has better quality control, takes less time, and costs less to build. However, IBS precast concrete projects are plagued with major issues such as cost overruns, delays, and worse end-product quality. Some wall units are manufactured in factories, where the shape, material quality, and finishing may be more precisely regulated. The transportation to unload the wall panel is a crane (Pradeepa et al., 2016). However, these walls cannot be carried far from the production because of their great size and weight. As a result, they can only be used within a short radius of the precast facility. Oversize elements necessitate police escort and road management. These units should be examined before delivery since site rejection due to quality concerns and return to pre-caster are not trivial matters. There should be a 'Plan B' in place so that any over width cargoes that are unable to unload due to unforeseen reasons can be stored on site. When loading delivery trucks, it is critical to guarantee proper weight distribution and load stability. Prior to loading, the weight of precast elements (as well as their centre of gravity) should be examined and

validated. Before shipping, all loose or unnecessary material on a precast unit should be cleaned off. Lifting anchors should be tested to ensure their operation. It is critical that units be loaded so that unloading may be done in the proper sequence for increased safety during installation (Jefferson et al., 2019). This, however, should never come at the price of safe transportation. As a result, some double handling may be necessary at the installation site. Therefore, it is better if the panels do not need to be stored and be installed right away when it arrived. Precast concrete wall panel has its own advantages and disadvantages. Focusing on disadvantages, there are several of them such as transportation, connections, workmanship, and tolerances. Transportation is the main problem as it is related to the size, storage, handling, and the weight of precast wall panel since the existing precast concrete wall panel, known as huge IBS product, is produced in a factory and delivered to the site. The experiment evaluates the panel's behaviour in terms of damage, cracking, and maximum load bearing capability.

2. FINDINGS

An idea of making a lightweight panel was considered when examining the issue of transportation because it is fragile and can be easily damaged en route to site. Compact Interlocking Precast Wall Panel built in this study has a compact size, which will ease the transportation, lifting and installing stages. It is also a lightweight panel with interlocking joint, both criteria of which help to solve the problem of current precast wall panel. Moreover, the weight of the innovated product was reduced to 156 kilograms (156 kg) for 1 m^2. Two models were made to compare the size of standard ratio of precast wall panel. A proposed weight for Compact Interlocking Precast Wall Panel was made using the ratio of lightweight panel ratio. Next, the size was upgraded to be smaller than the previous precast wall panel as the latter requires a truck to be transported, which increases the cost of transportation especially when the project is in a big scale and totally uses precast products. For precast wall panels, the time taken to be transported is longer to reach the site since the truck that carry them must be handled with care to prevent damage or any unexpected incidents. In this study, the size proposed is smaller and easier to handle compared to the original one with the dimension of 1 m^2. Lastly, interlocking jointing was proposed to be included because in conventional precast wall panel, there is an existing problem related to the connection of the precast wall panel. The connection needs to be properly installed because it will cause leakage and sound insulation failure once it installed erroneously. Thus, interlocking joint is used to answer these issues.

3. METHODOLOGY

This study starts with identifying the characteristics, the problems related to precast wall panel, objectives of the study, method used for the findings and results, analysis of idea to improve the problem, and ends with the development of a new product. The advantages of precast wall panel are thermal resistance, moisture protection, fire safety, acoustics, durability, maintainability, and green construction (Shin et al., 2016). However, there are also disadvantages such as it being unsuitable for small projects, its fragility during transportation,

lack of integration, and difficulty to connect (Taheri et al., 2016). It also incurs high cost because it is still a novel material among contractors in Malaysia. Furthermore, a common problem on precast wall panel is transportation. As stated before, transportation is the main issue of this study along with other problems such as dimension of precast wall panel, storage, handling, and the weight of precast wall panel. All these problems need to be solved through innovation. Hence, the objectives of this study are to know the issue of precast wall panel, the effective strategy to improve the issue existed for precast wall panel and the marketability of the new innovation idea for precast wall panel. To answer these, there are three methods used in this study. Firstly, a literature review pertaining few products related to wall panels was done. This included solid precast wall panel, interlocking hollow core precast wall panel, lightweight precast wall panel, and interlocking compressed earth bricks. The literature review describes the benefits and disadvantages that should be considered to develop a better product. Secondly, a simulation of the innovation developed is required to know the dimension, characteristics, benefits, and proposed weight. This is important to investigate whether the innovated product can solve the current problems in literature. Lastly, a desk study about the precast wall panel's dimensions and weight was conducted. A desk study was carried out by collecting some data from local organization's papers, articles, and books. Additionally, this study was analysed with the guidance of experts. The results of findings were collected, gathered, and generated to complete the analysing phase. The analysis of data was then made after the result was obtained. Finally, after the analysis process, a new product was developed. The data collected from the literature reviews, simulation and desk study were able to determine whether the newly innovated product can solve the issues discussed and offer a better alternative to all stakeholders.

4. CONCLUSION

In conclusion, the introduction described the background of study which is the implementation of IBS in Malaysia and its many issues, with a focus on transportation as major problem to be tackled. The objectives of this study are to review the current issues of precast wall panel, to propose a compact interlocking precast wall panel and to suggest the marketability of compact interlocking precast wall panel in construction industry. All the objectives stated are based on the research questions which leads to the data collection process.

For the methodology of the study, literature reviews were done according to the selected element. Other than that, simulation was made to add to the data collection for this study. Finally, a desk study was carried out to gain a precise data. A design framework of this study was conducted which include identification of problem, objectives of the study, methods used to complete the study, the analysis of the results collected, and the product itself.

In addition, results and findings were presented where analysis of literature review answered the first research objective, the data from simulation answered the second objective, and the desk study for marketability answered the third objective. From the findings, it is found that

the proposed innovation can be developed to be a new better product. As the simulation was included to answer the second research objective, the production process was also described to figure out the process of making the Compact Interlocking Precast Wall Panel. Overall, a Compact Interlocking Precast Wall Panel was proposed to fill the gap to solve the current precast wall panel's issues with transportation problems due to the weight, dimension, storage, and handling issues.

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Sekian, terima kasih.

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Setuju.

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