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THE 11TH INTERNATIONAL INNOVATION, INVENTION & DESIGN COMPETITION INDES 2022

EXTENDED ABSTRACTS BOOK



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INNOVATION OF THE ACRYLIC LIGHT-TRANSMITTING CONCRETE (ALTC) FOR WALL PANEL

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ABSTRACT

The nation's socioeconomic development is significantly influenced by the construction industry. The goal of sustainable development in the construction industry is also important to preserve the natural environment. The rapid development of Malaysia's construction industry to some extent poses a problem because the lack of sunlight in the building causes an increase in excessive electricity. Therefore, this innovation project focuses only on the development of normal concrete wall panels in building construction. Problems may arise when there is an issue of low illuminance levels in a building that does not meet the standards and recommendations of lux because of opaque normal concrete wall panel properties. Therefore, an innovative concept called Acrylic Light-Transmitting Concrete (ALTC) wall panel is created to address the identified issues. The study aims to develop an innovation of the ALTC for wall panels. The objectives of the innovation project are to review the current issues related to normal concrete wall panels, to develop an innovation for the ALTC wall panel, and to suggest the marketability of the ALTC wall panel. The method used to achieve the objectives are document analysis, experimental programme and desk study. The current issues and the ALTC wall panel testing results have been discussed based on the data collected. Hence, a comparative analysis is made to compare the normal concrete wall panels and the ALTC wall panel as the result findings. Furthermore, based on the desk study method, the ALTC wall panel may be marketed to the potential user. It was hoped that the innovative concept of the ALTC wall panel would improve both the design, properties, and quality of future development.

Keywords: acrylic, light-transmit, concrete, wall, illuminance, lux, building

1. INTRODUCTION

Urbanization and population growth may significantly impact the construction industry (Mohd Yazit et al., 2020). However, this development presents a challenge, to an extent due to the reduced sunlight penetration within buildings, leading to increased reliance on excessive electricity consumption. Consequently, energy costs escalate, emphasizing the importance of utilizing materials in wall panels that promote sustainable building design. To achieve the most sustainable buildings, the Industrialized Building System (IBS) emerges as a top choice. IBS is widely recognized as a leading product manufacturer in the construction industry, particularly in Malaysia.

2. METHODOLOGY

Document analysis was the first data collection method used to achieve the first objective of reviewing the current issues related to normal concrete wall panels. All data from Ezaccess



UiTM such as articles, journals, paper conferences, thesis and dissertations, Ebooks and others were gathered and analysed to substantiate and support the objectives of this study. These helped to analyse the types of precast wall panels, issues, and the problems of normal concrete wall panels in building construction. Then, the data collected from previous studies and research regarding normal concrete walls from the internet are used to generate the idea to develop new products to solve the current issues.

The experimental programme was chosen as the data collection method to achieve the second objective. During the development of this product, there were two methods of development used, such as the ALTC specimen and ALTC prototype to facilitate some testing. So, the preparation of materials, mixing design of concrete, the procedure of developing this product, and testing of the product is explained in detail.

The last data collection method is to achieve the last objective which is to suggest the marketability of ALTC wall panel. All the data from Ezaccess UiTM such as articles, journals, paper conferences, thesis and dissertations, Ebooks and others were gathered and analysed to substantiate and support the objectives of this study. Therefore, the depth and breadth of the desk study emphasize the credibility of the market potential of the innovative ALTC wall panel product. The result of the desk study for the marketability of ALTC wall panel will be further discussed in the next chapter.

3. FINDINGS

3.1 Workability Test

There were differences in slump height where for Mix 1 is 95 mm while Mix 2 is 100 mm. Mix 1 represents normal concrete wall panel while Mix 2 represents ALTC wall panel. Nevertheless, the Mix 2 ALTC shows a high slump due to 0% of course aggregates used, and a high w/c ratio compared to normal concrete wall panel.

3.2 Light Transmittance Test

The test was carried out for about 30 minutes starting from 10.50 am until 11.20 am on 28 June 2022. All the points were tested at the same time to provide an accurate data record and differentiate the light transmittance for each point. After the test was done, the minimum and maximum values of light transmittance were determined as well as the average values of light transmittance.

3.3 Thermal Comfort

The thermal comfort test was carried out for about 30 minutes starting from 10.50 am until 11.20 am on 28 June 2022 the same time as the light transmittance test using a 4-in-1 metre device and the table shows the two types of results which are the air temperature and relative humidity. All the points were tested at the same time to provide an accurate data record and



can differentiate the air temperature and relative humidity for each point. The record of the thermal comfort test is for Point A, Point B and Point C. After the test was done, the minimum and maximum values of the air temperature and relative humidity were determined as well as the average values.

3.4 Compressive Strength Test

The specimens of ALTC have the highest compressive strength value of 22.8 kN for ALTCB3 1.0 cm spacing compared to 20.0 kN of ALTCA3 0.5 cm spacing and 20.0 kN of NC03 for the normal concrete specimens after 28 days, possibly because the parallel orientation of the acrylic rods contribute to the solution of the horizontal deformation due to vertical loading. They have much higher strength than normal concrete specimens without any acrylic rods, which have a compressive strength value of 20.0 kN which is the standard compressive strength for G20, possibly because the acrylic rods stretch horizontally and cause a high modulus elasticity of the concrete during loading.

3.5 Density Test

For mass in air, the specimens of ALTC have better density where the lowest density value is 2010.2 kg/m3 for ALTCB1 with 1.0 cm spacing, compared to 2012.1 kg/m3 of ALTCA1 with 0.5 cm spacing and 2396.5 kg/m3 of NC01 for the normal concrete specimen after 7 days. Meanwhile, for mass in water, ALTCB1 has the lowest density which is 987.5 kg/m3, and ALTCA1 is 990.8 kg/m3 while the NC01 has the highest density in water which is 1391.8 kg/m3. The density of water is approximately 1 kg per litre, while that of air is approximately 1.2 g per litre. As a result, the air is approximately 830 kg/m3 times less dense than water (Pitroda, 2022).

4. CONCLUSION

In this study, the issue of low illuminance levels in a building that does not meet the standards of lux because of opaque normal wall panel properties was researched. The result shows that the ALTC wall panel has a good workability test, a high 875.7 lx of illuminance level, 22.8 kN of compressive strength and a low density of 987.5 kg/m3. Consequently, the ALTC wall panel has demonstrated promising market prospects in various sectors, across regions, industry participants, materials, and applications. This highlights the undeniable potential of the ALTC wall panel as an excellent product choice for transmitting light, thereby saving energy and cost across diverse construction projects.



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