MECHANICAL PROPERTIES OF LOW CARBON AND SUSTAINABLE BUILDING BLOCK UITILISING OIL PALM TRUNK FIBER

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Tuan,

LAPORAN AKHIR PENYELIDIKAN 'MECHANICAL PROPERTIES OF LOW CARBON AND SUSTAINABLE BUILDING BLOCK UITILISING OIL PALM TRUNK FIBER'

Merujuk kepada perkara di atas, bersama-sama ini disertakan 2 (dua) naskah Laporan Akhir Penyelidikan bertajuk 'MECHANICAL PROPERTIES OF LOW CARBON AND SUSTAINABLE BUILDING BLOCK UITILISING OIL PALM TRUNK FIBER' oleh kumpulan Penyelidik dari Fakulti Kejuruteraan Awam untuk makluman pihak tuan.

Sekian, terima kasih.

Yang benar,

MAZLINA MOHAMAD
Ketua
Projek Penyelidikan

5. Report

5.1 Proposed Executive Summary

Cement block has been used in the construction of low-cost housing due to its bigger surface area when compared to brick. Another advantageous of cement blocks is that they require less cement mortar and less labour during construction of housing units. Nowadays cement block weight has been an issue in the construction industry. As the building become higher and enormous, the block weight will become a significant factor in the design and hence as the determinant for the economical factor in the construction cost. Moreover, the use of high cement based building block also reduces the thermal comfort index of the building.

In order to overcome this issue, lightweight block will be developed by introducing the use of natural fiber namely oil palm trunk fiber at high percentage in order to reduce the amount of cement and sand. Studies have been conducted on the use of OPTF (Ahmad and Mohd Saman, 2003) for concrete but the percentages used was very little, i.e 5%. The function of the fiber is just to increase the mechanical properties and improve the toughness. This also did not solve the problem of abundance wastage of OPTF at the oil palm plantation. The focus of this project is to show that fibres processed from the trunk of the oil palm tree, can be utilized in the production of bio-cement composite block with satisfactory engineering properties and dimensional stability.

In this work; an investigate will be made on the potential of using oil palm trunk fiber in the manufacturing of cement block by adding high percentage of fiber with the addition of foam mortar to enhance the lightness of the block. Studies also include the water absorption characteristics and bondability test between foam cement mortar and fibers. A new shape of block will also be proposed to reduce the use of cement mortar to connect individual unit and longer man-hours during construction.

5.2 Enhanced Executive Summary

Cement block has been used in the construction of low-cost housing due to its bigger surface area when compared to brick. Another advantageous of cement blocks is that they require less cement mortar and less labour during construction of housing units. Nowadays cement block weight has been an issue in the construction industry. As the building become higher and enormous, the block weight will become a significant factor in the design and hence as the determinant for the economical factor in the construction cost. Moreover, the use of high cement based building block also reduces the thermal comfort index of the building.

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In this work; an investigation will be made on the potential of using oil palm trunk fiber in the manufacturing of cement block by adding high percentage of fiber to enhance the lightness of the block. Studies also include the physical and mechanical properties as well as water absorption characteristics and bondability test between cement mortar and fibers.

5.3 Introduction

In the present era of environmental consciousness, more and more materials are emerging in construction, furniture and other sectors as substitute for high carbon footprint materials. Wide range of plastics, synthetic material, concrete, metals, etc. is being substituted. However, the real substitution and service to environment both are possible if this material is sustainable as well as renewable. Efficient utilisation of plantation/ fast grown species and utilizing the smaller particles and fibres obtained from various lignocellulosic materials including agro wastes to develop 'panels/blocks' is thus certainly a rational and sustainable approach. Any lignocellulosic waste matter can, therefore, be turned into panels through appropriate R&D work and technology development. Shortage of wood raw materials could be minimised by utilising vast quantities of lignocellulosic wastes available in the country. By varying the process parameters and binding agents, wide variety of composite wood products could be made from such raw material and can substitute solid wood for various purposes.

The development and use of wood-cement composites attest to their attraction as building materials. In addition to their resistance to fire, these materials have a special attraction for use in warm, humid climates where termites and decay are a major concern (Simatupang *et al.*, 1990). Cement particles board has been used in the construction of low-cost housing due to its bigger surface area when compared to brick which required less cement mortar and man-hours during construction of housing units. Nowadays, cement board weight has been an issue in the construction industry. As the building become higher and enormous, the board weight will become a significant factor in the design and hence as the determinant for the economical factor in the construction cost. The addition of fibre in the production of cement board or cement bonded particle board still does not solve the problem of the high weight to strength ratio. This is due to the size of the fiber (wood shredded) which has very high aspect ratio and the function of the fiber is just to increase the mechanical properties and improve the toughness.

There are number of variables that would influence the properties of the final product: wood species (or in a more broader sense, lignocellulosic raw material species) and its physical and chemical characteristics, particle size and geometry, cement type, any additives (usually curing accelerators are common, but there are also curing retarders), wood-water-cement proportions, temperature of the environment, because a chemical reaction takes place, and time allowed for setting. All these group of variables, and their interactions, makes the theoretical prediction of properties very difficult, as is the development of a standard manufacture process that can be applied with all wood species.

The research for durability and strength of wood/fiber-cement composites were conducted by many researchers; Lee, (1985a), Stahl et al., (1977), Moslemi and