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SUITABILITY OF BAMBOO BRICK AS A LIGHTWEIGHT CONSTRUCTION MATERIAL

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ABSTRACT

The increasing issues of pollution create awareness that leads to the close down of some mining sand quarries. The usage of river sand as an alternative resources also contributed to pollution. Consumption of sand must be reduced in order to stop its negative impact on environment. Bamboo is the alternative raw material in construction that is used for bricks and concrete. Bamboo is one of the fastest growing plants, abundant and low cost material. Many studies were done on bamboo especially on mechanical and physical properties of Semantan bamboo (*Gigantochloa scortechinii*). However, there is no study on the properties of Akar bamboo (*Dendrocalamus pendulus*). Therefore, one of the objectives of this thesis was to evaluate the properties of Akar bamboo and as well as Semantan bamboo as a lightweight construction materials. The basic properties of bamboo evaluated were compressive strength, specific gravity, water absorption and dimensional stability. Bamboo skin can significantly increase compressive strength and significantly reduce water absorption and dimensional stability of bamboo. The presence of nodes in bamboo significantly reduce the compressive strength. In this study, waterproof coating was used in bamboo brick samples. The usage of waterproof coating has significantly reduced water absorption and dimensional changes of bamboo. The waterproofing agent like Axel Deram however not only act as water barrier but can provide good bonding strength when bamboo was embedded into cement mortar. Further study of bamboo as lightweight construction material is thermal conductivity. Thermal conductivity of laminated bamboo is similar to solid wood. For unreinforced brick, the properties evaluated were curing time, water-cement ratio and size of aggregates. These properties influence the compressive strength and water absorption. The suitable water to cement ratio that can be used is 0.6 since water absorption of sand is quite high with value of 7%. The minimum curing time for brick to obtain its full strength is at 28 days. Particle size of sand for better strength of cement brick must not be smaller than 5mm. A prototype of bamboo brick was manufactured and tested for compressive strength, water absorption and thermal conductivity. The reinforcement of bamboo into cement brick has reduced the weight of construction material to 1418 – 1663 kg/m^3 which was lower than 1800 kg/m^3 for lightweight category. The compressive strength of bamboo brick was higher for bamboo in parallel direction towards bamboo fibre. The compressive strength of bamboo was significantly higher in parallel direction to grain compare to compressive strength in perpendicular direction to grain. Akar bamboo and Semantan bamboo have the potential as a lightweight construction material with compressive strength of 20.37 N/mm^2 and 11.63 N/mm^2 which are acceptable for structural application. Thermal conductivity of bamboo brick was significantly lower about 12.81% than thermal conductivity of cement brick.

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CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND

Asia is the most densely populated continent in the world and home to approximately 60% of the world's population. During the early 60's, most of the citizens in Asia's developing countries lived in rural areas. It is expected that the numbers of Asian to shift from rural area to urban regions would increase up to 50% by the year 2020. Increase of populations and living expenses reduced adequate shelter and affordable housing for the majority of the poor in most of the countries in Asia. Although great efforts have been made by most government in Asia in providing decent shelter for their people, it is difficult to keep pace with the high demand for housing that is affected by high building materials cost and high construction growth rate. Table 1.1 shows the supply of residential units in Malaysia from the year 2011 to 2014. This table shows that the number of residential units has increased from year to year which proved the demand for housing is higher.

Table 1.1:
Supply of residential units in Malaysia

Items	Number of Residential Units			
	2011	2012	2013	2014
Existing Stock	4.55mil	4.62mil	4.73mil	4.83mil
Completions	65,866	72,195	81,639	96,879
Incoming Supply	438,266	481,649	692,475	759,220
Starts	115,578	138,301	145,779	155,667
Planned Supply	596,060	599,715	593,856	646,049

Source: Property Stock Report – NAPIC

Steel, cement, reinforce concrete, gypsum, timber, bamboo and brick are some of the building materials widely been used in most countries. Among these building material, bricks are the most common construction material that were introduced since 7000 B.C. Bricks is not expensive, possess good sound and heat insulation, adequate resistance against fire and weathering as well as attractive appearances (Jayasinghe and Mallawarachchi, 2009). Bricks were anciently made of mud and traditionally dried