SIMULATION AND APPLICATION OF NATURE FIBER/POLYESTER ALUMINUM HONEYCOMB FOR THERMAL ANALYSIS FOR MALAYSIAN SHELTER APPLICATION

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DECLARATION

I declare that this thesis entitled "Simulation And Application Of Nature Fiber/Polyester Aluminum Honeycomb For Thermal Analysis For Malaysian Shelter Application" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Date : 20 January 2023

APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (Refrigeration And Air Conditioning Systems) with Honours.

Signature	:	
Supervisor Name	:	Dr. Muhammad Zulkarnain
Date	:	20 January 2023

DEDICATION

This dissertation is dedicated to my beloved parents Mohd Ramli Bin Muda and Kamariah Binti Jusoh, my family, and my friends whose unyielding love, support, and encouragement have enhanced my soul and inspired me to pursue and complete this research during a pandemic.

ABSTRACT

Humans have used composites for thousands of years. Nowadays, application of composites more used widely in many types of industrial. A composite material is a solid material that is formed by the combination of two or more distinct substances, each of which has its own set of properties, to produce a new substance that has properties that are superior to those of the original components in a particular application. In addition, composites obtain their extraordinary qualities by encasing fibers of one substance within the matrix of another substance, which serves as the host. The composites material consists aluminium honeycomb as core along the sheets panel (upper and lower) and nature fiber reinforced as adhesive. Material properties of the nature fibers and aluminium research has been done. Unfortunately, Malaysia has witnessed some of its worst floods for a long time. Many people have been physically and emotionally impacted as a result. Several of them experienced property damage and losses. Those who have lost their houses must find the designated flood refuge. Undoubtedly, the shelter will be full, as well as some refugees may have to remain in tents outside the shelter. The material of the tents was insufficient to shield and comfort the refugees from all weather conditions, especially extreme hot. In order to overcome the problems, modelling and assembly 3D nature fiber reinforcement honeycomb which sheet panel composite as skin while aluminium honeycomb as core using SOLIDWORKS. The 3D model has exported into ANSYS to perform simulation testing of material properties especially the thermal conductivity. Through the simulation testing, the most effective thermal conductivity of nature fibers can be determined correspond with previous research of thermal analysis. A new composite material can be identified in order to produce material of tents with most effective thermal conductivity for flood refugees.

ABSTRAK

Manusia telah menggunakan komposit selama beribu-ribu tahun. Pada masa kini, aplikasi komposit lebih digunakan secara meluas dalam pelbagai jenis industri. Bahan komposit ialah bahan pepejal yang terbentuk daripada gabungan dua atau lebih bahan yang berbeza, setiap satunya mempunyai sifatnya sendiri, untuk menghasilkan bahan baru yang mempunyai sifat yang lebih baik daripada komponen asal dalam sesuatu tertentu aplikasi. Selain itu, komposit memperoleh kualiti luar biasa mereka dengan membungkus gentian satu bahan dalam matriks bahan lain, yang berfungsi sebagai perumah. Bahan komposit terdiri daripada sarang lebah aluminium sebagai teras di sepanjang panel kepingan (atas dan bawah) dan gentian alam semulajadi yang diperkukuh sebagai pelekat. Sifat bahan gentian alam semulajadi dan penyelidikan aluminium telah dilakukan. Malangnya, Malaysia telah menyaksikan beberapa banjir terburuknya sejak sekian lama. Ramai orang telah terjejas secara fizikal dan emosi akibatnya. Beberapa daripada mereka mengalami kerosakan dan kerugian harta benda. Mereka yang kehilangan rumah mesti mencari tempat perlindungan banjir yang ditetapkan. Tidak dinafikan, tempat perlindungan akan penuh, begitu juga sesetengah pelarian mungkin terpaksa tinggal di khemah di luar tempat perlindungan. Bahan binaan khemah tidak mencukupi untuk melindungi dan memberi keselesaan kepada pelarian daripada semua keadaan cuaca, terutamanya panas melampau. Bagi mengatasi masalah tersebut, pemodelan dan pemasangan sarang lebah tetulang gentian alam semulajadi 3D yang panel lembaran komposit sebagai kulit manakala sarang lebah aluminium sebagai teras menggunakan SOLIDWORKS. Model 3D telah dieksport ke dalam ANSYS untuk melakukan ujian simulasi sifat bahan terutamanya kekonduksian haba. Melalui ujian simulasi, kekonduksian haba gentian alam semulajadi yang paling berkesan boleh ditentukan sepadan dengan penyelidikan analisis haba terdahulu. Bahan komposit baharu boleh dikenal pasti untuk menghasilkan bahan khemah dengan kekonduksian haba paling berkesan untuk pelarian banjir.

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LIST OF SYMBOLS AND ABBREVIATIONS

k	-	Effective thermal conductivity
q	-	Heat flow
L	-	Length of side wall
t1,t0	-	Temperatures at the borders
	-	
	-	
	-	
	-	

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CHAPTER 1

INTRODUCTION

1.1 Background

A composite material is a solid material that is formed by the combination of two or more distinct substances, each of which has its own set of properties, to produce a new substance that has properties that are superior to those of the original components in a particular application. Another name for this type of material is a composite. Composites are also known as composite materials. To be more precise, the term "composite" refers to a material for building that has been combined with other components.
In addition, composites obtain their extraordinary qualities by encasing fibers of one substance within the matrix of another substance, which serves as the host. Although the structural value of a bundle of fibers is modest, the strength of individual fibers may be used if they are immersed in a matrix that serves as an adhesive and binds the fibers together to give the material its solidity. This method is known as matrix-encapsulation. The stiff fiber is what provides the composite its structural strength, while the matrix is what shields the fiber from environmental stress and physical damage, in addition to providing them with thermal stability (Britannica, 2022).

These days, honeycomb sandwich has been supplied high performance for mechanical strength with linear to light weight. Sandwich constructions have a core and layers of material, and honeycomb sandwich is one type of sandwich. They make it possible to improve the mechanical qualities without significantly increasing the weight of the material.

Additionally, they strengthen the insulation against heat and sound. Indirectly, honeycomb sandwich structural have been selected for this application of Nature Fiber/Polyester Aluminum honeycomb for Thermal Analysis for Malaysian Shelter because it is related and suitable with the research that is focusing on thermal analysis. This contrasts with the monolithic constructions, which are made up of overlapping fabrics with certain orientations and have a more intricate geometry. Because components of this sort are supposed to be able to endure the greatest possible loads on the structure, they are not appropriate for use in the research.

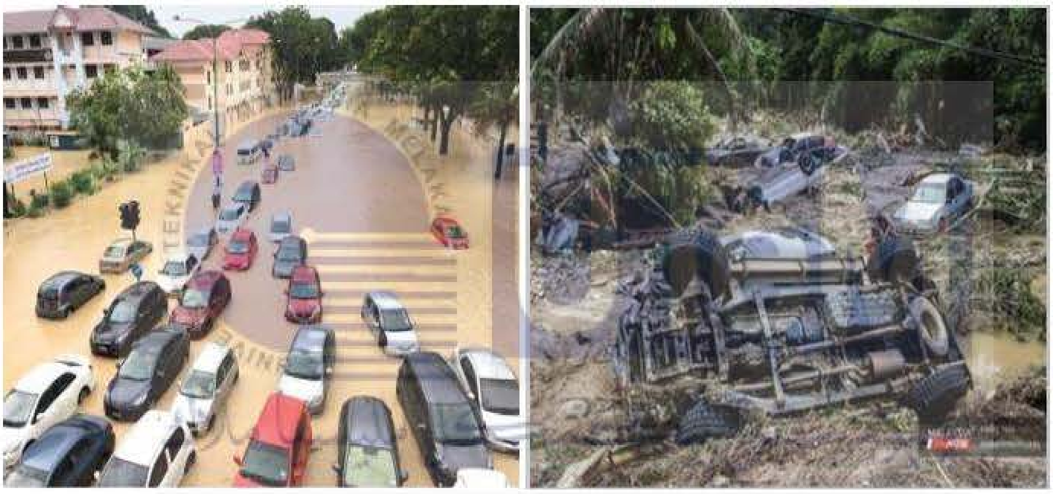

Figure 1.1 Disasters due to floods

The danger rating for a tsunami striking Malaysia in 2020 was 7,1 out of a possible 10, while the chance of floods was 6,6. Since 2003, Malaysia has witnessed some of its worst floods as illustrated in Figure 1.1, with over 6,000 people impacted by flash floods and landslides caused by flooding in 2017 (Statista, 2019). This statistic indicates that natural disasters occur often in our country. Many people have been physically and emotionally impacted as a result. Several of them experienced property damage and losses. Those who have lost their houses must find the designated flood refuge.

Undoubtedly, the shelter will be full, as well as some refugees may have to remain in tents outside the shelter. The material of the tents was insufficient to shield and comfort the refugees from all weather conditions, especially extreme hot. Therefore, these new composite materials will be more effective in terms of durability, weight, and heat resistance. Thus, despite remaining in the tent, the refugees will experience greater comfort.

1.2 Problem Statement

It is undeniable that our country is always surprised by natural disasters that hit, especially severe floods. Every year, many places and people have been affected by floods. This cannot be dammed because it is a natural disaster in this world and must be faced by every resident. Indirectly, the victims who have lost their homes must be moved to the flood reserved center for temporary placement. Sometimes, because too many refugees are placed in the center, the place will be crowded and half of them have to be placed in tents. There are various age groups among the refugees including infants and the elderly. Therefore, their temporary shelter should be comfortable in various aspects.

Naturally the climate in our country is always changing, especially warm and cold weather. This will affect the refugees and give them discomfort throughout their stay in the tent. To overcome this problem, research have been carried out related to thermal analysis for Malaysian Shelter Application by develop 3D sandwich honeycomb model simulation for random natural fiber composite and their thermal conductivity of the material.

1.3 Research Objective

The aim of this research is to build a tent that contains a new composite material which being produce to provide a convenience, comfortable and affordable for the victim as a shelter. Two objectives are made in order to achieve the aim of this project which is:

a) To develop 3D sandwich model of thin-walled honeycomb with nature fiber composite panel using fiber random distribution method.

b) To investigate thermal conductivity performance by varied nature fiber component content.

1.4 Scope of Research

The scope of this research are as follows:

a) Varied nature fiber reinforcement honeycomb which sheet panel composite as skin while aluminium honeycomb as core. Natural fiber is randomly distributed in longitudinal direction was developed in 3D simulation. The research limited by longitudinal fiber direction is considered during thermal analysis.

b) Varied nature fiber will be embedded randomly to achieve thermal conductivity for the composite material structure.

c) The material testing process will be subjected on each new composite material that selected.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, it is clarified about presentation composite material of Nature Fiber/Polyester Aluminum honeycomb in order to select the best nature fiber reinforced polyester for thermal analysis with a high level of user satisfaction attributes. This section contains about all discoveries obtained from literature reviews research on nature fiber and polyester, composite material, honeycomb, material selection, materials and methods, and thermal analysis of nature fiber reinforced polymer composite, which derived from the journals, article, internet, and the book that has the related topic to this study.

2.2 Nature Fiber and Polyester

2.2.1 Nature Fiber

The awareness among people regarding the advantages of natural products has steered the use of natural resources. Nature fibers are any raw materials with a hairlike structure that can be obtained directly from a vegetable (cellulose), animal or mineral source and can be transformed into nonwoven textiles like as felt or paper or spun into yarns and then woven into fabric. Figure 2.1 shows an example of a nature fiber in this context. An additional definition of a nature fiber may be that it is an aggregation of cells in which the diameter is insignificant in proportion to the length (Gholampour and Ozbakkaloglu, 2020). Despite the abundance of fibrous materials in nature, like wood, cotton, grains, and straw, just a handful of them may be used for textile manufacture or other industrial purposes.