



THERMAL ANALYSIS OF COMPOSITE MATERIALS FOR ROOFING


AZUDDIN BIN ZULKIPLI
(99384557)

A thesis submitted in partial fulfillment of the requirements for the award of
Bachelor Engineering (Hons) (Mechanical)

Faculty of Mechanical Engineering
Universiti Teknologi MARA (UiTM)

APRIL 2003

“I declared that this thesis is the result of my own work except the ideas and summaries which I have clarified their sources. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any degree”

Signed : 

Date : 22.05.2003

Azuddin Bin Zulkipli

UiTM No: 99384557

ABSTRACT

Composite materials are desirable in many industrial applications, including manufacturing, construction, machinery and appliances. Improvements can be made on the heat transfer properties of composite materials if experiments are conducted on its thermal properties. In this project, we made a research on thermal properties of a composite material designed for roofing, which is being used in many mosques in the country such as the mosque of Sultan Sallahuddin Abdul Aziz Shah, Shah Alam and Wilayah Persekutuan Mosque, in Kuala Lumpur. With this investigation, we will be able to analyze the thermal properties, particularly the heat transfer and thermal conductivity of the dome composites and investigate about its appropriateness as a roofing material for use in tropical climates. The company that has provided the samples of the composites is a local manufacturing company called Dian Kreatif Sdn Bhd, located in Malacca. Up to date, the company has constructed at least 55 domes used for mosques throughout the world, including the Prophet Mosque in Medina and the Putrajaya Mosque and also 22 boats. Tests were conducted on several separate samples as well as samples of different combinations of the composites using the thermal conductivity apparatus. Air temperatures and surface temperatures were taken in the interior and exterior of square models of the dome placed in a solar radiation simulator used as a heat source. Both the thermal conductivity apparatus and the solar radiation simulator are situated at the Mechanical Engineering Faculty of Universiti Kebangsaan Malaysia. Preliminary results show that the composite materials, together with its strength and durability can be appropriately used as roofing materials. However, further studies will have to be conducted on its cost effectiveness and feasibility as composites are very expensive.

TABLE OF CONTENTS

CONTENTS	PAGE
PAGE TITLE	i
ACKNOWLEDGEMENT	ii
ABSTRACT	iii
TABLE OF CONTENTS	iv
LIST OF TABLES	viii
LIST OF FIGURES	ix
LIST OF ABBREVIATIONS	xi

CHAPTER I

INTRODUCTION

1.1	Research Background	1
1.2	Scope of Research	2
1.3	Objectives of the research	2
1.4	Organization of thesis	3

CHAPTER II

LITERATURE REVIEW

Overview of Composites and Heat Transfer Theory

2.1	What is a composite material?	4
2.2	Characterization of Fiberglass/Epoxy composite	6
2.3	Heat transfer	8
	2.3.1 Mechanisms of Heat Conduction	8
	2.3.2 Conduction Heat Transfer	9
	2.3.3 Fourier Law of Conduction	9
	2.3.4 Thermal Conductivity	11
2.4	Steady State Conduction- One Dimension	12
	2.4.1 The Plane Wall	12
2.5	Insulation	15
2.6	Thermal Resistance	15

CHAPTER III

MATERIALS AND EXPERIMENTAL SET-UP

3.1	Materials	16
3.2	Experimental Investigations	17
	3.2.1 Thermal conductivity experiments	17
	3.2.1.1 Experimental Material	17
	3.2.1.2 Experimental Apparatus	19
	3.2.1.3 Experimental Theory	20
	3.2.1.4 Experimental Methodology	23
	3.2.2 Heat transfer investigation	24
	3.2.2.1 Sample materials	24
	3.2.2.2 Experimental Apparatus	25
	3.2.2.2.1 Solar radiation simulator (sky simulator)	26
	3.2.2.3 Experimental Methodology	29