FINITE ELEMENT ANALYSIS OF COMPOSITE CONE UNDER COMPRESSION TEST

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FINITE ELEMENT ANAYLSIS OF COMPOSITE CONE
UNDER COMPRESSION TEST

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A report in partial fulfillment of the requirements for the award of the degree of
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SUPERVISOR DECLARATION

We hereby declare that we have checked this project and in our opinion this project is satisfactory in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering”

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STUDENT DECLARATION

I hereby declare that the work in this project is my own except for quotations and summaries which have been duly acknowledged. The project has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature ....

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LIST OF SYMBOL

FRP	*Fiber Reinforced Plastic*
F	*Force*
D_i	*Initial Diameter*
A	*Cross section Area*
%	*Percentage*
T	*Thickness*
θ	*Angular angle*
E	*Elastis of Modulus (Young' Modulus*)
H_c	*Height from Center*
wt %	*Weight percent*
r	*Radian*
V	*Volume*
s	*Slant height*

A_b	*Base area*
z	*Height of apex*
S	*Surface area*
s_s	*Specific Energy Absorption*
σ	Crush stress
ρ	Density
$\bar{p}$	Mean crush stress
D_1 and D_2	internal and external of diameter of the section undergoing crush

ABSTRACT

A study of finite element analysis of composite cone under compression test is presented in this thesis. The behaviors of different angles of composite cone under compression test were been analyzed. The study and analyzed performance of composite cone in energy absorption point of view also had been carried out. The analysis were conducted using finite element Algor software and the theoretical value were calculated based on theoretical determination of properties on lamina level. It has been observes that with increasing cone angle from 5^0 to 15^0 for all cone, composite cone can withstand higher load and the specific absorption was improved. It also concluded here, the 15^0 cone stand highest load and energy absorption.

ABSTRAK

Projek ini ialah kajian terhadap analisis '*finite element*' komposit kon dibawah ujikaji pemampatan. Tindak balas komposit kon bagi sudut yang berbeza dibawah ujiakaji pemampatan diperhatikan. Kajian dan analisis terhadap prestasi komposit kon dalam tenaga penyerapan telah dilaksanakan. Analisis dijalankan dengan menggunakan perisaian Algor dan nilai teori diperolehi dengan berpandukan penentuan teori sifat-sifat di paras satu lapisan. Dapat diperhatikan di sini, dengan peningkatan sudut bagi kon dari 5 darjah sehingga 15 darjah untuk semua kon, komposit kon boleh menahan daya yang lebih tinggi dan tenaga penyerapan telah bertambah. Dapat disimpulkan di sini, 15 darjah kon dapat menahan daya yang paling tinggi dan meyerap tenaga penyerapan yang tinggi.

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Composite materials are being used for applications in aircraft and automotive structures to meet stringent weight band manufacturing cost constraints. Composite materials can exhibit crushing modes which are significantly different from the crushing modes of metallic materials. Axial crushing of fiber-reinforced plastic (FRP) composite tubes has indicated that significant energy absorption can be obtained from these materials, under some circumstances exceeding that which can be obtained from metal tubes of similar size, and thus offering the prospect of providing energy absorption with structures of weight less than that of comparable metal structures [1].

The energy-absorption capability is dependent on the mechanism by which the structure collapses. Much of the experimental work on the energy absorption of composite materials has been restricted to the axial compression of axisymmetric cylindrical tubes. One end of the tube is chamfered to initiate crushing. Failure starts at the chamfer tip, and the damage zone propagates down the tube without catastrophic fracture [2,3]. Many investigations have been carried out to determine the effects of
tube geometry [4,5], fiber architecture [6,7] fiber type [8], resin type [9,10], and Kerth et al. [11] and testing conditions [10,12–16] on the energy absorption capability.

Hamada et al. [9] concluded that thermoplastic composite tubes (carbon/PEEK) absorb higher energies than thermoset composite tubes (carbon/epoxy). Hamada et al.[13] found that quasi-statically tested tubes displayed higher specific energy absorption than impact-tested tubes for carbon (PEEK) composite.

Furthermore, Hamada [17] developed a calculation method to predict the mean crushing load. The method was applied to glass-fiber-cloth/ epoxy and carbon-fiber/ PEEK composite tubes. He concluded that the predicted values were similar to the experimental values for glasscloth/ epoxy while the difference is large for the carbon/ PEEK composites.

Work on axial compression of axisymmetric tubes to be used in energy absorbing applications has been extended to cones by Price et al. [18]. Their study concentrated on the axial crushing of glass-fiber/polyester composite cones. They concluded that, for cones with a wall thickness greater than 2 mm, a progressive crushing failure type would occur starting at the small end unlike tubular specimens, no trigger being necessary for cones. The specific energy absorption varies with cone angle, wall thickness and diameter in a complex way and in some cases exceeds the values recorded for axisymmetric tubes. The crush zone morphology and failure micromechanisms also vary with specimen geometry. An initial assessment has been made for the relationship between energy absorption and failure mode.

1.2 OBJECTIVES

i. To analyses behaviors of different angle of composite cone under compression load.
ii. To analyze the performance of composite cone in energy absorption point of view

1.3 SCOPES OF PROJECT

i. To determine the fabrication angles for cone
ii. To study the compression test behaviors of composite cones
iii. To analyses energy absorption of composite cones

1.4 PROBLEM STATEMENT

In passenger vehicles the ability to absorb impact energy and be survivable for the occupant is called “crash worthiness” of the structures. The challenge is determining what specific design features are needed in the geometry and what material systems will enable greater safety without negatively affecting the overall economics of fabrication and production. So this is the usage of the shape of composite cone in automotive field.