UNIVERSITI TEKNOLOGI MARA

DYNAMIC CHARACTERIZATION OF FIBRE REINFORCED COMPOSITE (S-GLASS) IN RIGID ARMOURED VEHICLE

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ABSTRACT

This thesis describes the identification of dynamic properties and characteristics of S-Glass composite material which is used as spall liner in armoured tank. To achieve this, the project puts its focus on analytical approach, numerical method and finally an experimental method using modal testing.

The analytical approach utilised the Ritz method. Finite element method using LUSAS software was employed in the approximation numerical approach. The experimental work carried out focused on transient testing of a plate membrane.

In this study, it was observed that the natural frequencies obtained from the experiment and analytical analyses (1C3F) were closely matched. However for other boundary conditions the natural frequencies did not match even though the modes shapes were similar.

For future works similar study can be carried out but the plates for testing have to be produced under controlled conditions. This is to ensure that the material properties are measured for specific bonding and grain orientation as well as fabrication process.

Candidate's Declaration

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This topic has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

In the event that my thesis be found to violate the conditioned mentioned above, I voluntarily waive the right conferment of my degree and agree be subjected to the disciplinary rules and regulations of Universiti Teknologi MARA.

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CHAPTER 1
INTRODUCTION

1.1 Background

The advent of high strength and light weight composite materials and newly developed resin materials have radically changed the concepts of advanced space structure and Armoured vehicles [1]. This high strength –to-weight or modulus-to-weight ratios of composites could also result in lighter structural components with lower operating costs and better maintenance history. Since, most current space structures, unmanned vehicles, aircraft structures and high performance defence vehicles are designed to be robust; designers have been quick to realize the advantages of this advanced material.

In response to this, the United State Army Tank-Automotive Command (TACOM) had been evaluating alternative lighter weight materials such as titanium alloys and ceramic tile/polymer-matrix composites (PMCs) that are currently the only practical possibilities for lighter-weight structural armour applications [2]. The alloys do have disadvantages when a spall liner[1] is required that there are relatively to fabrication example machining and welding. Although PMCs offer some advantages for example freedom from spalling against chemical threats, a quieter operator environment and a high mass efficiency against ball and fragment ballistic threats. Nevertheless, spall liners have been identified as providing improved protection for the tank crews but they still have a number of problems.

[1] A layer of lead-impregnated plastic foam, which is used to line the interior surfaces of armoured vehicles to absorb the energy of fragments produced by penetrative attacks. It also acts as a radiation shield.