DYNAMIC & STATIC FINITE ELEMENT ANALYSIS OF NON-UNIFORM CROSS-SECTION FUNCTIONALLY GRADED COMPOSITE BEAM SUBJECTED TO THERMO-MECHANICAL LOADING

By

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FINAL PROJECT REPORT

Submitted to
the Faculty of Engineering and Quantity Surveying
in Partial Fulfillment of the Requirements
for the Degree of

BACHELOR OF ENGINEERING (HONS)
in
MECHANICAL ENGINEERING

At

INTI INTERNATIONAL UNIVERSITY
Persiaran Perdana BBN, Putra Nilai, 71800 Nilai
Negeri Sembilan, Malaysia

JANUARY 2018

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APPROVAL

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Mechanical Engineering

Approved:

Abdolreza Toudehdehghan
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April 2018

DECLARATION

I, the undersigned, hereby declare that this report is my own independent work except as specified in the references and acknowledgements. I have not committed plagiarism in the accomplishment of this work, nor have I falsified and/or invented the data in my work. I am aware of the University regulations on Plagiarism. I accept the academic penalties that may be imposed for any violation.

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Abstract

Material improvement is quite vital as it is the key driver of the world we live in, because all areas of human undertakings in this developed world rely upon material advancement for their execution. The development of materials from solid material to composite or alloy materials and the advancement of composite materials depends on the constraint of one class of materials that requires the improvement of other classes of materials. For the need to have two materials consolidated, and to have the capacity to work and hold their properties after being subjected to harsh working environments, functionally graded material (FGM) was introduced. Although FGM was at first created for thermal barrier application, nonetheless the use of this imperative enhanced material has been expanded and used to unravel various issues in the applications of engineering. This research is conducted to reveal insight into this imperative material. Chapter 1- An introduction of functionally graded material is presented, together with a brief historical background of FGM with my research approach. Chapter 2- Diverse sorts of functionally graded materials that are delivered today and their applications especially capitalizing on power energy sector. Chapter 3- Methodology process whereby modelling non-uniform two layered composite material beam. Onward simulation analysis of static and thermal-static loadings whereby stage one results can be found in stage one report. Progressively, in stage two introducing FGM properties into the composite model with thermal-mechanical loading of static and dynamic. Chapter 4 – Results and discussion by comparing composite (2 layer) beam with FGM beams defined. Chapter 5 – Project conclusion and future work.

ACKNOWLEDGEMENTS

First and foremost I am very grateful to God Almighty for without his grace and blessings, this study would not have been possible. As a token of gratitude to all who directly and indirectly contributed to the success of this project, we would like to extend our gratitude and thankfulness to the following people.

Expressing my indebtedness appreciation and respect to my honourable supervisor Mr Abdolreza Toudehdehghan. His constant guidance and advice played the vital role in making the execution of the investigation to my thesis. He always gave me his suggestions that were crucial in making this project as flawless as possible.

Last but not least, I would like to extend my gratitude towards the ANSYS lab management staff of INTI International University for allowing me to use the lab whenever needed and special thanks to Assoc. Prof. Dr. Chua Keng Hoo, FEM ANSYS subject specialist for his expertise to several guidance.

DEDICATION

My Mother

A strong and gentle soul who taught me to trust in God, believe in hard work and I'll bear the fruits of my labour

My Uncle

For being my pillar of support, encouragement and guardian during my educational career

This thesis is also dedicated to my supervisor Mr. Abdolreza Toudehdehghan who encouraged me to build my motivation towards the world of Functionally Graded Materials (FGM)

Along with all hard working and respected

Lecturers

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LIST OF ABBREVIATIONS

FGM	Functionally Graded Material
FEA	Finite Element Analysis
HM	Homogeneous Material
Cr-(Re)	Chromium
Al2 O3	Aluminium Oxide
CFB	Combustion Fluidal Boilers
HDPE	High Density Polyethylene
Al-HDPE FGM	Aluminium High-Density Polyethylene Functionally Graded Material
PV	Photovoltaic

NOMENCLATURE

Symbol	*Definition*
$\theta(\xi)$	*Temperature profile*
ξ	*Dimensionless normal axis*
Γ	*Dimensionless thermo-geometric parameters*
β	*Inhomogeneity indices*
Pt	*Young Modulus (top)*
Pb	*Young Modulus (bottom)*
n/h	*Thickness of FGM layer and material parameter respectively.*
z	*layer thickness*