

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

By

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APPROVAL

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Approved:



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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.

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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 Toudeshdeghhan 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
Al ₂ O ₃	Aluminium Oxide
CFB	Combustion Fluidal Boilers
HDPE	High Density Polyethylene
Al-HDPE FGM	Aluminium High-Density Polyethylene Functionally Graded Material
PV	Photovoltaic

NOMENCLATURE

<i>Symbol</i>	<i>Definition</i>
θ (ξ)	<i>Temperature profile</i>
ξ	<i>Dimensionless normal axis</i>
Γ	<i>Dimensionless thermo-geometric parameters</i>
β	<i>Inhomogeneity indices</i>
P_t	<i>Young Modulus (top)</i>
P_b	<i>Young Modulus (bottom)</i>
n/h	<i>Thickness of FGM layer and material parameter respectively.</i>
z	<i>layer thickness</i>