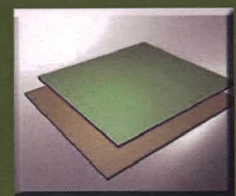


ADVANCES IN COMPOSITE MATERIALS



Iskandar Idris Yaacob
Md Abdul Maleque
Zahurin Halim



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Table of Content

Chapter 1 A Critical Review of Metal Matrix Composite Brake Rotor <i>Md Abdul Maleque</i>	1
Chapter 2 Technology of Moulding for Composite Auto Brake Rotor <i>Md Abdul Maleque</i>	7
Chapter 3 Fabrication of Nickel Aluminide (Ni ₃ Al) by Hot Isostatic Pressing (HIP) Faizal Abu Zarim, Iraj Alaei, I.I. Yaacob	13
Chapter 4 Investigation of Mechanically Alloyed Nd-Fe-B Powder <i>I.I. Yaacob and H.K. Jun</i>	17
Chapter 5 Synthesis And Characterization Of Nanocrystalline Ni ₃ Al Intermetallic Produced by Mechanical Alloying And Reaction Synthesis <i>R.Ismail and I.I. Yaacob^b</i>	23
Chapter 6 The Effect of Hard Nanofillers on Mechanical Properties of PVC Nanocomposites <i>Noorasikin Samat, Muhammad Alif Mohd Yusoff and Mohd Shahrul Rizal Bin Zakaria</i>	29
Chapter 7 Fatigue Fracture Mechanism of PVC/CaCO ₃ nanocomposite <i>Noorasikin Samat, Alan Whittle and Mark Hoffman</i>	34
Chapter 8 Mechanical Behaviour of Eco Core Composite Sandwich Structure <i>Norhasnidawani Johari Safiyah Hazwani Abd. Rahim and Zahurin Halim</i>	40
Chapter 9 Characteristics of Oil Palm Biomass via Mixture of Empty Fruit Bunch (EFB) Fiber and Mesocarp Fiber <i>Zahurin Halim, Nabiha Mohd Noh and Nurshazana Mohamad</i>	45
Chapter 10 Mechanical Behaviour of Oil Palm Empty Fruit Bunch (OPEFB) Albumen-Composites Concrete	49

Afiqah Omar, Nur Humairah A. Razak and Zuraida Ahmad

Chapter 11	55
The Influence of Biopolymer and Natural Fiber on the Physical and Mechanical Properties of Cement Composite	
<i>Norshahida Sarifuddin and Zuraida Ahmad</i>	
Chapter 12	62
Thermal and Morphological Study of Biopolymer Cotton-Albumen Clay (BCAC) Composites	
<i>Zuraida Ahmad, Teoh Swin Le and Kumaran A/L Samannamuthaliar</i>	
Chapter 13	68
Effect of Compaction Time on the Properties of Coir Fiber Reinforced Cement-Albumen Composite	
<i>Amir Zakwan Roslin, Nur Humairah A. Razak and Zuraida Ahmad</i>	
Chapter 14	74
Oil Palm Empty Fruit Bunch (OPEFB) for Lightweight Composites Concrete	
<i>Afiqah Omar, Nur Humairah A. Razak and Zuraida Ahmad</i>	
Chapter 15	80
Fabrication of Metal Matrix Composite Automotive Brake Rotor (Part 1)	
<i>Md Abdul Maleque</i>	
Chapter 16	86
Fabrication of Metal Matrix Composite Automotive Brake Rotor (Part 2)	
<i>Md Abdul Maleque</i>	
Chapter 17	90
Wear of Aluminium Matrix Composite – Effects of Reinforcement Combination	
<i>Md Abdul Maleque and Rezaul Karim</i>	
Chapter 18	96
Mechanical Properties of Wood Plastic Composites	
<i>Ooi Chong Jin and Shahjahan Mridha</i>	
Chapter 19	101
Properties of Wood Fiber Reinforced Polypropylene Composite	
<i>Shahjahan Mridha and Nafis Sarwar Islam</i>	

Chapter 20		108
The effects of chemical and mechanical treatments on coir fibre to mechanical properties of coir-albumen-concrete		
	<i>Zuraida Ahmad and Nurizan Omar</i>	
Chapter 21		114
Architecture of Chopped Fiber Glass in Plastic Composite Processed Under Different Loads		
	<i>Ahmed Nazrin Md Idriss and Shahjahan Mridha</i>	
Chapter 22		119
Variation of Fiber Architecture on Loads applied in Fabrication of Epoxy/Woven Fiber Glass Composite		
	<i>Ahmed Nazrin Md Idriss and Shahjahan Mridha</i>	
Chapter 23		125
Impact Behavior of Carbon/ Epoxy Composite in Moisture and Temperature environments		
	<i>Shahjahan Mridha</i>	
Chapter 24		132
Impact Strength Behaviour of the Woven and Chopped Fiber Glass Composites at Different Temperatures		
	<i>Ahmed Nazrin Md Idriss and Shahjahan Mridha</i>	
Chapter 25		138
An Investigation of Hybrid Composites Tubes Subjected to Quasi-Static Loading		
	<i>Farrah Yussof¹ and Zuraida Ahmad</i>	
Chapter 26		144
Mechanical Behaviour of Biopolymer Cotton Albumen Clay (BCAC) Composites		
	<i>Teoh Swin Le, Kumaran A/L Samannamuthaliar and Zuraida Ahmad</i>	
Chapter 27		150
The Effect of Processing Parameters on Tensile Properties Empty Fruit Bunch (EFB) Fiber Reinforced Thermoplastic Natural Rubber Composites		
	<i>Noor Azlina Hassan, Norita Hassan, Sahrim Hj. Ahmad and Rozaidi Rasid</i>	
Chapter 28		155
Manganese Doped Hydroxyapatite Powder through Hydrothermal Method		
	<i>Asep Sofwan Faturohman, Alqap, Iis Sopyan and Niur Izzati Mazmaa</i>	

Chapter 29	161
Synthesis and Characterization of Sol-Gel Method Derived Zinc Doped Hydroxyapatite Powder	
<i>Asep Sofwan Faturohman Alqap, Nor Hidayu and Iis Sopyan</i>	
Chapter 30	167
Synthesis and Characterization of Nickel Iron–Silicon Nitride Nanocomposite	
<i>Iskandar I. Yaacob</i>	
Chapter 31	172
Fabrication of Nickel Aluminide Intermetallic-Alumina Nanocomposite	
<i>Roslina Ismail and Iskandar I. Yaacob</i>	
Chapter 32	178
Investigation on the Effect of Water Immersion on Cotton Albumen Composite	
<i>Zahurin Halim, Zuraida Ahmad and Fauziah Md Yusof</i>	
Chapter 33	182
Numerical and Experimental Investigation of Peel Strength of Composite Sandwich Structures	
<i>Zahurin Halim , Shahnor Basri and Mohd Ramli Ajir</i>	
Chapter 34	190
Finite Element Analysis of Interlaminar Stresses in Edge Delamination	
<i>Zahurin Halim and Meor Mohd. Adli Taib</i>	

Finite Element Analysis of Interlaminar Stresses in Edge Delamination

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Keywords: FEA, fibre reinforced laminates, delamination, interlaminar stresses.

Abstract: Edge delamination in fiber-reinforced composite laminates has been a significant structural reliability concern. This particular laminate failure mode is caused by the high interlaminar stresses concentrated near the free edges. Due to the complex fiber/matrix microstructure of laminates, an accurate evaluation of these stresses and determining their exact role in laminate failure has been difficult. This chapter aims to investigate the interlaminar stresses in edge delamination by modeling it using finite element analysis software (ANSYS).

Introduction

Fiber-reinforced laminates are one of the basic forms of composite materials. Laminates are typically manufactured using a number of pre-peg unidirectional plies bonded together into a layered structure. They are most effective in the form of thin plates or shells and are used in a wide variety of high-performance applications, such as military and aerospace structures [1]. The appeal of laminates, in addition to their superior strength-to-weight and stiffness-to-weight ratios, is in their ability to be custom-tailored to meet specific performance needs. The ply fiber orientation and ply stacking sequence in lamination allow the stiffness and strength properties to be designed directionally dependent in response to the applied load. This gives laminates a unique advantage over conventional materials [2].

Design and material parameters can cause laminates to fail in unusual modes. One major mode of failure is inter-ply debonding, or delamination. While laminates are primarily designed to withstand in-plane loads, high interlaminar stresses can develop in regions with abrupt changes in material and/or geometry, such as at free-edges, holes, cut-outs, etc. The interlaminar stresses in these regions are highly localized with steep gradients. As a result, delamination may form and propagate into a large crack. It is well known that a localized delamination can lead to severe structural weakening as well as reduce structure durability. For this reason, there have been many theoretical and experimental studies on the mechanics of delamination in composite laminates [3]. However, due to the complex nature of the delamination mechanisms, the problem continues to attract research interest.

Method

ANSYS is a comprehensive general-purpose finite element computer program that contains more than 100,000 lines of code. ANSYS is capable of performing static, dynamic, heat transfer, fluid flow, and electromagnetism analyses. ANSYS has multiple windows incorporating a graphical user interface (GUI), pull-down menus, dialog boxes, and tool bar.