



Flexural Behaviour of Sandwich Composite Panels Fabricated Through Different Vacuum Bagging Techniques

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fabric/epoxy face sheet,
Three-point bending test,
Flexural properties.

Abstract

The experimental investigation here focuses on the fabrication of sandwich panels using a single hot vacuum bag, modified vacuum bag, multiple bag and a single hot vacuum bag with platen compression techniques. The present vacuum bagging system cannot be used to prepare sandwich structures when the pressure needs to exceed one bar for bonding considerations. In order to avoid this issue, a new methodology that follows a modified and then a multiple bag technique is proposed to fabricate sandwich panels with high temperature curing of epoxies. Sandwich composites with glass fabric-epoxy face sheet as skin material and a low density thermoset unfilled rigid foam-Polyisocyanurate (PIR-100kg/cu.m), as core material, are considered here. Specimens are tested for flexure for varied spans and at a constant skin to core weight ratio. The flexural strength, rigidity and shear properties are evaluated from the observations to find the influence of the core and span to depth ratios on the respective properties of the sandwich composites.

The work had been presented at an international conference **Fatigue Durability India 2015**, 28-30th May 2015, IN TATA AUDITORIUM, Indian Institute of Science, Bangalore.

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Introduction

A composite material can be defined [1] as a combination of two or more materials that results in better properties than those of the individual constituents. The two main constituents of a composite material are reinforcement and a matrix. The main advantages of composite materials are their high strength and stiffness, combined with low density, when compared with bulk materials, allowing for a weight reduction in the finished part. The reinforcing phase provides the strength and stiffness which may be harder, stronger, and stiffer than the matrix. A sandwich-structured composites [2] are a special class of composite materials, fabricated by attaching two thin but stiff skins to a lightweight, but thick core. These materials have increasingly been used in a variety of industrial applications such as [3] marine, automobile industry, aeronautics, and aerospace as it is convenient for designers to design for specific requirements with precision and work with the desired characteristics, due to high strength to weight ratios. Polyisocyanurate (PIR) [5] foams represent the system of choice to produce Glass fabric-faced sandwich panels, providing energy efficiency and compliance to severe fire safety requirements.

The manufacturing techniques are also seen to contribute [6] toward performance of the composite. Vishakh et. al. [2] and Surya Teja Varma [4] have investigated the flexural properties of foam core glass epoxy sandwich composites, followed room temperature vacuum bagging technique. Menta [6] developed a non-autoclave vacuum bag process using atmospheric pressure alone that eliminates the need for external pressure normally supplied by an autoclave or a press is an attractive method for composite fabrication. In order to protect against bag or seal failure, part lay-ups are sometimes 'double bagged'. Double bagging [7] [8] involves placing a first, inner bag over the lay-up which is then sealed to the

tool base. A second, outer bag is placed over the inner bag and is also sealed to the tool base. The various flexural properties of sandwich specimens such as flexural strength, flexural strength per unit width, bending strength per unit width, bending stress, shear strain were obtained under 3 point bending [9][10] to find the sandwich beam flexural and shear stiffness.

Experimental

Approach of Investigation

The present investigation deals about fabrication of sandwich panels using four different techniques. A Thermo set rigid unfilled polyisocyanurate foam (PIR) of density 100kg/m³ is used as core and glass/epoxy as the skin material. The skin to core weight ratio is maintained at 4:1 with volume fraction of 0.3 in the skin for the fibre, and the beams were tested for flexure.

Table 1: Materials Considered For Fabrication

Material	Name
Skin Reinforcement	E - Glass Fabric-Plain Weave
Core	PIR-100 kg/m ³
Resin	LY556
Hardener	EH200

Table 2: Material Properties of Core

Properties	PIR-100
Elastic Modulus(M Pa)	14.6 MPa
Poisson's Ratio	0.29

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A decorative graphic element consisting of a light blue horizontal bar with a rounded right end, and a red circular gradient shape positioned behind the bar's end.

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Hybrid Fiber Composites Anish Khan, Sanjay Mavinkere Rangappa, Mohammad Jawaid, Suchart Siengchin, Abdullah M. Asiri, 2020-07-02 Fiber reinforced composites are exceptionally versatile materials whose properties can be tuned to exhibit a variety of favorable properties such as high tensile strength and resistance against wear or chemical and thermal influences. Consequently, these materials are widely used in various industrial fields such as the aircraft, marine, and automobile industry. After an overview of the general structures and properties of hybrid fiber composites, the book focuses on the manufacturing and processing of these materials and their mechanical performance, including the elucidation of failure mechanisms. A comprehensive chapter on the modeling of hybrid fiber composites from micromechanical properties to macro scale material behavior is followed by a review of applications of these materials in structural engineering, packaging, and the automotive and aerospace industries. *Processing and Fabrication of Advanced Materials, XVII: Part 8: Polymer-based composites and nano composites: Volume Two*, 2009. Papers presented at the Seventeenth International Symposium on Processing and Fabrication of Advanced Materials XVII held at New Delhi during 15-17 December 2008. [Sandwich Composites](#)

Senthilkumar Krishnasamy, Chandrasekar Muthukumar, Senthil Muthu Kumar Thiagamani, Sanjay Mavinkere Rangappa, Suchart Siengchin, 2022-01-25 A composite sandwich panel is a hybrid material made up of constituents such as a face sheet, a core, and adhesive film for bonding the face sheet and core together. Advances in materials have provided designers with several choices for developing sandwich structures with advanced functionalities. The selection of a material in the sandwich construction is based on the cost, availability, strength requirements, ease of manufacturing, machinability, and post-manufacturing process requirements. *Sandwich Composites: Fabrication and Characterization* provides insights into composite sandwich panels based on the material aspects, mechanical properties, defect characterization, and secondary processes after the fabrication such as drilling and repair. **FEATURES** Outlines existing fabrication methods and various materials aspects. Examines composite sandwich panels made of different face sheets and core materials. Covers the response of composite sandwich panels to static and dynamic loads. Describes parameters governing the drilling process and repair procedures. Discusses the applications of composite sandwich panels in various fields. Explores the role of 3D printing in the fabrication of composite sandwich panels. Due to the wide scope of the topics covered, this book is suitable for researchers and scholars in the research and development of composite sandwich panels. This book can also be used as a reference by professionals and engineers interested in understanding the factors governing the material properties, material response, and the failure behavior under various mechanical loads. **Handbook of Composites from Renewable Materials, Design and Manufacturing** Vijay Kumar Thakur, Manju Kumari Thakur, Michael R. Kessler, 2017-03-03 This unique multidisciplinary 8 volume set focuses on the emerging issues concerning synthesis, characterization, design, manufacturing, and various other aspects of composite materials from renewable materials and provides a shared platform for both researcher and industry.

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Biocomposites for Lightweight Sandwich Structures M.Y.M. Zuhri, S. M. Sapuan, 2024-12-19 Biocomposites for Lightweight Sandwich Structures Engineering Properties and Applications highlights how the relationship between biocomposites and sandwich structures can provide a unique combination of superior properties that can be optimized for environmentally friendly lightweight applications It introduces current performance of biocomposites sandwich structure applications machining and manufacturing methods energy absorbing capabilities and strengthening techniques of structures as well as potential challenges and future perspectives on performance improvement Provides latest research on biocomposites and use in lightweight engineering applications Explores the suitability of core designs using biocomposites and related environmentally friendly materials Includes recent manufacturing technologies and important performance criteria of sustainable materials for lightweight structures Discusses existing commercial materials and those that are currently under research and development This comprehensive reference will be of interest to materials mechanical and aerospace engineers and those working in related fields interested in development of materials for lightweight designs

ACMSM25 Chien Ming Wang, Johnny C.M. Ho, Sritawat Kitipornchai, 2019-09-03 This book presents articles from The Australasian Conference on the

Mechanics of Structures and Materials ACMSM25 held in Brisbane December 2018 celebrating the 50th anniversary of the conference First held in Sydney in 1967 it is one of the longest running conferences of its kind taking place every 2 3 years in Australia or New Zealand Bringing together international experts and leaders to disseminate recent research findings in the fields of structural mechanics civil engineering and materials it offers a forum for participants from around the world to review discuss and present the latest developments in the broad discipline of mechanics and materials in civil engineering

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Zhang,2019-08-08 Mechanics of Structures and Materials Advancements and Challenges is a collection of peer reviewed papers presented at the 24th Australasian Conference on the Mechanics of Structures and Materials ACMSM24 Curtin University Perth Western Australia 6 9 December 2016 The contributions from academics researchers and practising engineers from Australasian Asia pacific region and around the world cover a wide range of topics including Structural mechanics Computational mechanics Reinforced and prestressed concrete structures Steel structures Composite structures Civil engineering materials Fire engineering Coastal and offshore structures Dynamic analysis of structures Structural health monitoring and damage identification Structural reliability analysis and design Structural optimization Fracture and damage mechanics Soil mechanics and foundation engineering Pavement materials and technology Shock and impact loading Earthquake loading Traffic and other man made loadings Wave and wind loading Thermal effects Design codes Mechanics of Structures and Materials Advancements and Challenges will be of interest to academics and professionals involved in Structural Engineering and Materials Science **The Indian Textile Journal** Sorabji M. Rutnagur,2013 8th

International Conference on Advanced Composite Materials in Bridges and Structures Brahim Benmokrane, Khaled Mohamed, Ahmed Farghaly, Hamdy Mohamed, 2022-09-26 This book comprises the proceedings of the 8th International Conference on Advanced Composite Materials in Bridges and Structures ACMBS 2021. The contents of this volume focus on recent technological advances in the field of material behavior, seismic performance, fire resistance, structural health monitoring, sustainability, rehabilitation of structures, etc. The contents cover latest advances especially in applications in reinforced concrete, wood masonry and steel structures, field application, bond development and splice length of FRB bars, structural shapes and fully composite bars, etc. This volume will prove a valuable resource for those in academia and industry.

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Proceedings of MPCPE 2024 Nikolai Vatin, Svetlana Roschina, Saurav Dixit, 2024-12-27 This book gathers selected contributions in the field of civil and structural engineering as presented by international researchers and engineers at the International Conference on Materials Physics Building Structures and Technologies in Construction Industrial and Production Engineering MPCPE held in Vladimir, Russia, on April 22-25, 2024. The book covers a wide range of topics including the theory and design of capital construction facilities, engineering and hydraulic structures, development of innovative solutions in the field of modeling and testing of reinforced concrete, metal and wooden structures, as well as composite structures based on them, investigation of complex dynamic effects on construction objects and many others. Intended for professional builders, designers and researchers. The contributions, which were selected by means of a rigorous international peer review process, highlight numerous exciting ideas that will spur novel research directions and foster multidisciplinary collaborations.

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Table of Contents Flexural Behaviour Of Sandwich Composite Panels Fabricated

1. Understanding the eBook Flexural Behaviour Of Sandwich Composite Panels Fabricated
 - The Rise of Digital Reading Flexural Behaviour Of Sandwich Composite Panels Fabricated
 - Advantages of eBooks Over Traditional Books
2. Identifying Flexural Behaviour Of Sandwich Composite Panels Fabricated
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Flexural Behaviour Of Sandwich Composite Panels Fabricated
 - User-Friendly Interface

4. Exploring eBook Recommendations from Flexural Behaviour Of Sandwich Composite Panels Fabricated
 - Personalized Recommendations
 - Flexural Behaviour Of Sandwich Composite Panels Fabricated User Reviews and Ratings
 - Flexural Behaviour Of Sandwich Composite Panels Fabricated and Bestseller Lists
5. Accessing Flexural Behaviour Of Sandwich Composite Panels Fabricated Free and Paid eBooks
 - Flexural Behaviour Of Sandwich Composite Panels Fabricated Public Domain eBooks
 - Flexural Behaviour Of Sandwich Composite Panels Fabricated eBook Subscription Services
 - Flexural Behaviour Of Sandwich Composite Panels Fabricated Budget-Friendly Options
6. Navigating Flexural Behaviour Of Sandwich Composite Panels Fabricated eBook Formats
 - ePub, PDF, MOBI, and More
 - Flexural Behaviour Of Sandwich Composite Panels Fabricated Compatibility with Devices
 - Flexural Behaviour Of Sandwich Composite Panels Fabricated Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Flexural Behaviour Of Sandwich Composite Panels Fabricated
 - Highlighting and Note-Taking Flexural Behaviour Of Sandwich Composite Panels Fabricated
 - Interactive Elements Flexural Behaviour Of Sandwich Composite Panels Fabricated
8. Staying Engaged with Flexural Behaviour Of Sandwich Composite Panels Fabricated
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Flexural Behaviour Of Sandwich Composite Panels Fabricated
9. Balancing eBooks and Physical Books Flexural Behaviour Of Sandwich Composite Panels Fabricated
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Flexural Behaviour Of Sandwich Composite Panels Fabricated
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Flexural Behaviour Of Sandwich Composite Panels Fabricated
 - Setting Reading Goals Flexural Behaviour Of Sandwich Composite Panels Fabricated
 - Carving Out Dedicated Reading Time

12. Sourcing Reliable Information of Flexural Behaviour Of Sandwich Composite Panels Fabricated
 - Fact-Checking eBook Content of Flexural Behaviour Of Sandwich Composite Panels Fabricated
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements
 - Interactive and Gamified eBooks

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