Analysis of Composite Beam

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Abstract- *The objective of this work to determine experimentally the textural behavior of composite sandwich beams and compare the results with predictions of theoretical models. Sandwich beams were fabricated by bonding unidirectional carbon/epoxy face sheets (laminates) to aluminum honeycomb cores with an adhesive all constituent materials (composite laminates, adhesive and core) were characterized independently. Special techniques were developed to prevent premature failures under the loading pins and to ensure failure in the test section. Sandwich beams were tested under four-point and three-point bending. Strains to failure in the face sheets were recorded with strain gages, and beam detections, and strains in the honeycomb core were recorded by using techniques. The beam face sheets exhibited a softening non-linearity on the compression side and a non-linearity on the tension side. Experimental results were in good agreement with predictions from simple models which assume the face sheets to behave like membranes, neglecting the contribution of the honeycomb core, and accounting for the non-linear behavior of the face sheets.*

The vibrations produced in the structures or components are the primary source of problems in machine tools,aircraft and automobile structures. Vibrations can be overcome by introducing damping in these structures. A recent method to improve the damping ability of structures is by fabricating these with composites in order to enhance their service life. In addition, composites are found to have superior strength, stiffness, improved corrosion and fatigue resistance. The damping of FR composites depends on the structure, diameter and orientation of fiber in matrix. Damping at the fiber-matrix interface dissipates a significant amount of energy. In the current investigation, damping of structural composite beams has been studied to estimate the damping ratios and natural frequencies

I. INTRODUCTION

Sandwich concept is a proven construction technique that combines low weight with exceptionally high strength thereby making it ideal for a wide range of applications in the aerospace, marine, wind energy and transportation industries. In principle a sandwich consists of two faceplates (facings or faces), which are comparatively thin but of high strength and stiffness, enclosing a core structure, which is relatively thick but light-weighted, and possesses sufficient stiffness in the direction normal to the plane of the faceplates. The components of the sandwich material are bonded together, using either adhesives or mechanical fastenings, such that they can act as a composite load-bearing unit. The skins withstand the bending stresses and give the structure a hardwearing surface whereas light core material carries the shear stresses generated by loads, distributing them over a larger area. Combing together different materials and geometries, it is possible to obtain a wide range of structures and therefore to reach a great flexibility of use

In present investigation a number of literatures published so far have been surveyed, reviewed and analysed. Most of the researchers studied the modal analysis as well as strength analysis of corrugated sandwich structure .However, in many industrial applications, reducing the weight of a structure without compromising its strength and stiffness is considered as one of the most important design criteria. Today, the search of the best performance, quality, and cost for space vehicles became a complex process and many of the researchers are being studying and implementing the corrugated structure which is best suited for the above mentioned criteria. Therefore, attempt has been made to investigate the modal analysis and the strength analysis of the corrugated structure.

II. LITERATURE SURVEY

1) A brief review on corrugated composite sandwich structure is mentioned in this paper. Corrugated Core may be made from a foamed polymer, folded sheet or corrugated web. Regardless of the core design, it should be stiff and strong in directions out-of-plane in order to keep the faces separated and parallel at the correct distance under in-plane and transverse normal loadings. The density of the core controls the impact behaviour of the structure. In order to obtain a sandwich structure with improved energy absorbing performance the must be of high density. Various types of core shapes are – triangular, trapezoidal and sinusoidal.

Skin or the face sheets are thin, most of the out-of-plane shear load is carried by the core, and it therefore should be stiff and strong in shear. The skin may be made of aluminium, steel, woven glass fibre or carbon fibre with polymer such as epoxy or polyester. If a sandwich panel is bent downward, the part of the sandwich above the neutral axis will stretch, and the part below the neutral axis will compress. Although the skin and core stretch and compress evenly at the location of the bond, the core and the skins have different material properties, and will in turn act differently to this bending. Glass fibre – epoxy, Glass fibre – polyester have a low density and high specific strength hence they are widely used for skin in a sandwich structure which are bonded to the core using a strong adhesive.

2)corrugated structure and their application in aeroplane wings are mention in this paper. It consists of design and construction of wings, important parts of wings like skin, controllers, etc. their material, design consideration their use. It also tells us about internal structure of wings and use of corrugated structure as a replacement of present structure.

3)This paper consist detail Vibration analysis of composite beam with crack. Detail information about ANSYS is specified. It explain us the procedure to be follow while analysis like beam modal, modelling procedure in ANSYS. In results it mentions comparison with previous studies on such test in tabular as well as graphical form in detail form considering each and every parameters such as (a) Effect of Volume Fraction of fibre on Natural frequencies, (a) Effect of Volume Fraction of fibre on Natural frequencies, (c) Effect of Support conditions on Natural frequencies, (d) Effect of Crack locations on Natural frequencies, (e) Vibration analysis of composite beam with multiple cracks. Beams and beamlike elements are principal constituent of many structures and used widely in high speed machinery, aircraft and lightweight structures. Crack is a damage that often occurs on members of structures and may cause serious failure of the structures. The crack in a composite structure may reduce the structural stiffness and strength and consequently their static and dynamic behaviour is altered. The increased use of laminated composite beams requires a better understanding of vibration and buckling characteristics of such beams. Determination of the dynamic characteristics of cracked laminated composite beams is essential not only in the design stage but also in the performance of the structure .Vibration analysis can be also used to detect structural defects such as cracks, of any structure offers an effective, inexpensive and fast means of non-destructive testing.

Cracks occurring in structural elements are responsible for local stiffness variations, which in consequence affect their dynamic characteristics. This problem has been a subject of many papers, but only a few papers have been devoted to the changes in the dynamic characteristics of composite beam. In the present investigation an attempt has been made to the reviews on composite beam with crack in the context of the present work and discussions.

4)Glass fibres are having excellent properties like high strength, flexibility, stiffness and resistance to chemical harm. It may be in the form of roving's, chopped strand, yarns, fabrics and mats. Each type of glass fibres have unique properties and are used for various applications in the form of polymer composites. The mechanical, tribological, thermal, water absorption and vibrational properties of various glass fibre reinforced polymer composites were reported.

5) Objective of the paper was to prepare an aluminium alloy glass fibre sandwich panel and test for the bending moment properties of the sandwich panel using universal testing machine. Theoretically calculates the bending behaviour of sandwich panel. Sandwich beams were tested under Air Bending. Stress-strain, stress-displacement, load-displacement, strain-Time, Stress-Time, displacement-time and load-time were recorded by using AIMIL UTM. Experimental results were in good agreement with predictions from simple models.

6)In this paper owing to the practical applications of the composite materials in particular concern of sandwich panels because of very high strength to weight ratio) vibration analysis is done on ANSYS. One of the primary requirements of aerospace structural materials is that they should have low density, very stiff and strong. Sandwich panels are thin-walled structures fabricated from two flat sheets separated by a low density core. FEA modelling is developed by consideration of rotary inertia. The free vibration analysis of sandwich panels is studied. Four nodded isoperimetric shell element is used for FEA. The effects of sandwich design parameters, such as face thickness, core thickness and pitch, on the global bending and vibration responses are determined.

7) A critical review and analysis of crack detection on any beam (here concrete beam) by image processing technique so as to eliminate the errors from manual inspection and offset from the complexities of some of the costly and skilful processes is proposed in this paper. Manual inspection is the acclaimed method for the crack inspection. In the manual inspection, the sketch of the crack is prepared manually, and the conditions of the irregularities are noted. Since the manual approach completely depends on the specialist's knowledge and experience, it lacks objectivity in the quantitative analysis. So, automatic image-based crack detection is proposed as a replacement. Literature presents different techniques to automatically identify the crack and its depth using image processing techniques. Based on the review, analysis is provided based on the image processing techniques, objectives, accuracy level, error level, and the image data sets.

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III. PROBLEM STATEMENT

Beams and beam like elements are principal constituent of many structures and used widely in high speed machinery, aircraft and lightweight structures. Any industrial machinery requires the structure with high strength, rigidity material which can give long life, less failure possibilities of structure, low cost and easy availability. Considering above requirements, Aluminium 3003 is being used as a material for corrugated core and E-glass fibre is being used as material for face sheet of corrugated structure.

Objective:-

- To study vibration analysis of composite beam experimentally and analytically.
- To study strength analysis of composite beam experimentally and analytically.
- To study the revise advantages and applications of composite beam

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IV. FINITE ELEMENT ANALYSIS OF BEAM RESULT

Both End Fixed Boundary Condition

The experimental ansys test is conducted by using both end fixed boundrary condition method of both corrugted and honeycomb aluminum alloy 3003. The aluminum alloy 3003 plate of dimension 500 mm long 100 mm wide .The two plates are joined by araldite. the specimens for bending is cut into for parent material bending of dimension as per the bending parameters .The three point bending is performed on Universal testing machine by using static gradual loading the specimen is bend uptill post yielding of material. The flexural test technique measures behavior of materials subjected to simple loading. The goal of the present review is to do an examination of stresses and strain on corrugated shape compared with honeycomb shape sheet under three-point testing.

1) **For 280 N the deformation is 0.02mm**

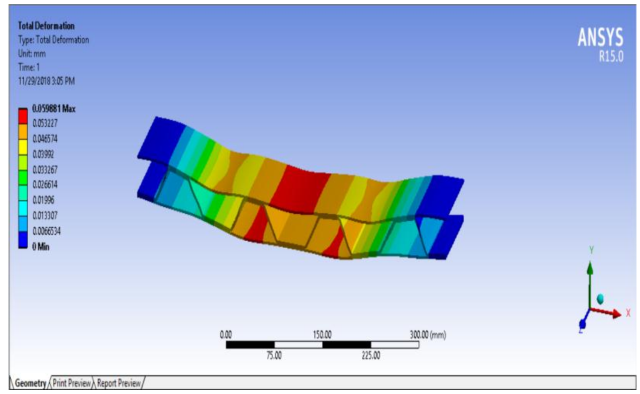

Fig No:-5 Deformation for 280 N

2) **For 560 N the deformation is 0.05mm**

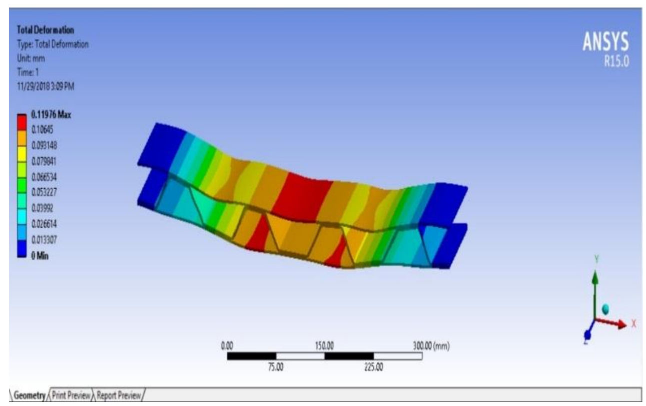

Fig No:-6 Deformation for 560 N

3) **For 840 N the deformation is 0.08mm**

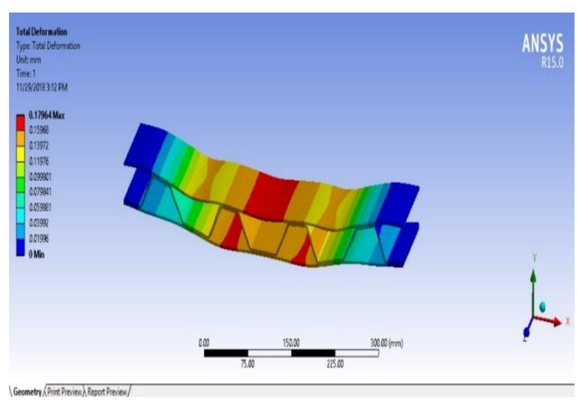

Fig No:-7 Deformation for 840 N

4) **For1120 N the deformation is 0.11mm**

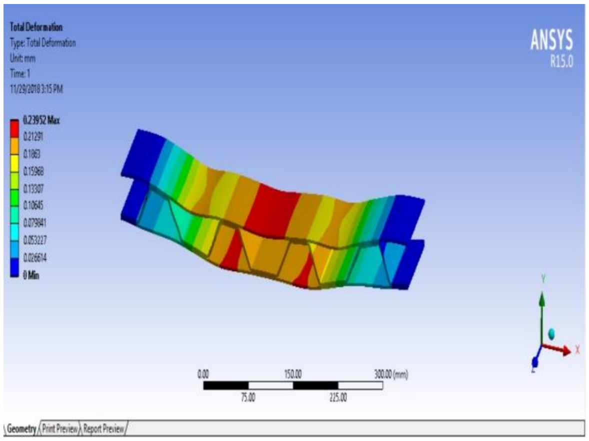

Fig No:-8 Deformation for 1120 N

5) **For 1400 N the deformation is 0.14mm**

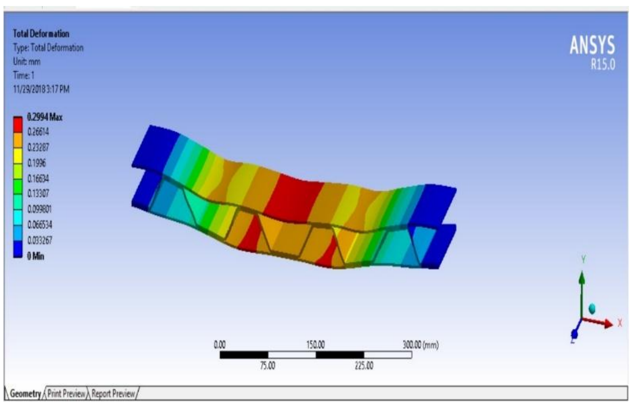

Fig No:-9 Deformation for 1400 N

Results of FEA

Sr.No.	Load (kN)	Deflection of FEA(mm)
1.	280N	0.02mm
2.	560N	0.05mm
3.	840N	0.08mm
4.	1120N	0.11mm
5.	1400N	0.14mm

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