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# Investigation and Analysis of Compression Characteristics of Honeycomb Core Structures

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**ABSTRACT:** Now a day's Composite materials have been widely playing a vital role in the automotive, aerospace and other fields due to its less weight and good performance. Glass fiber honeycomb structures are fabricated by simple slotting technique, adhesive bonding and assembling with square architecture. For, adhesive bonding phenolic resin is used. The aim of the present study is to investigate the Compression properties & Specific Energy absorption of the square and Triangular honey comb structure of the glass fiber. In this we dealt with fabrication of the Sandwich panel structures of square and triangular shape and Compression properties. A Finite element analysis is also done to quantify the effects of imperfections on the compressive strength of composite honeycombs. Finally both experimental and analytical predictions are compared. The main criterion of this work is for providing new opportunities for light weight material & high strength structural design.

**KEYWORDS:** Composites, Honey comb, Sandwich Structures, Ls-dyna.

## I. INTRODUCTION

As of late, lightweight composite structures have seen significantly expanding use in airship and satellites, where the drive for weight sparing is most prominent. Composite sandwich structures are perceived as offering a high quality to weight proportion and additionally high particular twisting solidness and quality attributes under conveyed loads [1][10]. A run of the mill honeycomb sandwich board comprises of two thin and high-quality skins attached to a thick and lightweight center with in-plane two-measurement intermittent cell structures. Contrasted and a strong part, it has high particular quality and particular solidness, and has been generally utilized as a part of aeronautical, aviation, car and common enterprises [8]. A commonplace honeycomb sandwich board comprises of two thin and high-quality skins attached to a thick and lightweight center with in-plane two-measurement occasional cell structures. Contrasted and a strong part, it has high particular quality and particular firmness, and has been generally utilized as a part of aeronautical, aviation, car and common ventures. [3]. Because of the auxiliary many-sided quality of honeycomb sandwich board, it is hard to get an exact arrangement in the theoretic examination [8]. Composite sandwich structures offer a high clasping quality and particular bowing solidness to weight proportion under connected load. The light weight of the sandwich structure makes it alluring in cutting edge applications, for example, air ship and satellites [11][3]. In this exploratory review, a pressure test with a crosshead rate of 1 mm/min was directed on square and triangular honeycomb glass fiber-epoxy center structures to decide their particular vitality retention and make a correlation between them [3]. The Sandwich Panel" which is synthesis of a "powerless" center material with "solid and firm" appearances reinforced on the upper and lower side. The facings give for all intents and purposes the majority of the general bowing and in plane extensional unbending nature to the sandwich. . On a fundamental level, the essential idea of a sandwich board is that the face plates convey the twisting anxieties though the center conveys the shear stresses [12]. The sandwich is an alluring basic plan idea since, by the best possible selection of materials and geometry, developments having high proportions of solidness to-weight can be accomplished. Since unbending nature is required to forestall basic precariousness, the sandwich is especially appropriate to applications where the stacking conditions are helpful for clasping [12]. Sandwich boards are utilized not just due to their favorable circumstances as far as weight sparing and auxiliary execution, additionally as a successful intends to diminish costs. Along these lines, there is dependably an enthusiasm for the improvement of new materials and plans for ease elite centers.

## II. FABRICATION AND TESTING OF HONEYCOMB

Fabrication of square honeycomb starts from prefabricated composite sheet materials by Cutting, Slotting with respect to dimensions and finally bonding into required square shaped honeycomb structure with the help of Phenolic Resin.

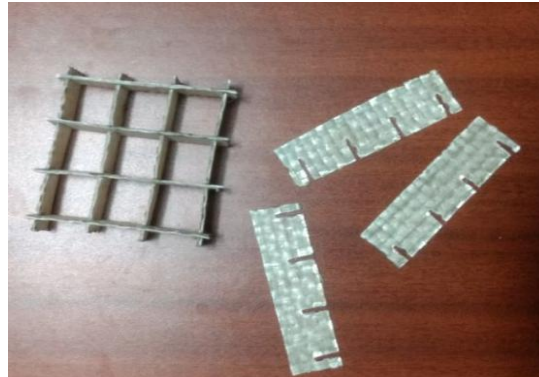


Fig.1— Fabrication of square honeycomb

Dimensions of Square honeycomb Structure: 70 X 70 X 20, Thickness: 1.2 mm, Weight: 65.1 gm, Area of Square:  $70 \times 70 = 4900 \text{ mm}^2$

Fabrication of triangular honeycomb is same as the square honeycomb, dimensions of triangular honeycomb structure - 70 X 60 X 20, Thickness: 1.2 mm, Weight: 55.49 gm, Area of triangle:  $70 \times 60 = 4200 \text{ mm}^2$ .

The compression characteristics of fabricated structures of square and triangle honeycomb were tested using the unidirectional compression test equipment.

## III. FINITE ELEMENT ANALYSIS

The limited component recreation of the case portrayed thus was performed in the standard three ordinary strides utilizing the essential parts of the LS-DYNA code, the initial one being the working of the model by methods for the interior pre-processor called limited component show manufacturer FEMB (Finite Element Model Builder), the second step being the non-straight dynamic investigation and the last one being the post processing of the investigation comes about utilizing the POST-GL processor of the LS-DYNA for the elucidation and representation of the processed information.

The FEA model comprised two types of finite elements, shell and brick elements. The composite faceplates and corrugation were modelled with four-node thin shell elements.

Both the upper moving and the lower stationary head of the press used in the experimental testing works were modelled using one eight-node brick element for each of them without any further discretization since the material model assigned to these parts was the rigid one (i.e., non-deformable).

### a) Material properties

This section refers to the material types used to model the distinct parts of the specimen, the moving platen and the stationary base. It includes the effects of directionality in the material stress-strain response allowing a different fibre orientation to be specified at each through thickness integration point for shell elements.



Table 1—Material properties of the unidirectional plies in the laminate <sup>7</sup>

Material Properties	Symbol	Property value
Modulus of elasticity in the ply longitudinal direction (a)	$E_a$	34,620 MPa
Modulus of elasticity in the ply transverse direction (b)	$E_b$	9580 MPa
Shear modulus in plane (a b)	$G_{ab}$	2935 MPa
Poisson ratio between (a) and (b) directions	$V_{ab}$	0.2884
Poisson ratio between (b) and (a) directions	$V_{ba}$	0.0798
Tensile strength in the longitudinal direction	$X_t$	860 MPa
Tensile strength in the transverse direction	$Y_t$	35 MPa
Compressive strength in the longitudinal direction	$X_c$	442 MPa
Compressive strength in the transverse direction	$Y_c$	130 MPa
Shear strength in plane (a b)	S	67 MPa

Table 2—Material property of the rigid plate

Material	Density (kg/m <sup>3</sup> )	Young's modulus(Gpa)	Poisons ratio
Steel	7.8e <sup>3</sup>	210	0.33

b) Contact interfaces modelling

Apart from geometry, meshing and assignment of element and material properties, equally important part of the model creation was the declaration of contact interface types between the independent interacting parts of the model and within each of them, as deformation proceeds. The treatment of sliding and impact along interfaces has always been very important in order to simulate a “physical ‘performance between interacting structural members being in contact, i.e., keeping geometric boundaries without models independent parts penetrating each other. They are “Nodes\_to\_surface” contact interface and “Eroding\_single\_surface” type.

This type was selected in order to prevent penetration of the specimens internal nodes could be in contact with the rigid platens due to the foam core brick elements erosion/elimination during the simulation procedure.

#### IV. RESULTS AND DISCUSSIONS

After the Compression test conducted the deformed structures of the both Experimental and simulation results is as follows.



Fig. 2—Triangular Honeycomb-Experimental Deformed Shape top view

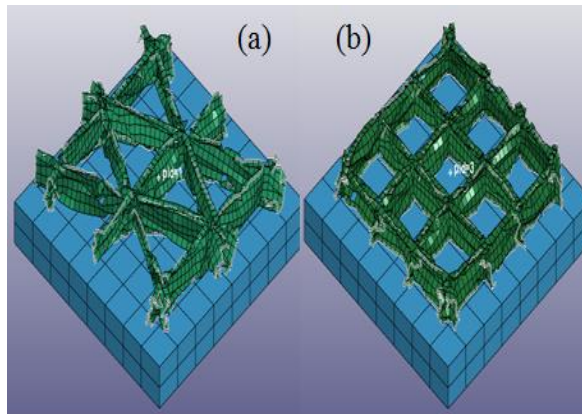


Fig. 3—Triangular (a) and Square Honeycomb (b) FEA deformed shapes

The FEA observed peak load is 53.2KN and experimental observed peak load is 36.6KN, similarly for square honeycomb FEA observed peak load is 44.5 KN and experimental observed peak load is 36.5 KN

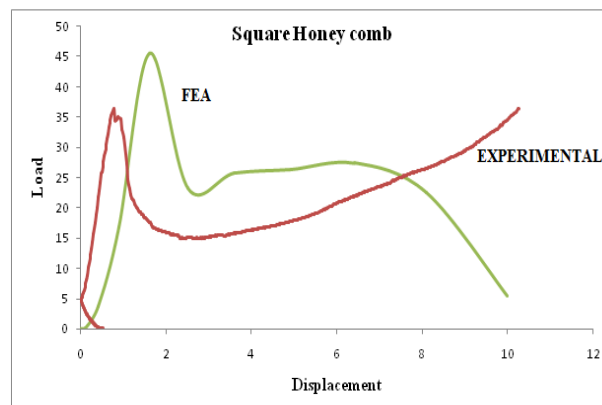


Fig. 5—Experimental Results Vs FEA Results of Square Honey comb structures

## V. CONCLUSIONS

When compression characteristics of the both honeycomb cores, the triangular honey comb structures were found to offer strength and energy absorbing characteristics well in excess of those offered by the Square Honeycomb core. When compared the weight values, Triangle honey comb was less weight than the square comb so that weight to strength ratio is more in Triangle Honey Comb. Hence it is proved experimentally and by FEA the results of the triangular honeycomb is better compared to the square honeycomb.

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