DESIGN, FABRICATION AND TESTING OF BRASS HONEY COMB SANDWICH STRUCTURES

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Abstract

Brass alloy honeycomb structures were designed and fabricated to find the mechanical properties. Fabrication process was done by hydraulic press method which was reduced core corners without any cracks as per the dimensions. Because the rolling formations were given slight deviation from the geometry and it was not perfect matching during the bonding. To overcome this problem folding method was introduced to manufacture the panels. In folding process, a new folding tool was successfully developed to get fabrication of honeycomb core to achieve the desired shape of honeycomb panels with that bonded by common adhesive and which were used to compare the bending properties of panels. The deformation behaviours of honeycomb panels were investigated by the three-point bending test. The load–displacement graph obtained to various core heights at the 30°C and showed various stages of deformation. The experimental results of the specimen were compared with theoretically analysis of the panels with various regions. Brass used as a conductive elastomeric EMI gaskets in various industries. Compared to the aluminium core its given good bending properties and less shear properties which can be used in high temperature Applications

Key words: Brass Sandwich panel, Honeycomb core, 3-point bending test, Shear stress, face bending stress & Natural frequency

I. Introduction

The honeycomb sandwich construction can embrace an unrestrained variety of materials and panel designs. The composite structures provide enormous usefulness as an ample range of core and facing material combinations can be selected. Compared to other materials honey comb structure improved Strength, Stiffness to weight and strength to weight ratios. The honey comb panel consists of two thin face sheets and core with adhesive layers .The core was hollow hexagonal shape with specified thickness and this research panel used face sheets and core material made of brass for gaskets applications. A review of prose indicates that miniature work on flexural bending test, Facing bending stress and Natural frequency of honeycomb panels has been carried out. [1] Numerical Investigation into Effect of Cell Shape on the Behaviour of Honeycomb Sandwich Panel [2] Failure modes for sandwich beams of GFRP laminate skins and Nomex honeycomb core are investigated. A failure mode map for loading under 3-point bending is constructed, showing the dependence of failure mode and load on the ratio of skin thickness to span length and honeycomb relative density. [3] Honeycomb core made of polypropylene. The core is welded to a Twintex skin by means of a welding foil theoretical thickness of approximately 0.7 mm. Honeycomb sandwich panels are layered structures that consist of at least five layers two thin face sheets are bonded to a thick honeycomb core. Because of the wide range of panel parameters, numerical modelling is needed to provide insight into the structural characteristics of a particular panel the second section deals with the significant amount of scatter & third, fourth panels are studied about Measurement uncertainty. [4] Study the Effect of Core Type on Impact Performance of Honeycomb Sandwich Panel. [5] GFRP & Nomex model has investigated and theoretical models using honeycomb mechanics and traditional beam theory are described. Materials used for cores include polymers, aluminium, wood and composites. Core materials Selected based on their fire-resistance or thermal properties. Comparison of theoretical and measured out-of-plane compressive modulus, compressive strength, shear modulus and shear strength. In this paper, the Brass core and face sheet materials were introduced to study the bending properties, Shear properties and natural frequency of the panel and experimental values were examined by being compared values of different core height panels sandwich panels

II. Experimental Investigation

The schematic arrangements of sandwich beams was fabricated and given in Fig (a) and (b). Two face sheets were made in same thickness t_1 and core thickness was h. The face sheet and core materials have same properties and the thickness was varied. Core material and face sheets were made by brass.

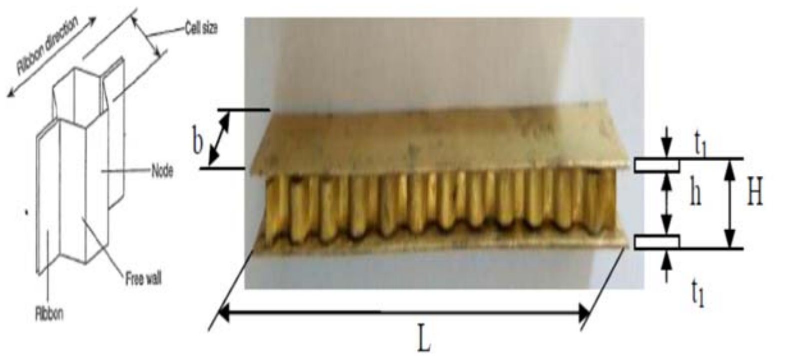


Figure (a) schematic representation

Figure (b) Sandwich Panels

1.1 Material Properties

The following property of the brass material was listed.

- Alloy Type: Binary
- Content: Copper & Zinc
- Density: 8.3-8.7 g/cm3
- Melting Point: 1652-1724 °F (900-940 °C)

The core cell size and thickness were 10.5mm and 0.5mm and the fabricated height of core were in different sizes 6mm, 8mm & 10mm. The Adhesive PM200 was purchased to bond for both the face sheets and core. It has the highly bonding capacity for metal joining.

1.2 Tool Fabrication

The tool was made of DIN 2714 steel as per the design and profile cut was done by wire cut method .The wire material was made in copper alloy and 0.3mm diameter. The voltage was given 230V. The profile cut dies was shown in Figure (c) Length = 250mm, Width = 100mm & Thickness = 50mm

Figure (c) Honeycomb core die

1.3 Specimen Preparation

The honeycomb strip was fabricated by press route 30T. Brass strip kept on the die and the press was operated to fold the strip and the strip got as per the design structure. The fabricated core was shown in Figure (b). The press route was most preparable one to get the desired flat and cornering surfaces. The specimen was prepared different core heights to improve the sound bonding and mechanical properties. The panel bending test has shown in fig(d).

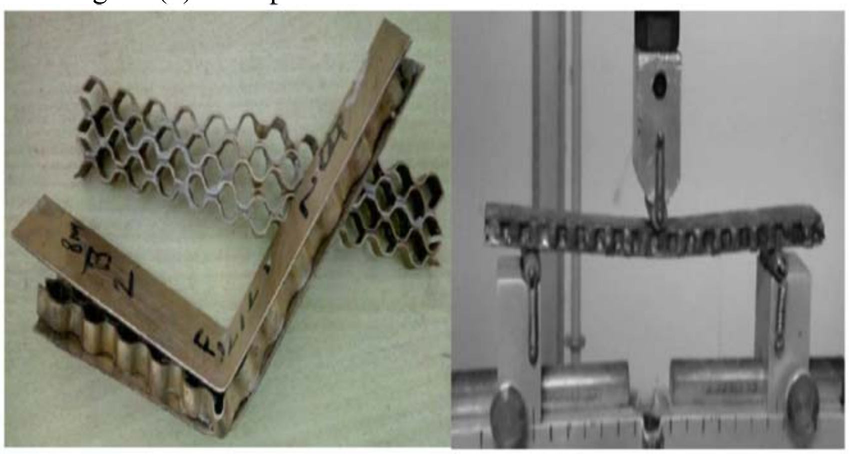


Figure (d) Panel Testing

The following equation (1) used for calculate the bending stiffness

$$D= (P/\delta)\, L^3 / 48 \qquad (1)$$

Where P is the ultimate load, δ is the deformation of the honeycomb Panel; L is the span of beam. Core shear stress was calculated by the equation (2)

$$\tau = P/ (H+h)\, b \qquad (2)$$

Where H-Height of the panel, h-height of the core, b-width of the panel and the facing bending stress also determined the following equation (3)

$$\sigma = PL / 2t_1\, (H+h)\, b \qquad (3)$$

Natural frequency was calculated based on determined experimental deformation value as the below equation (4)

$$f = 1/2\pi\, \sqrt{g}/ \delta \qquad (4)$$

Theory analysis of bending stress was calculated by equation (5) and the values are compared with experimental

$$D_t = EbHX^2 / 2 \qquad (5)$$

Where E is the Young's modulus of the brass, b is the width of the beam, H is the thickness of the beam and X is the distance between factsheets and core. A comparison of Experimental value and theoretical value as listed in the Table 1.

III. Results and Discussion

The load – displacement curves were obtained with various core heights and average curves existed in the 3-point bending test was shown in figure 4.1. The deflection was gradually increased certain limit before fracture. The 8mm panel was 0.89 kN, 10mm panel was 0.91kN and 12mm panel was 0.98kN. When the group is enhanced by increasing the strength of the core height was shown the graph. During panel testing the flat core area starting to peal the adhesive at the corner. The deformation basically occurred at the edge of the sandwich panel, showing that the weakest part of the panel is situated at its edges and buckling occurred at middle of the cell after fracture. Bending stiffness was increased based on core height and decreasing of Shear stress and facing stress as described in the table 1. The natural frequency was enlarged gradually based on panel height.

Table. 1 Bending Properties

Panel Thickness (mm)	Load (kN)	Deflection δ (mm)	Bending Stiffness D Experimental ($MN\text{-}mm^2$)	Bending Stiffness D Theoretical ($MN\text{-}mm^2$)	Core Shear Stress τ (Mpa)	Facing Bending Stress σ (Mpa)	Natural Frequency (Hz)
8	0.89	10.2	14.54	10.20	2.11	211.90	1.54
10	0.91	8.2	14.86	12.00	1.68	168.51	1.71
12	0.98	6.1	16.01	14.40	1.48	148.48	1.99

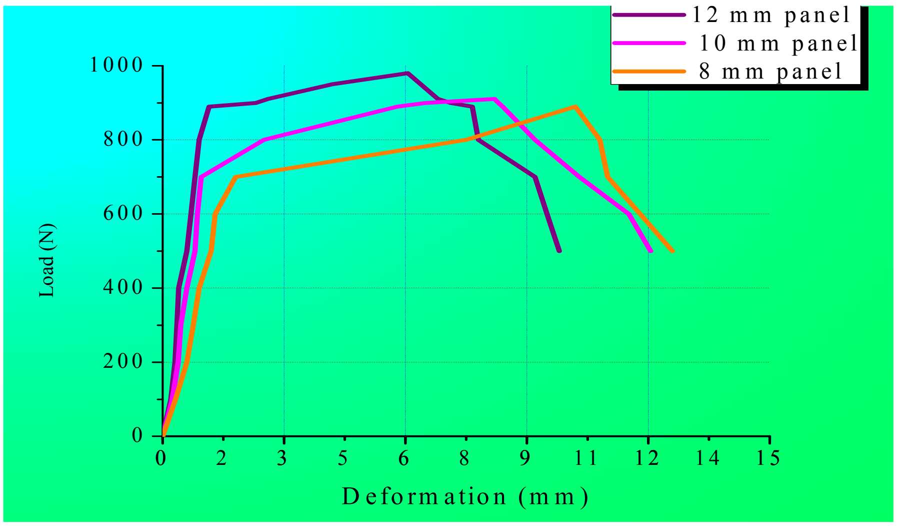


Figure. 4.1 Load Vs Deformation

Bending stiffness theoretical value was lesson compared to Experimental value due to bonding capability. The bonding strength was varied based on the core and panel areas shown Figure 4.2.

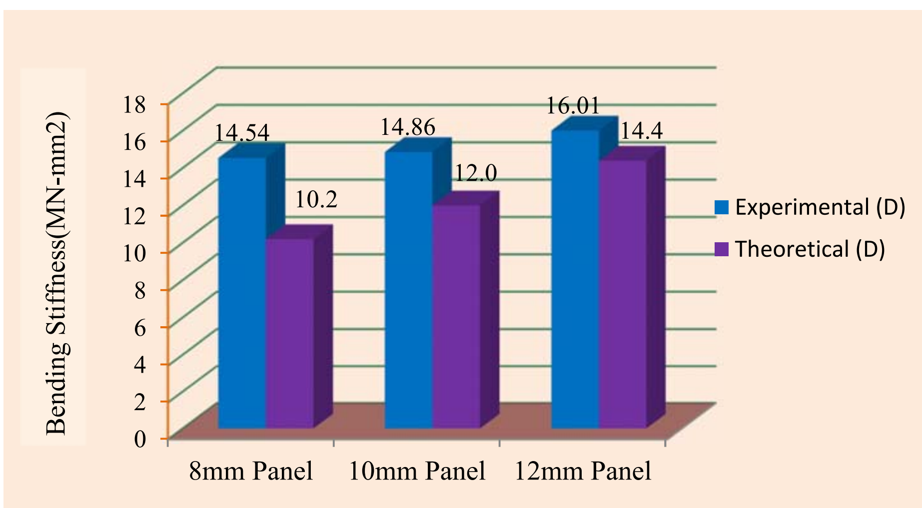
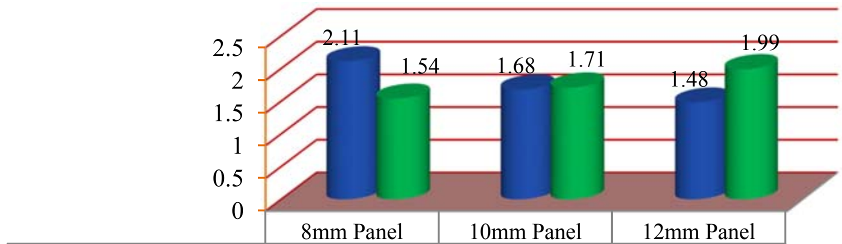


Figure 4.2 Bending Stiffness

The Core shear stress variation of panels was gradually reduced from lower to higher core heights and increased the frequency values were studied from the Figure 4.3. The core spaces the facing skins and transfers shear between them to get the homogeneous structure of the composite Panel.



	8mm Panel	10mm Panel	12mm Panel
Core Shear Stress (Mpa)	2.11	1.68	1.48
Natural Frequency (Hz)	1.54	1.71	1.99

Figure 4.3 Core shear stress and Natural Frequency

Face bending stress was condensed due to various core heights. Sandwich panels create tension in the upper skin and compression in the lower skin. Face bending creates the tension and its obtained value was very less

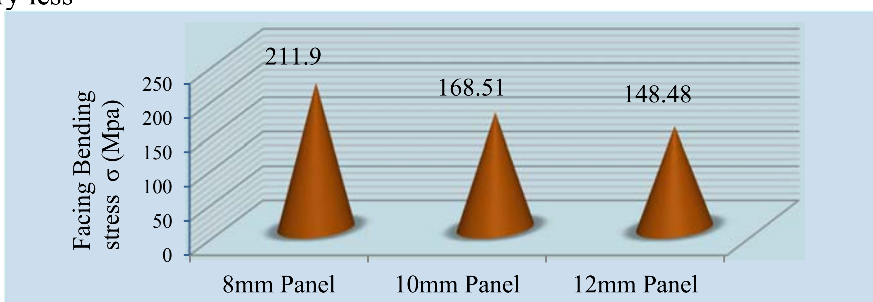


Figure 4.4 Facing Bending stress

IV. Conclusion

The paper presented the method of honeycomb core panel prepared and bonded with adhesive. The result shows the bonding capability of panel and stiffness of the panel with various core heights. The experimental test was investigated by applying the 3-point bending and studied the Core shear stress, face sheet bending stress and Natural frequency. During the test process of mechanical deformation was categorized into three zones based on the characteristic load-displacement behavior, namely linear-elastic zone, plastic-plateau zone and densification zone. The experimental results recommended that the bending properties of the higher core panel is quit high compared to lower core panel and also found that the gradient of deflection curve is high for lower core height. The stress values were always reduced due to increasing of core heights of composite panels and increasing of Natural frequency. During the panel testing different types of failures are occurred like Panel buckling, skin wrinkling, Intracellular buckling and Shear crimping. These can be measured with various mechanisms.

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