Estimation of Flexural Strength and Shear Strength of Sandwich Panel by Varying Foam Density

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Abstract: ***The sandwich structure composed of E-glass fibre, diviny cell foam and epoxy resin were subjected to three point bending test to assess bending strength. Three types of foam cores with different density (60 kg/m^3, 80 kg/m^3 and 100 kg/m^3) were investigated. The effect of foam density on flexural rigidity was assessed. It has been observed that the sandwich structures with higher foam density withstand a higher bending load& higher shear strength show less flexural stress and flexural modulus when compared with low density core.***

Keywords: composite, flexural strength, shear strength, sandwich, foam density.

1. Introduction

In recent days, lighter and stronger materials are being evolved in order to satisfy the needs of the advancing technology. A lot of research work is going in to laminate composite structures to fulfill this requirement. Design and fabrication of these materials is continuously evolving to make even stronger and lighter structures. In terms of structure, materials can be divided into four basic categories: metals, polymers, ceramics, and composite materials. A composite material is a combination of two or more materials in right proportions to get single entity and improved qualities from the single material. Fiber reinforced composite materials are finding increased application in aircraft, spacecraft, automobile fields and electronic industry since, it has high strength to weight ratio and stiffness.

Alberto Corigliano et al (2000) studied the main results of an experimental and numerical investigation on the mechanical behavior of a composite sandwich primarily designed for naval engineering applications. The extensive experimental tests and numerical simulations confirmed the remarkable potentialities of the innovative sandwich structure with syntactic foam core and skins interconnected by transverse piles. The structured material was thus proven to be very well suited for naval engineering and more generally, for advanced transportation related technologies. Noted from experiments is the considerable weakness of the sandwich skins bonding. The risk can be eliminated or reduced by improving the production technology on this aspect.

Mercado et al (2000) reported that the load carried by sandwich structures continues to increase after core yielding. Knowing that the core could not carry additional load after yield, this increasing load carrying capacity of post yield sandwich structure initiated the postulation that the additional shear load was transferred to the face sheets.

2. Material Selection

The main pre-process part of the panel fabrication is the selection of the materials for the manufacture of the sandwich composites. The materials selected include the glass cloth for the facing sheets, resin, hardener, and the core material.

2.1 Core Selection

The core material selected for this study was Diviny cell closed-cell 'H' grade foam core (density = 80kg/m^3,60 kg/m^3 and 100 kg/m^3 of thickness = 10 mm). This foam core was chosen because of its superior fatigue and impact resistance, damage tolerance, light weight and excellent cost effectiveness. The core material used in this study can be used for the vast majority of composite applications where both handle aminating and closed molding process such as in fusion is employed. The upgrade H grade, improvements have been made in the critical area of performance. Strength properties have been improved by 15% from the H60 core. Both the thermal and the dimensional stability have also seen significant improvements in the upgrade core. The core diviny cell® H 80 can be processed at up to 90° C with minimal dimensional changes. Divinycell® H 80 has also got good chemical resistance and the core cell size is reduced. Continuous operating temperature is -200°C to +70°C.

2.2 Face Sheet Selection

320 Grams square meter (Gsm) with thickness of 10 mils woven open form E-glass fabric cloth was used as face sheets. The open form cloth was selected for this work as the resin is impregnated into the next layer of cloth easily when compared to closed form cloth. The properties of E-glass cloth are high stiffness, high strength to weight ratio, non flammable, resistant to heat, good chemical resistance, relatively insensitive to moisture and good electrical insulation.

3. Results and Discussion

To investigate the effects of foam density, three types of specimens were used: 60 kg/m^3,80 kg/m^3 and 100 kg/m^3 From the result it was observed that as the foam density increases the flexural rigidity was increased. The maximum load of the specimens for the static bend test is summarized in Table 1. Figure 1 shows the load displacement curves of the static bend test for the three types of specimen.

Table 1: Flexural rigidity of sandwich panels (varying foam density)

Sl No	Foam density (kg/m^3)	Span length (mm)	Breadth (mm)	Flexural rigidity (Mean) $N\text{-}mm^2$	S.D	C.V	Critical load (N)
1	100	200	30	7031250	.356	.078	226
2	80	200	30	5576509	.425	.086	200
3	60	200	30	5062500	.265	.057	138

S.D = Standard deviation C.V = Coefficient of variance

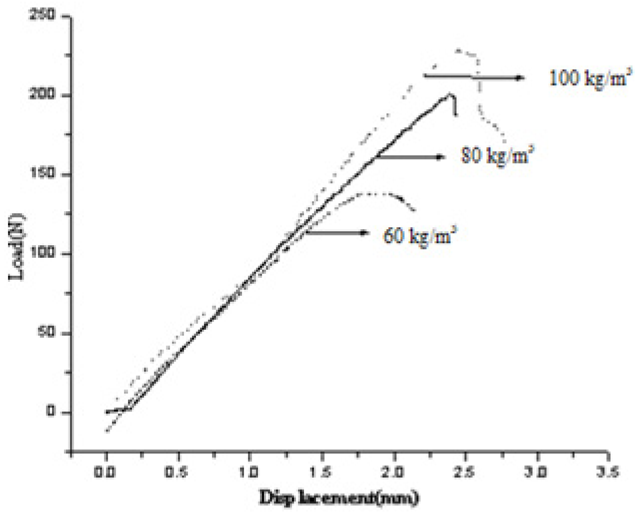

Figure 1: Load vs Displacement curves of sandwich specimens (varying foam density)

Table 2: Ultimate shear strength and shear modulus of sandwich panels

Sl No.	Foam density (kg/m^3)	Ultimate shear strength, σ_s(kPa)	Shear modulus G (MPa)
1	60	963	8.78
2	80	2443	13.75
3	100	2844	16.32

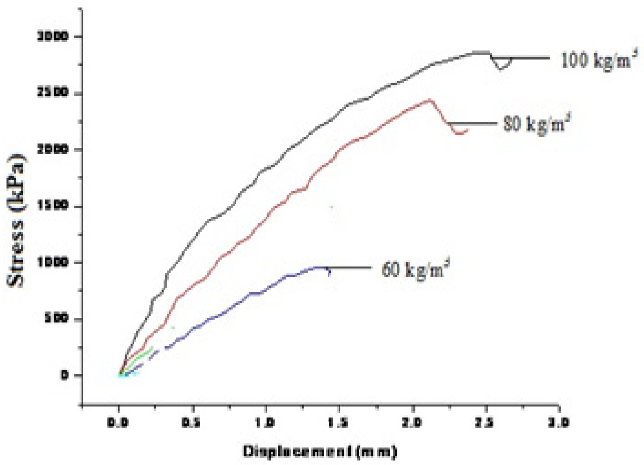

Figure 2: Core shear test results

4. Conclusion

This work deals with the evaluation of flexural strength of sandwich panel by varying foam density. This research work has four phases such as materials selection, flexural strength of GFRP skins, flexural strength and shear strength of sandwich panel. From the result it was concluded that flexural rigidity of sandwich panel with high core density shows significant improvement in flexural rigidity& shear strength.

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