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Acoustic performance of composite material skinned sandwich panel.

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Abstract:- *This is the paper giving information on experiments and results performed on honeycomb structure made of composite material. Studied different manufacturing processes for manufacturing of glass fiber honeycomb structure , those are given in the paper. With that easy and economic method is also given. Software design is shown. It is having many benefits. While experimenting this project different cases were studied they are given with their resuts.*

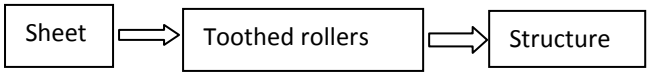
Key Words: Composite material , Sandwich panel, Acoustic performance, Honeycomb Structure

1. INTRODUCTION

As noise pollution and regarding problems are increasing day by day ,there are many experiments are going on to reduce these problems , this is one of them. To catch or to trap sound in the walls itself , this is idea of experiment. With selection of appropriate structure of wall , selecting right material . there were two facesheets used which were made of two different material. But core was made of only glass fiber , so there were 4 cases with change in thickness of 2 material. And after getting final results , best among them can be selected for use.

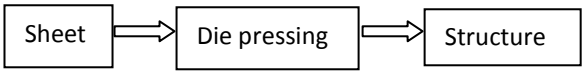
1.1 Honeycomb structure manufacturing methods

There are four different methods for manufacturing honeycomb structure namely, Corrugating roll method, Expansion, Die method, Mould method. Firstly, the sheet of glass fiber is layered with epoxy resin and hardener and cured at room temperature. The process is followed as:



1.2 Proposed manufacturing method

The most economical from the above methods is the mould method. Here two dies (male and female) are used instead of rollers which are less expensive compared to rollers. Here the glass fiber sheet is pressed between male and female die by applying resin. The resulted sheet is made of semi hexagonal shapes.



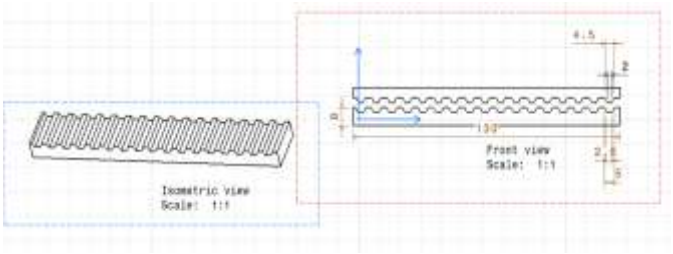


Fig-1: Design of die with dimensions

2. CAD DESIGN

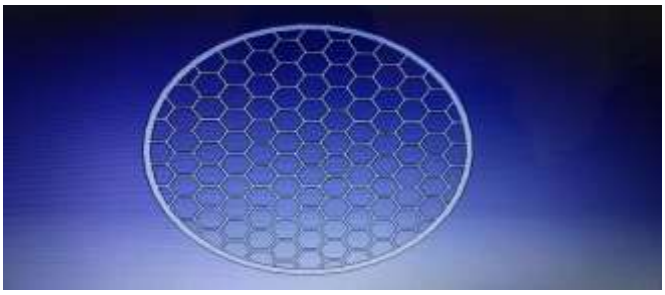


Fig-2: CAD modelling of Honeycomb structure.

CAD design for honeycomb structure was done in CATIA V5. The CAD design is made according to the impedance tube having diameter 100mm.

3. Manufacturing

In this paper, the honeycomb structure of glass fiber is made by mould method which consist of two dies (male and female).

3.1 Die pattern making

Fig-3: Die made from 3D printing.

Male and female die is made by CNC, VMC and 3D printer with proper dimension. The dimensions are stated below;

For Upper die: Length= 130mm, Width=20mm,
Diameter= 4.8mm.
For Lower die: Length= 130mm, Width=20mm,
Diameter= 5mm.

3.2 Honeycomb structure making

Fig-4: Procedure for honeycomb structure.

When die are manufactured the glass fiber with the resin applied are compressed between both the male and female die. The sheet of core material is passed through the male and female die. Then the die is pressed over and so the core material takes the shape of the die and forms semi hexagonal shape. After getting semi hexagonal shapes, the strips are placed over each other in such a way that they form full hexagonal structure (Honeycomb structure). Hardener is used with required proportion for the strips so that they does not get too hard of soft. With the help of resin the strips are stick together. The number of strips are stick together in such a way that they form a rectangle. Then the curve is cut with the help of grinder of required diameter (100mm) and thickness (20mm). Thus a circular shape core material of glass fiber is made having honeycomb shape structure.

3.3 Standard Proportion

Resin to hardener ratio=3:1(curing time-12hrs)
Catalyst (100% hardener) to hardener (cobalt octate) Ratio=1:1.
Glass fiber (300gm/m^2) to resin (100gm)

3.4 Face sheets

Table-1: Dimensions of material

Material used	Diameter	Thickness
Glass Fiber	100mm	1mm,2mm
Aluminum	100mm	1mm,2mm

Fig-5: Face sheets of Aluminum and Glass fiber.

4. RESULTS

4.1 Analytical results

4.1.1 Glass fiber as face sheet:

$$TL_0=10\log\{[1+n\pi\frac{\bar{\rho}f}{\rho c}\left(\frac{fmn}{f}\right)^2]^2+\left(\frac{\pi\bar{\rho}f}{\rho c}\right)^2[1-\left(\frac{fmn}{f}\right)]^2$$

}

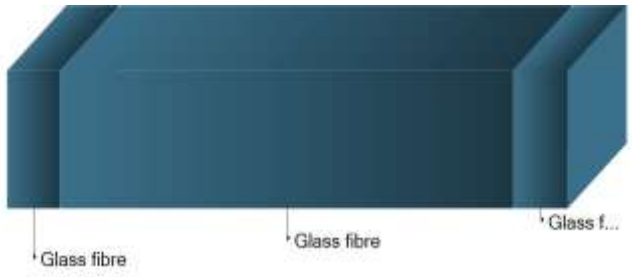


Fig-6: Structural diagram.

Table-2: Specifications:

Layer No.	Material	Thickness [mm]	Material Type
1	Glass fiber	1.0	Absorber
2	Glass fiber	20.0	Absorber
3	Glass fiber	1.0	Absorber

Table-3: Glass fiber specifications:

Material Type	Absorber
Flow Resistivity [kPa*s/m^2]	17.0
Density [kg/m^3]	140.0

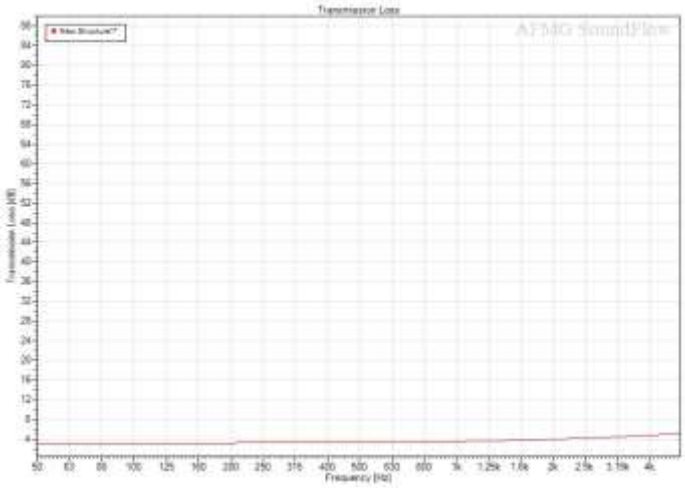


Chart-1: Transmission loss vs Frequency

From the above chart, Transmission loss is increasing slowly but consistently with maximum value of 5.23db.

4.1.2: Face sheet as Aluminum:

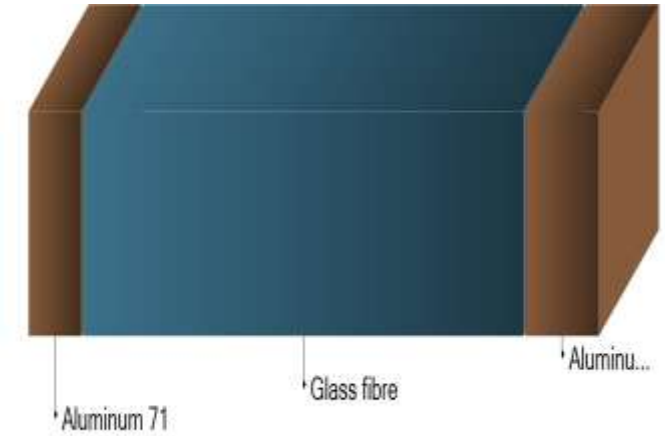


Fig-7: Structural diagram

Table-4: Specifications:

Layer No.	Material	Thickness [mm]	Material Type
1	Aluminum	1	plate
2	Glass Fiber	20	Absorber
3	Aluminum	1	plate

Table-5 Glass fiber specifications:

Density[kg/m^3]	2700.00
Young's Modulus[GPa]	76.1
Poissons Ratio	0.34
Bending Loss Factor	0.01

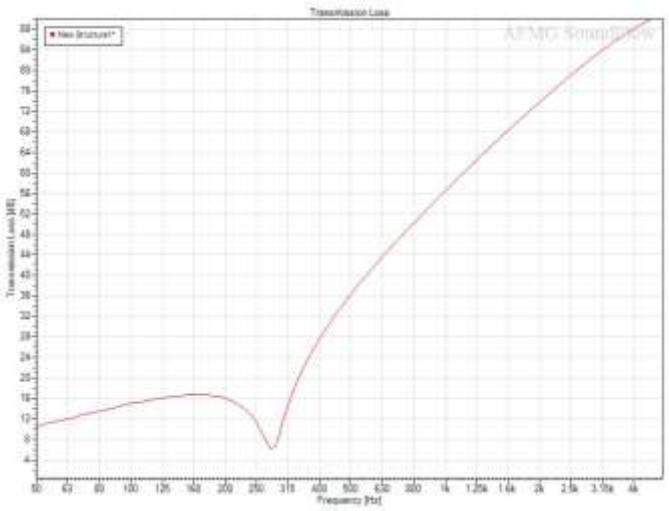


Chart-2 transmission loss vs frequency

CONCLUSIONS

Using face sheet as Aluminum and core material as glass fiber, it is concluded that Transmission loss first increases and decreases upto frequency 300Hz and then goes on Increasing. If size of face sheet is increased the transmission loss also goes on increasing. Sound Transmission loss for different frequencies were calculated and compared with different frequency for different thickness of facesheet.

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