Analysis of Honeycomb Sandwich with Rubber Filled Core

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Abstract

This analysis of honeycomb sandwich is to improve the energy absorption capability when exposed to external force. This is achieved through providing some supportive element to its core. The supportive element which is used in this analysis is rubber material. Rubber is a material that is good at absorbing external physical force, acts as excellent vibration absorber and also has other feature like decent tensile force etc. Thus the analysis is proceeded with honeycomb cells filled with rubber material in its core and analyzed with different variable loads and variable filling patterns.

Keywords: honeycomb, sandwich, rubber,core.

I.INTRODUCTION

Honeycombs and honeycomb materials are used to fabricate sandwich panels with a honeycomb core possessing tremendous compressive strength. Utilizing materials such as paper, thermoplastics or cloth for core material allows for the production of lightweight honeycomb structures with substantial structural strength regardless of building component strength. Honeycomb refers to a hexagonal design structure used in panels, cores and other construction materials. Based on the shape used in honeybee nests, the honeycomb design provides an exceptional combination of strength and efficiency, while drastically reducing the weight of the component. Applications for honeycomb panels and panel systems include use in enclosures, flooring, walls and decorative shapes. A wide variety of synthetics and metals are manufactured in honeycomb shapes. Common materials used include aluminum, phenolic-impregnated Kraft paper, aramid fibers and polypropylene. Honeycombs can be filled with different materials, such as urethane foam, or they can be left without a filler material; proper selection depends on the required application. Other possibilities for honeycomb materials are plywood, steel and stainless steel.

Many composite materials are researched now days on honey comb for a better improvement based on the honeycomb material and material used in the core of honeycomb. Recently, cellular-filled structure has gained popularity due to its evident promotion in energy absorption capacity of absorber (ZhonggangWang et al, 2018) .And also honeycomb cell walls can be coated with material to its thickness for better improvement of stiffness improvement and energy absorption (RuoshuiWang et al, 2018). In this analysis we are going to fill the honeycomb cells with rubber material and analyze the displacement of the honeycomb structure

on different loadings. And compare the displacement value with empty cell honeycomb structure under same loading.

II.EXPERIMENTAL PROCEDURE

A. Modeling of Honeycomb

In this analysis the software used for creating the model is solidworks 2015. The dimension of the honeycomb structure is based on normal honeycombs used in the industrial manufacturing. The dimension may vary on depending upon the usage of the honeycomb. In here the thickness of honeycomb is 1mm, and the height is 20mm. and the hexagonal shape of the honeycomb dimension is 5mm, this is the face dimension of the hexagonal.

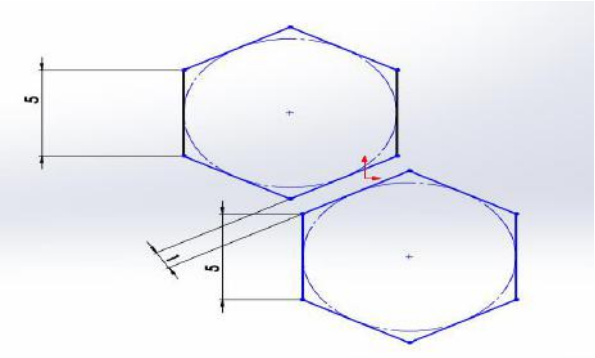

Figure 1: Sketch of Honeycomb Polygonal

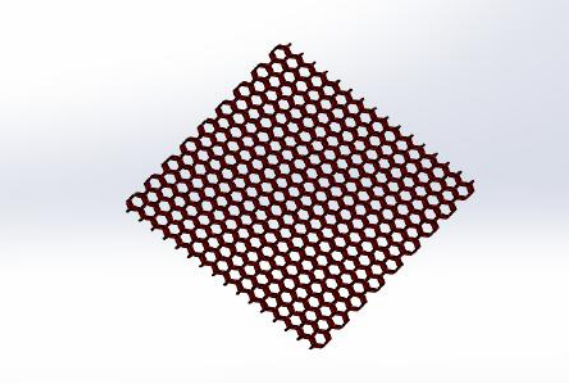

Figure 2: Honeycomb 3D model

The modeling is defined on the top plane. First two polygon structures of 5mm is drawn, for constrains the gap between the two structures is of 1 mm.

B. Modeling of Core

The core material is also created using the solidworks 2015 modeling software. This structure is rather simple and is based on the honeycomb cell dimension.

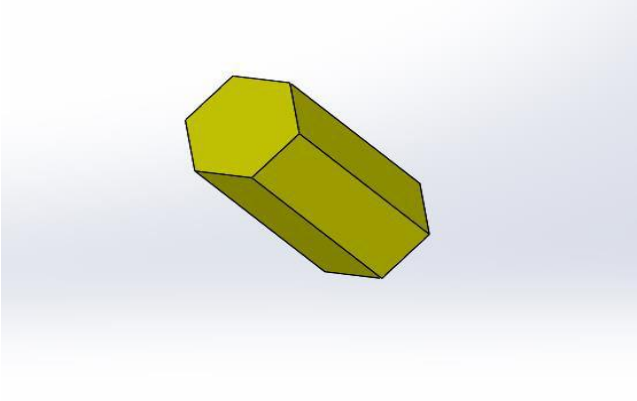

Figure 3: Core Material 3D Model

C. Assembling of Honeycomb Sandwich

The assembling of the honeycomb sandwich is done by creating an assembly file in the components and are inserted and coincide with each other surfaces.

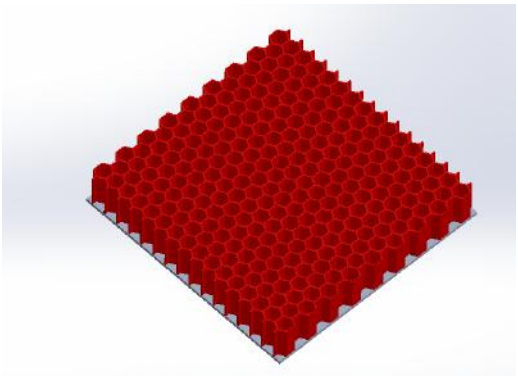

Figure 4: Honeycomb Sandwich Assembly

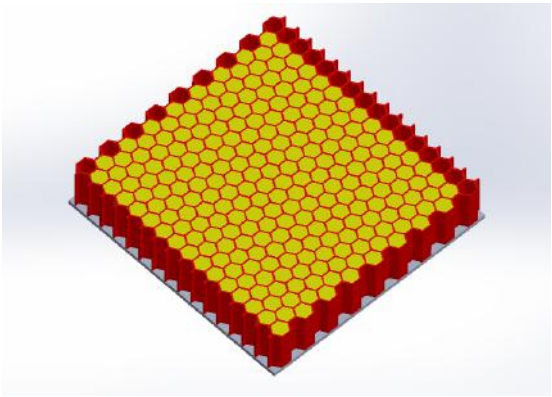

Figure 5: Honeycomb Cell Filled With Rubber

D. Analysis of Honeycomb Sandwich

The analysis is done through solidworks 2015 using the solidworks simulation. In this simulation the material used for the honeycomb is mentioned. The first step is material selection. The material used in this is aluminium 3003 H18 for honeycomb and natural rubber for the core material.

Properties	
Name:	3003-H18
Model type:	Linear Elastic Isotropic
Default failure criterion:	Max von Mises Stress
Yield strength:	1.85e+008 N/m^2
Tensile strength:	2e+008 N/m^2
Elastic modulus:	6.9e+010 N/m^2
Poisson's ratio:	0.33
Mass density:	2730 kg/m^3
Shear modulus:	2.5e+010 N/m^2
Thermal expansion coefficient:	2.32e-005 /Kelvin

Properties	
Name:	Natural Rubber
Model type:	Linear Elastic Isotropic
Default failure criterion:	Unknown
Tensile strength:	2e+007 N/m^2
Elastic modulus:	10000 N/m^2
Poisson's ratio:	0.45
Mass density:	960 kg/m^3

Next the contact of the components is determined. The composite honeycomb structure has many contacts, when compared to the regular honeycomb sandwich structure. After that the load and fixture comes in, the bottom of the sandwich is taken as the fixed geometry and the upper sandwich panel is defined as the loading area.

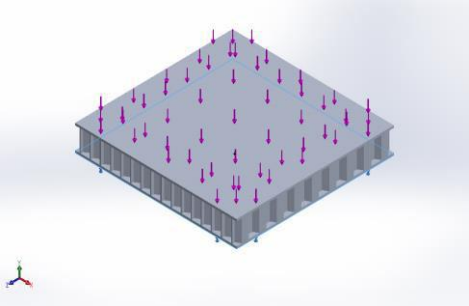

Figure 6: loading and fixture

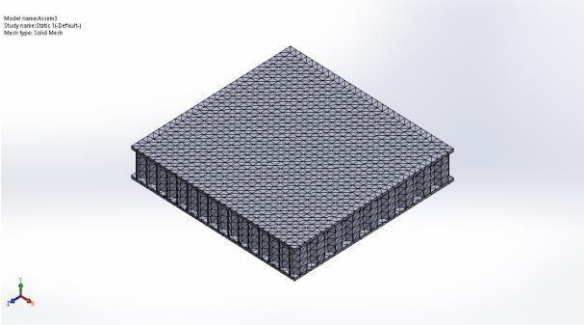

Figure 7: Mesh Model of Honeycomb

After the loading is done the structure is meshed using mesh command and finally the simulation is done after generated. The generated solution will be stress, displacement and strain.

III.RESULT AND DISCUSSIONS

The honeycomb sandwich and the composite honeycomb filled with rubber material are analyzed. And their displacement analysis is shown below.

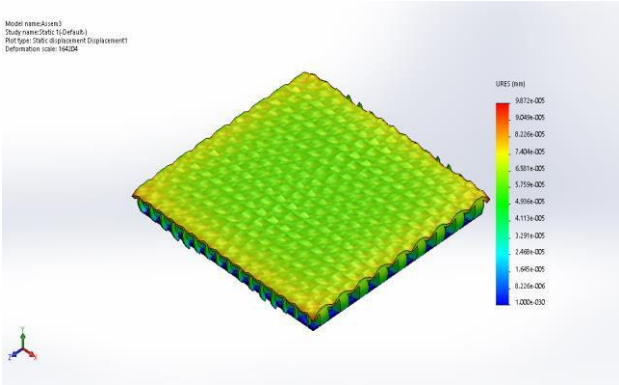

Figure 8: Displacement analysis of honeycomb under 1000N load

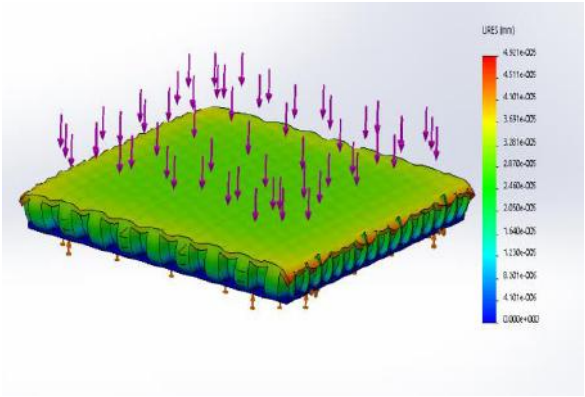

Figure 9: Displacement analysis of honeycomb with rubber material under 1000N load

Based on the analysis of the honeycomb model the displacement is high or maximum on the outer edge of the panel for both the models. The displacement of honeycomb sandwich without the rubber material, under 1000N load is 4-5mm. the displacement of honeycomb sandwich with rubber material in it cells, is 2-3mm under the load of 1000N.

IV.CONCLUSION

Thus from the analysis of both the honeycombs, the honeycomb filled with rubber material in its cells shows the low displacement value when compared to honeycomb without rubber material. Thus confirming the higher energy absorption capability. The rubber material is good shock and vibration absorbers, thus acting as a damper which provides an additional feature to the honeycomb.

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