

Design and Analysis of Hexagonal and Octagonal Honeycomb Structures

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ABSTRACT:

Due to the cost effectiveness, the automotive industries are specifically looking for different combination of materials for optimizing the production control and cost variation to bring up luxury design of interior and exterior look of the vehicle bodies. High strength, low weight is the major criteria in the selection. Honey comb sandwich materials with different structures play a key role in the automotive sector for obtaining good strength and durability.

In this project the designs of hexagonal and octagonal honey comb structures are analyzed and compared. The structures developed by using Solid-Works 2018 software. Solid-Works 2018 flow simulation is to be used to test the effectiveness and limitations of the structures. Thermal and static analysis are performed with different types of materials like Titanium, Aluminum, Stainless steel to identify the best material for low cost and high-efficient by applying various loads.

Key words: Honeycomb structures, hexagonal, octagonal, solid works etc.

I. INTRODUCTION

Honeycomb structures are regular or can be misleadingly made by human which have the math of honeycomb which permits the minimization of material to lessen weight and cost. These constructions are shifted broadly; the basic component being is that these designs comprise of a variety of empty cells shaped between slender vertical dividers. The cells are frequently resemble columnar and hexagonal shape which gives them in low thickness great pressure properties.



Fig: 1.1 Honeycomb Structure

Thermoplastic honeycomb centers (as a rule from polypropylene) are normally made by expulsion handled through a square of expelled profiles or expelled tubes from which the honeycomb sheets are cut.

As of late another, exceptional interaction to create thermoplastic honeycombs has been executed, permitting a nonstop creation of a honeycomb center just as in-line creation of honeycombs with direct overlay of skins into cost effective sandwich board.

II. DESIGN and DIMENSIONS

These designs are designed using Solid works 2018. All dimensions are in mm.

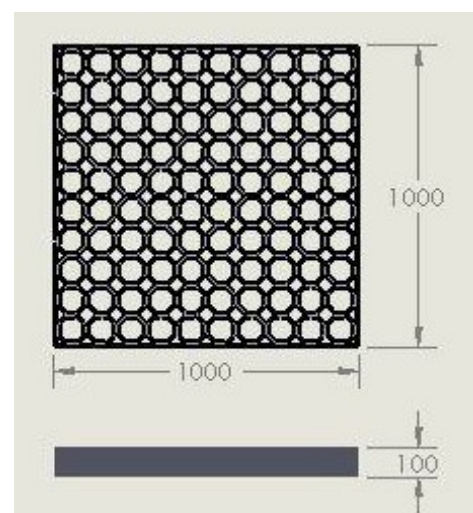


Fig: 1.2 Dimensions of Hexagonal and Octagonal Structure Model

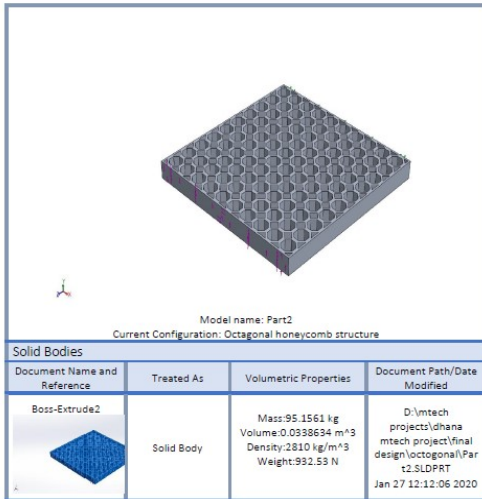


Fig: 1.3 Mesh formation

III. MATERIAL SELECTION AND PROPERTIES

As indicated by the exploration in aviation innovation the most utilized material for the honeycomb structures are Aluminum Alloy-7075, Stainless Steel Alloy-321, Titanium-Ti6Al-4V (Grade-5). These three materials are applied for the plans and reproduction is handled. The mechanical properties of the materials as per the evaluations utilized in Airplanes and Aerospace innovation.

Material Name	AISI 321 Annealed Stainless Steel (SS)
Model type:	Linear Elastic Isotropic
Default failure criterion:	Max von Mises Stress
Yield strength:	2.34422e+008 N/m ²
Tensile strength:	6.2e+008 N/m ²
Elastic modulus:	1.93e+011 N/m ²
Poisson's ratio:	0.27
Mass density:	8000 kg/m ³
Shear modulus:	-
Thermal expansion coefficient:	1.7e-005 /Kelvin

Table 4.2 Properties of Stainless-Steel Alloy

IV. ANALYSIS

The structures of Hexagonal honeycomb and Octagonal honeycomb structures are designed in Solid works Software with the same particular dimensions. The structures are analysed and compared to each other in three different types of materials. These analyses are done using Solid works simulation 2018 Software.

Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off
Jacobian points	4 Points
Element Size	42.0212 mm
Tolerance	2.10106 mm
Mesh Quality	High
Total Nodes	24021
Total Elements	11533
Maximum Aspect Ratio	8.7253
% of elements with Aspect Ratio < 3	79.5
% of elements with Aspect Ratio > 10	0
% of distorted elements(Jacobian)	0
Time to complete mesh(hh:mm:ss):	00:00:05

Fig: 1.4 Mesh Details
Bending moments on Hexagonal and octagonal structures

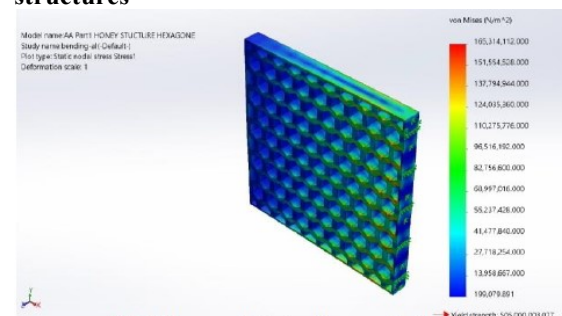


Fig 6.1: Honeycomb Structure Hexagone-Bending-Al-Stress

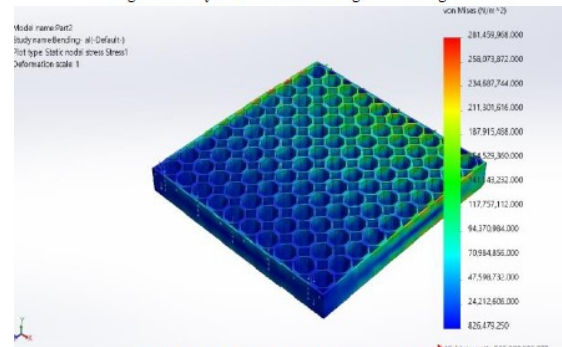


Fig 6.5: Honey Structure Octagone-Bending-Al-Stress

Shear load on hexagonal and octagonal structures

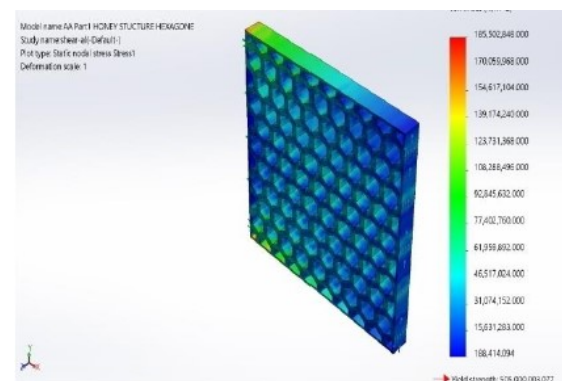
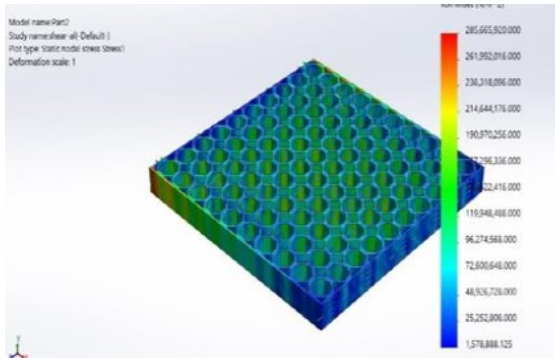


Fig 6.9 : Honey Structure Hexagone-shear-Al-Stress



Torsional loads on hexagonal and octagonal structures

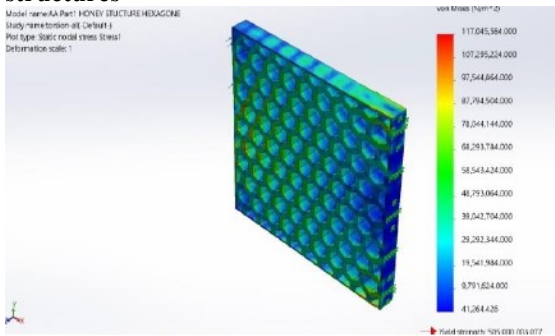


Fig 6.17 : Honey Structure Hexagone-Torsion-All-Stress

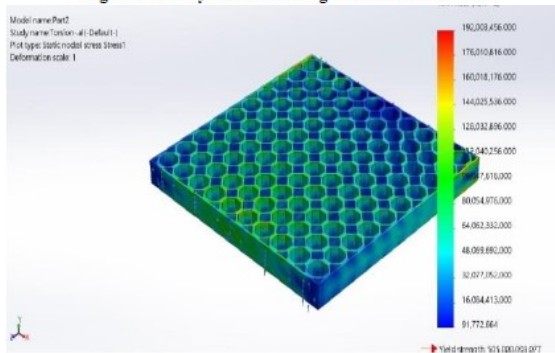


Fig 6.21: Honey Structure Octagone- Torsion -All-Stress

Same as above Loads of bending moment, shear load, torsion load, tensile load is also applied on all other 2 materials Stainless steel alloy and Titanium alloy. Each analysis considers of total 16 number of loads are analysed same as above. All those results are shown in the below table. The results are compared between the two hexagonal and octagonal honey comb structures. The followings results are accurate and verified thoroughly.

V. CONCLUSION

When the results are compared between Hexagonal honeycomb structure and octagonal honey comb structure we can observe that both the structures have equal strength in respective materials, but in some areas Octagonal structure have efficient performance than hexagonal structures. Main usage of this honeycomb structure is to reduce the weight and maintain the strength. According to weight ratio, octagonal honey comb structure weight is

less than hexagonal structure, and also the loading strength is equal as much as hexagon structure. So according to this analysis we can prefer Octagonal honeycomb structure in manufacturing of Airplane and Aerospace technology to reduce the weight.

VI. REFERENCES

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