Design and Analysis of Sandwich Composite Beam.

(Thermo-Plastic Skin And Honey Comb Core Sandwich)

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***Abstract*— The sandwich-structured composite is which is made of thermo-plastic skin which is been placed above and below the honey comb core which will be like a sandwich structure, which widely used in aerospace and naval applications. In this a sandwich composite for Semi-monocoque construction in aircraft fuselage is analyzed for its strength under different loading conditions. 3D modeling of sandwich composite beam is done in Pro/Engineer and further Static, Modal and Random Vibration analysis is done on the beam using finite element analysis software Ansys.**

Keywords*— Pro/E; Ansys; composite sandwich; static analysis; Modal analysis; Random vibrational analysis;

I. INTRODUCTION

A sandwich-structured composite is a special class of composite materials that is fabricated by attaching two thin but stiff skins to a lightweight but thick core. The core material is normally low strength material, but its higher thickness provides sandwich composite with high bending stiffness with overall low density [1]. the sandwich-structured composite is which is made of thermo-plastic skin which is been placed above and below the honey comb core which will be like a sandwich structure[3], when any force is applied on the sandwich composite the upper will undergoes compression stress and the lower skin will undergoes tensional stress[2]. The core in between the skins will be resisting the stresses acting on the sandwich and also we can say that increasing the thickness of core material will get stronger. This principle works in much the same way as an I-beam does [4].This kind of sandwich material will be widely used in aerospace and naval applications [5]. So I have chosen a semi monocoque for testing of this sandwich composite [6]. Semi-monocoque construction is an aircraft fuselage. I have designed 3D modeling of sandwich composite beam in Pro/Engineer and further Static, Modal and Random Vibration analysis is done on the beam using finite element analysis software Ansys.

II. DESIGN OF SANDWICH BEAM (SEMI MONOCOQUE)

Design of the of sandwich beam (semi monocoque) is done in Pro/E the 3D model and 2d drawings of sandwich beam (semi monocoque) is

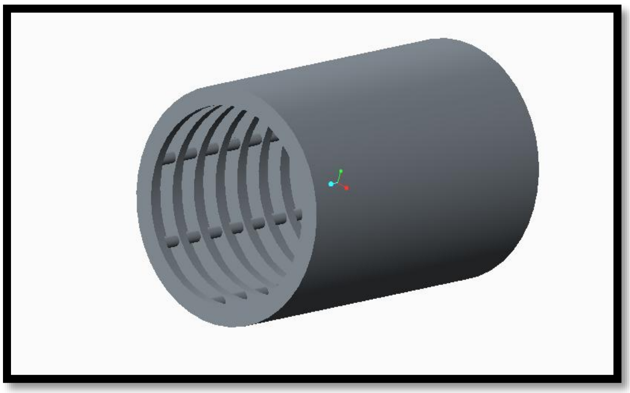

Fig.1. 3D Model of sandwich beam (semi monocoque)

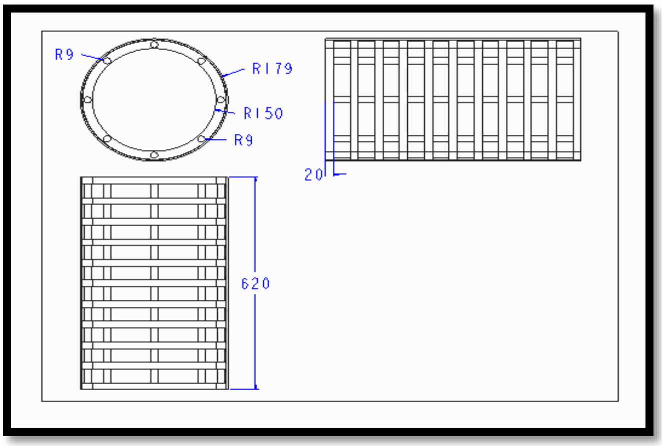

Fig.2. 2D Drawing of Sandwich Beam (Semi Monocoque)

III. *Analysis of sandwich beam (semi monocoque)*

A) Material properties

Skin carbon fiber rein forced thermo-plastics

Density	:	1430 kg/m3
Young's modulus	:	133000Mpa
Poisson's ratio	:	0.3

Stringers material properties of honey comb

Density	:	2900kg/m3
Young's modulus	:	165000Mpa
Poisson's ratio	:	0.25

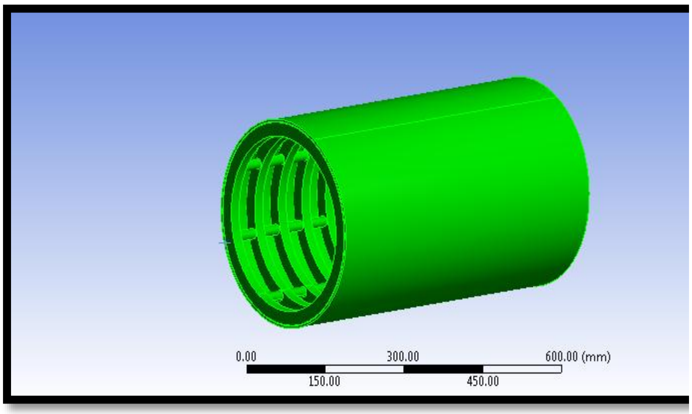

Fig.3. 3D Model of sandwich beam (semi monocoque) in Anysis

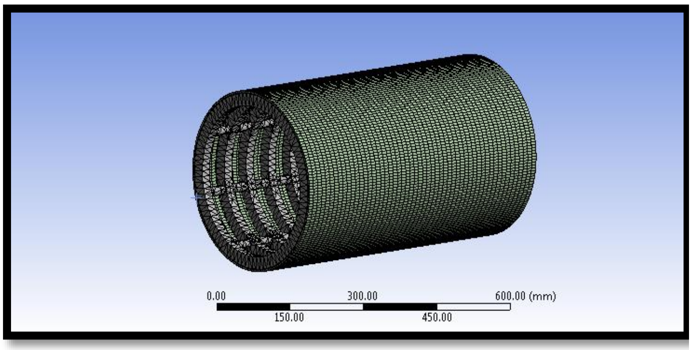

Fig.4. Generated mesh to design

After generating mesh to design it has been gone through three types of analysis

1. Static analysis
2. Modal analysis and
3. Random vibrational analysis

Under two different pressure conditions

Condition 1-14 psi

Condition 2-16 psi

1. Static analysis of sandwich beam (semi-monocoque)

Condition 1- pressure (14psi)

Total deformation

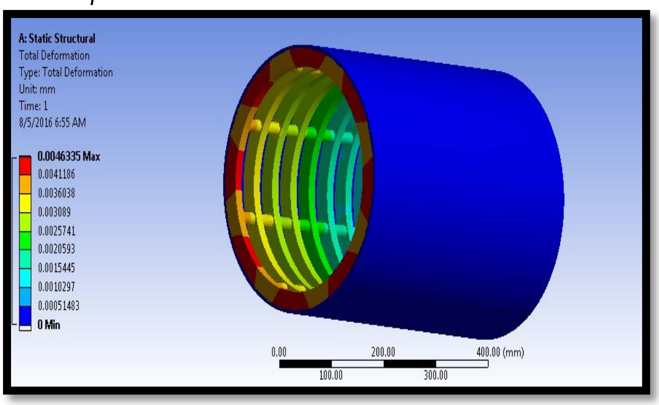

Fig.5. Total deformation of design14psi pressure

Von-mises stress

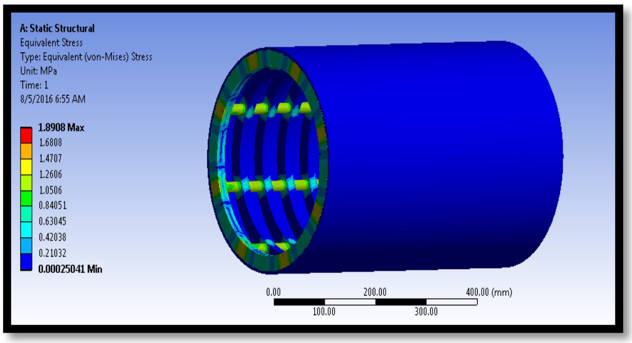

Fig.6. Von-mises stress of design14psi pressure

Von-mises strain

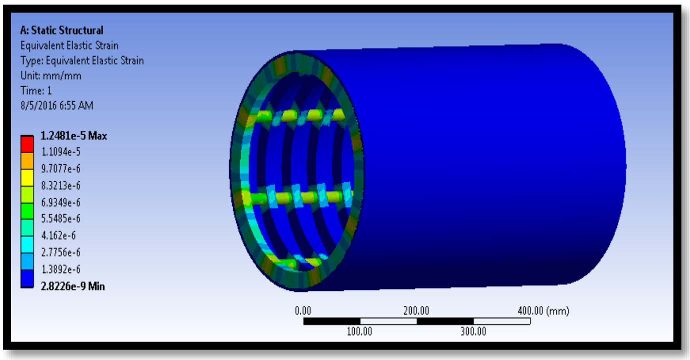

Fig.7. Von-mises strain of design14psi pressure

Condition 2- pressure (16psi)

Total deformation

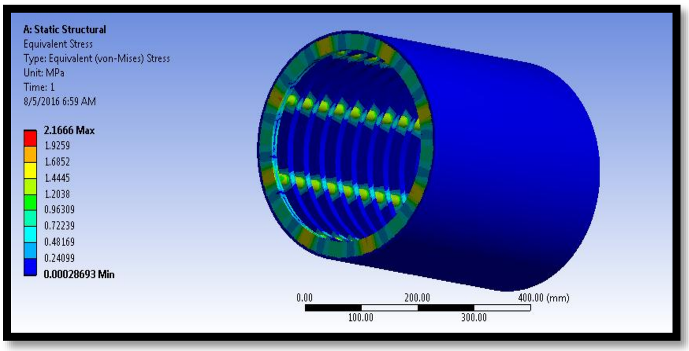

Fig.8. Total deformation of design at 16psi pressure

Von-mises stress

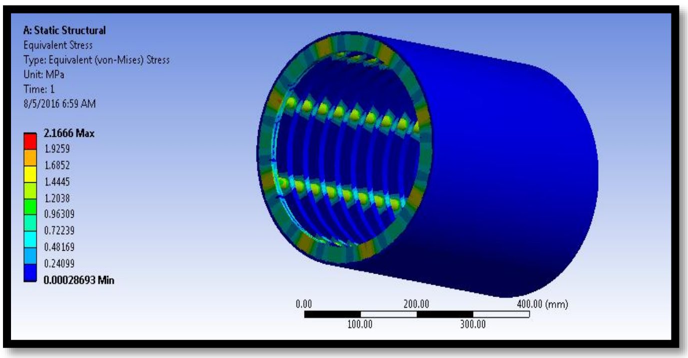

Fig.9. Von-mises stress of design at 16psi pressure

Von-mises strain

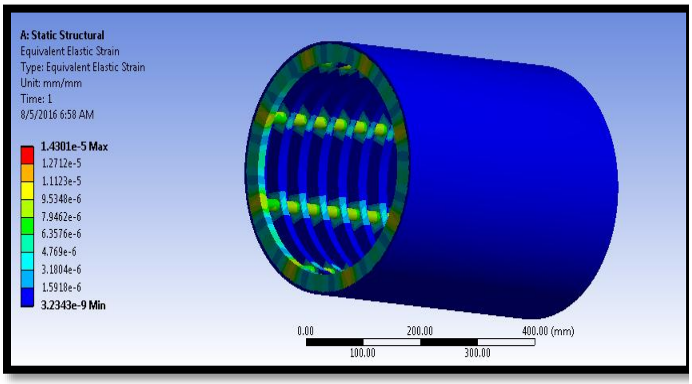

Fig.10. Von-mises strain of design at 16psi pressure

2. Modal analysis of sandwich beam (semi-monocoque)

Condition 1- pressure (14psi)

Total deformation 1:

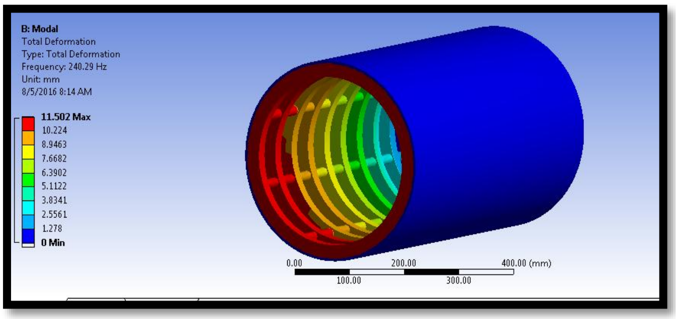

Fig.11. Total deformation 1 of design at 14psi pressure (model analysis)

Total deformation 2

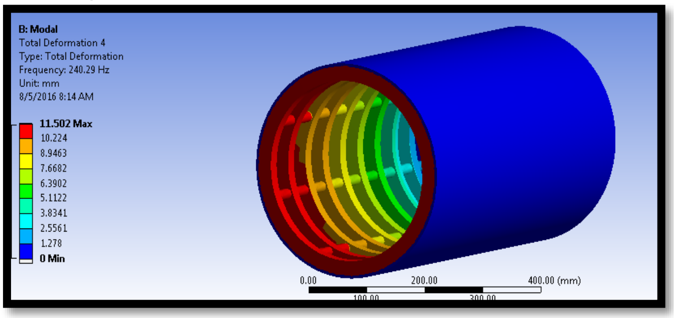

Fig.12. Total deformation 2 of design at 14psi pressure (model analysis)

Total deformation 3

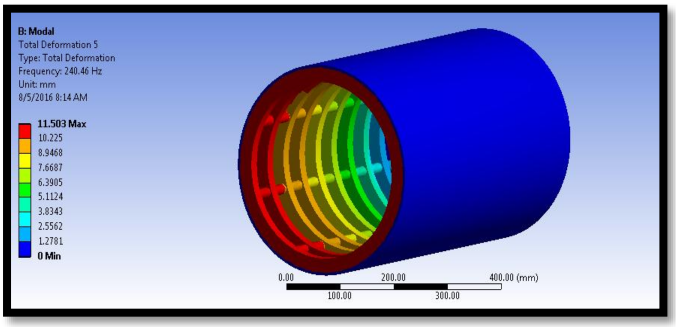

Fig.13. Total deformation 3 of design at 14psi pressure (model analysis)

Condition 2- pressure (16psi)

Total deformation 1

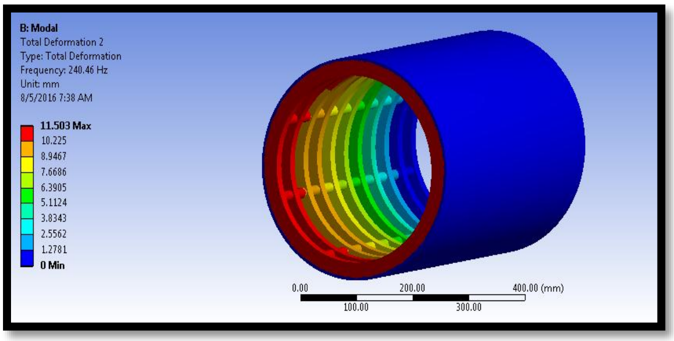

Fig.14. Total deformation 1 of design at 16psi pressure (model analysis)

Total deformation 2

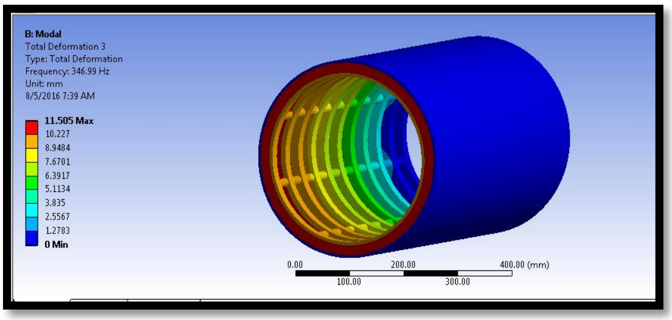

Fig.15. Total deformation 2 of design at 16psi pressure (model analysis)

Total deformation 3

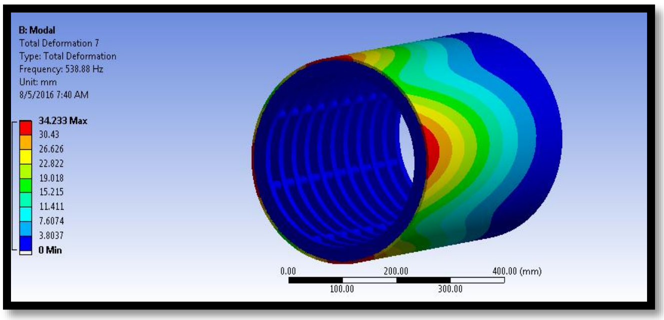

Fig.16. Total deformation 3 of design at 16psi pressure (model analysis)

3. Random vibrational analysis of sandwich beam (semi-monocoque)

Condition 1- pressure (14psi)

Directional deformation

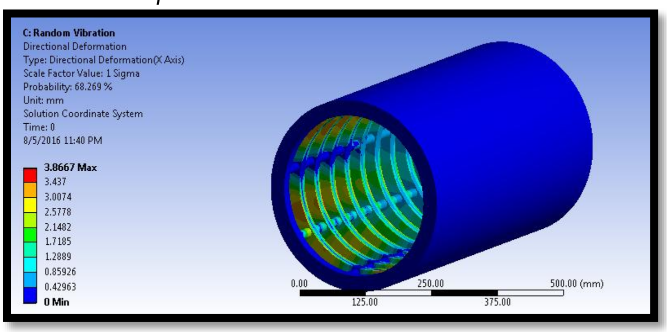

Fig.17. Directional deformation of design at 14psi pressure (Random vibrational analysis)

Shear stress

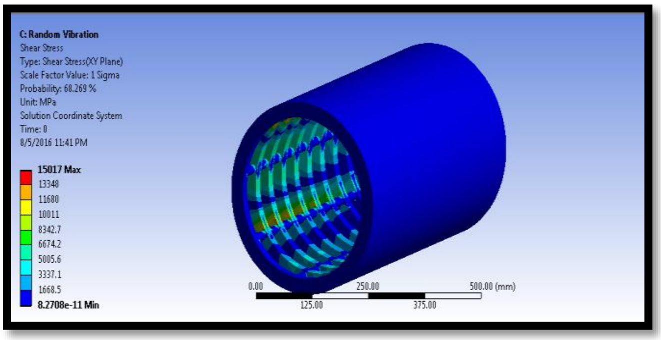

Fig.18. Shear stress of design at 14psi pressure
(Random vibrational analysis)

Shear strain

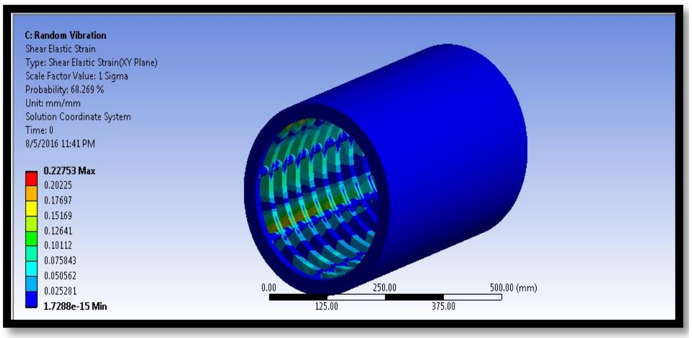

Fig.19. shear strain of design at 14psi pressure
(Random vibrational analysis)

Condition 2- pressure (16psi)

Directional deformation

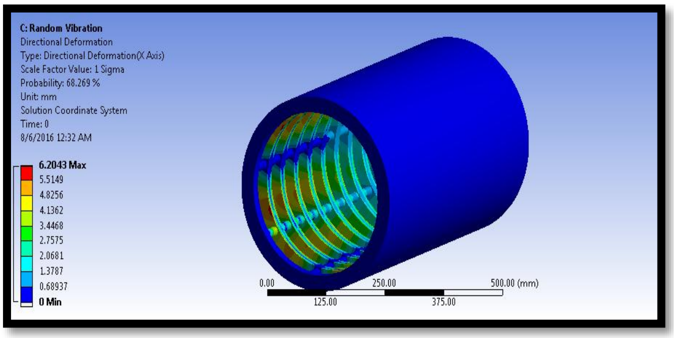

Fig.20. Directional deformation of design at 16psi pressure
(Random vibrational analysis)

Shear stress

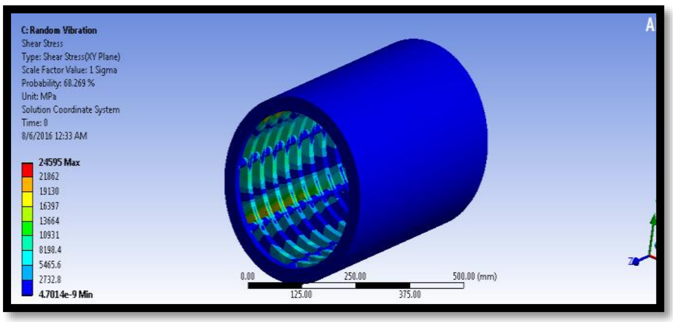

Fig.21. Shear stress of design at 14psi pressure
(Random vibrational analysis)

Shear strain

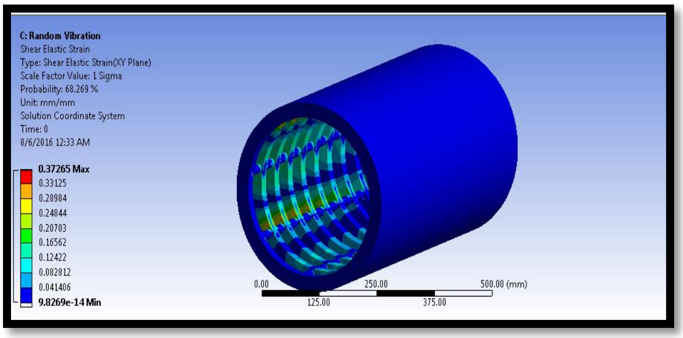

Fig.22. Shear strain of design at 14psi pressure
(Random vibrational analysis)

IV.RESULTS TABLES

TABLE I. **STATIC ANALYSIS**

Pressure condition	Deformation (mm)	Stress (N/mm^2)	Strain
14(Psi)	0.0046335	1.8908	1.24e-5
16(Psi)	0.00530	2.166	1.43e-5

TABLE II. MODAL ANALYSIS

Pressure condition	14 (Psi)	16 (Psi)
Frequency (Hz)	240.29	240.46
Deformation 1 (mm)	11.502	11.502
Frequency (Hz)	240.29	346.99
Deformation 2 (mm)	11.503	11.505
Frequency (Hz)	240.46	538.88
Deformation 3 (mm)	11.504	34.233

TABLE III. RANDOM VIBRATION ANALYSIS

Pressure condition	Directional Deformation (mm)	Shear Stress (N/mm^2)	Shear Strain
14 (Psi)	3.86	15017	0.22
16 (Psi)	6.204	24595	0.3726

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V. CONCLUSION

3D modeling is done in Pro/Engineer. Static, Modal and Random Vibration analysis is done on the beam using finite element analysis software Ansys. By observing the structural analysis results, the deformation, stress and strain values are increasing by increasing the pressure. The deformation and strain values are more. The stress value is less than its respective allowable strength value. By observing the modal analysis results, the deformation values are less when honeycomb is used but the frequencies are more. If the frequencies are increasing, vibrations will increase. By observing the random vibration analysis results, the directional deformation and shear strain are less but the shear stress values are more when honeycomb is used.

VI.REFERENCES

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