Design Of Steel Sandwich Structures For Structural Applications

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***Abstract*— Steel sandwich structure consist of two face sheets made from material such as metal or fibre composite bonded to light weight material called as core. This light weight structure used in application of aircrafts, wind turbine blades, marine and also in other industrial sectors. In this steel structure have top and bottom side mild steel face sheets are used and for core material selected mild steel. In this way minimum weight and increasing of strength can be obtained. In this paper analysis of steel structure is done in Ansys work bench and total deformation and equivalent stress is analyzed. The model of steel structure is generated in Pro-E. The rectangular core steel structure results are compared with circular core steel structure and V core steel structure of with same boundary conditions and loading.**

***Key Words* — Steel structure, Pro-E, , Ansys 14.5, Mild steel, Core**

I. INTRODUCTION AND LITERATURE REVIEW

In steel sandwich structures top plate and bottom plate made up of steel and core which is made up of steel are called as steel sandwhich structure. Core structures having different types which are O- core, I core, web core, Vf- core, corrugated core, c- core, z-core, hat- core, x- core which are shown in Figure 1. In this paper Circular core composite structure have two plates i.e. top and bottom side of plates are made from mild steel material and core which is made up of glass fiber reinforced polymer (E-glass/epoxy).

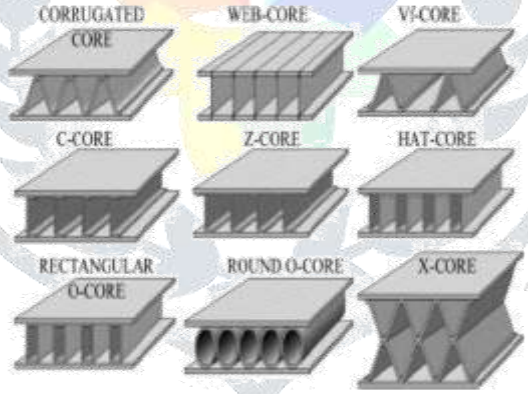

Figure1. Different steel sandwich structure with Various cores

Aydıncak, İlke develop an orthotropic material model after analysis of honeycomb structure which is generally used for honeycomb core [3].Tomas Nordstrand analyzed a corrugated board and which is analyzed in three point bending and evaluate the bending stiffness and also transverse shear stiffness [5]. Jani Romanoff discussed the bending effect on web core sandwich panel which is welded by laser [7]. Narayan Pokharel make a review on fully profiled sandwich panels and determined local buckling behavior which are based on polyurstyrene foam, thinner and high strength [9].

II. DESIGN AND ANALYSIS OF STEEL STRUCTURES

Circular core Steel structure, Rectangular core steel structure and V core steel structure which are generated in Pro-e and then it is imported into ANSYS workbench. In ANSYS workbench geometry shows three contact pairs. Material properties are given to the steel structures i.e. top and bottom plates are selected as a mild steel and core which is selected as a mild steel. Select the mesh size 3mm. For structural analysis of steel structures fixing the bottom plate from bottom side and applying the uniform load on top side of the plate and total deformation and equivalent stress noted.

A. **Circular core Steel Structure**

Top and bottom side plate of structure - 100mmx100mm5mm.
Core shape –Circular.
Core Height – 20.5 mm.
Inner diameter of Core structure – 15mm
Outer diameter of Core structure – 20.5mm

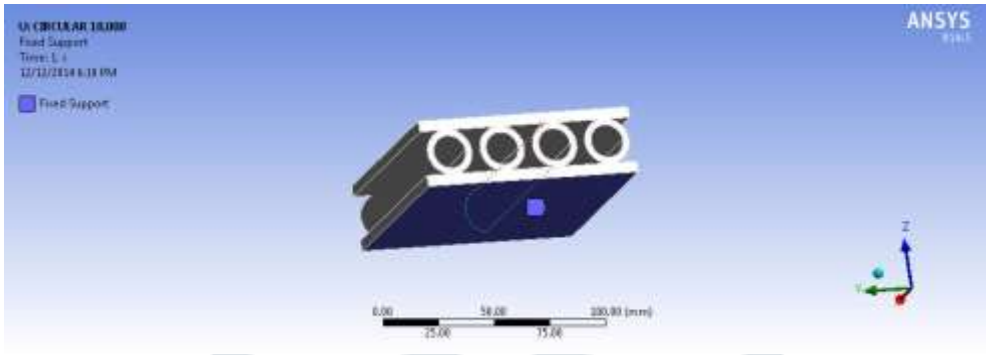

Figure 2. Position of fixing bottom plate in Circular core steel structure

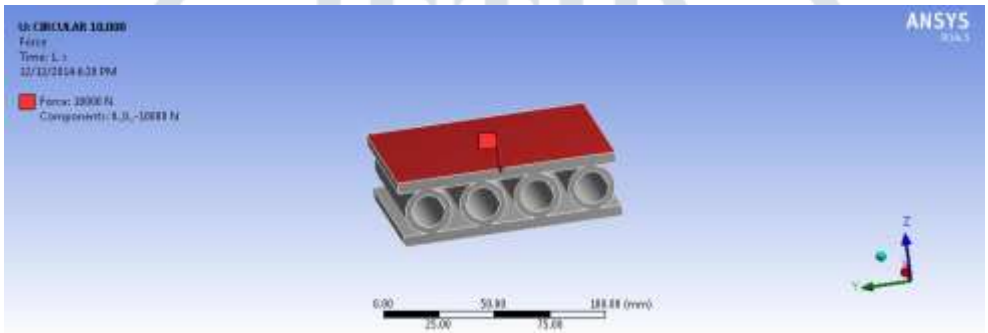

Figure 3. Position of applying force (10000N) on Circular core steel structure.

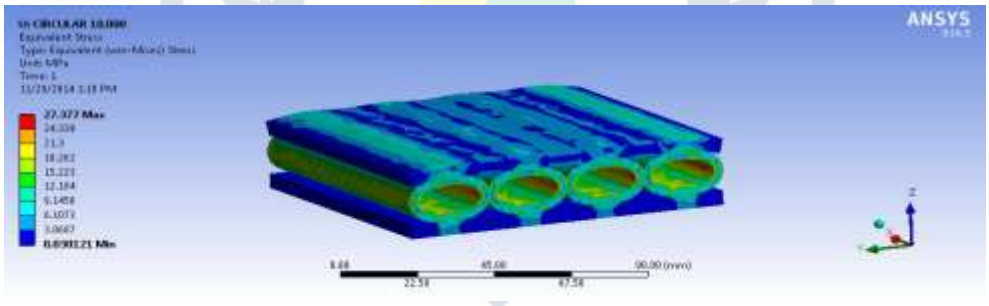

Figure 4. Equivalent stress of Circular core steel structure

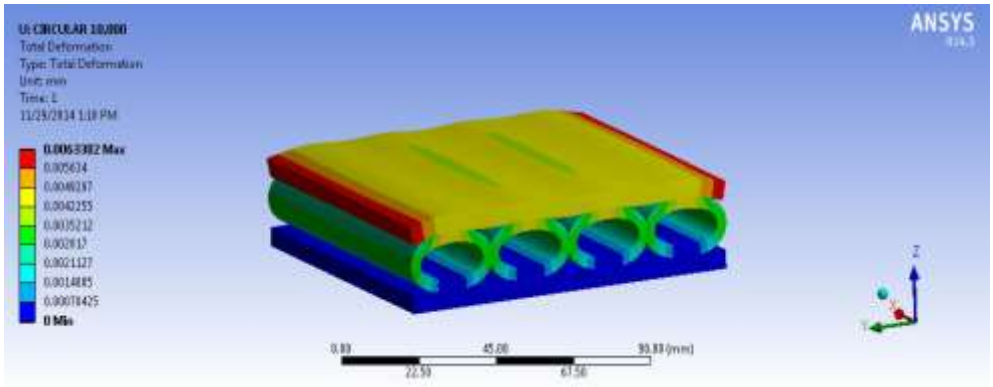

Figure 5. Total deformation of Circular core steel structure.

B. **Rectangular Core Steel Structure**

Top and bottom side plate of structure - 100mmx100mm5mm.
Core shape –Rectangular
Core Height – 20.5 mm.
Core structure – 100mmx20.5mmx3mm.

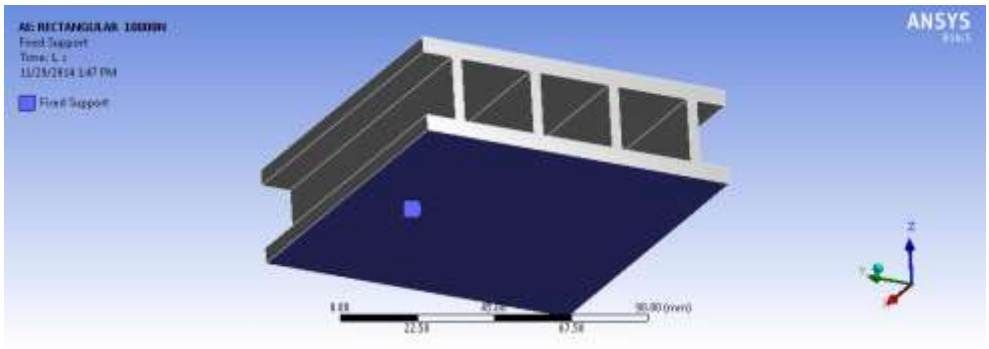

Figure 6. Position of fixing bottom plate in Rectangular core steel structure.

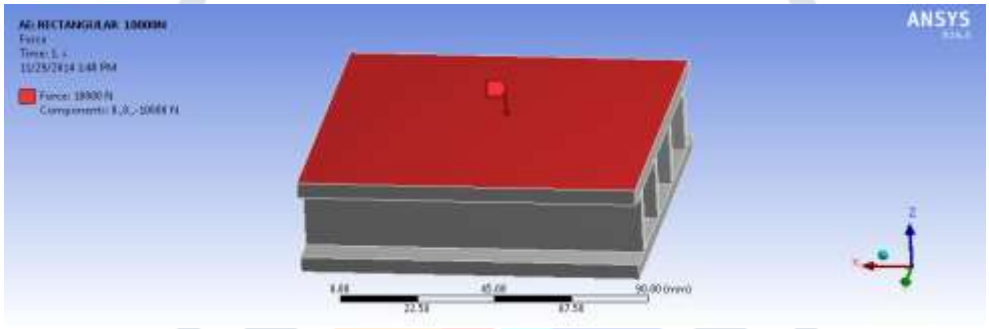

Figure 7. Position of applying force (10000N) on Rectangular core steel structure.

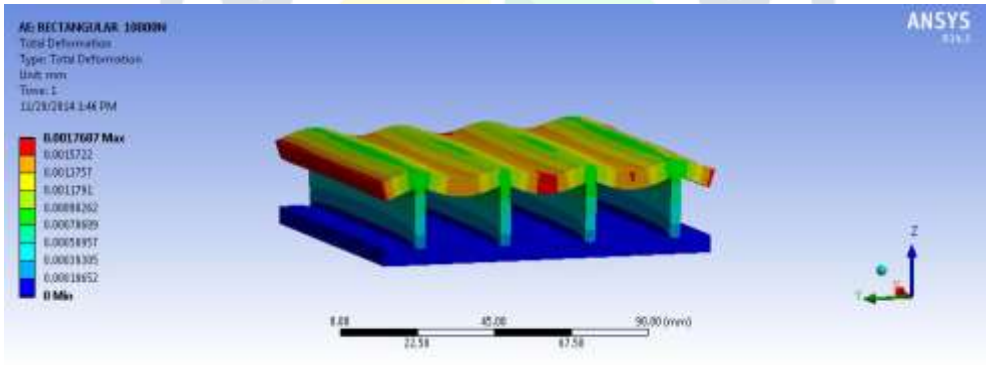

Figure 8. Total deformation of Rectangular core steel structure.

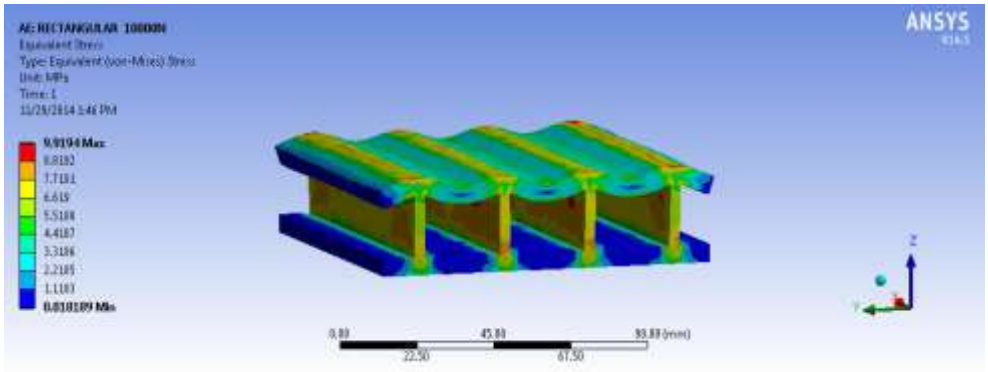

Figure 9. Equivalent stress of Rectangular core steel structure.

C. **V Core Steel Structure**

Top and bottom side plate of structure - 100mmx100mm5mm.
Core shape –V
Core Height – 20.5 mm.
Core structure - 3mm thickness.

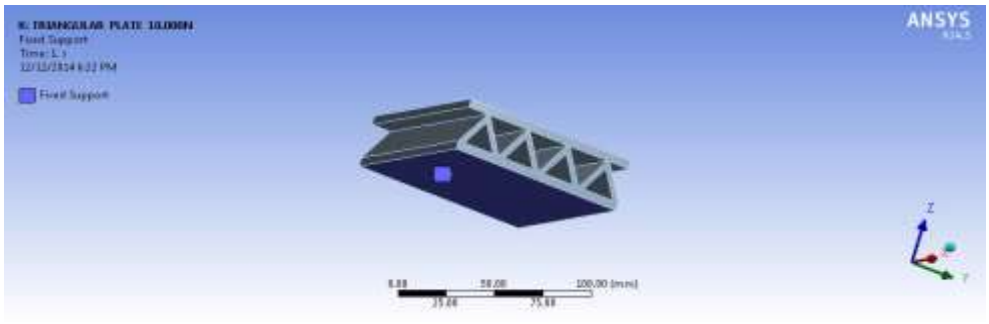

Figure 10. Position of fixing bottom plate in V core steel structure.

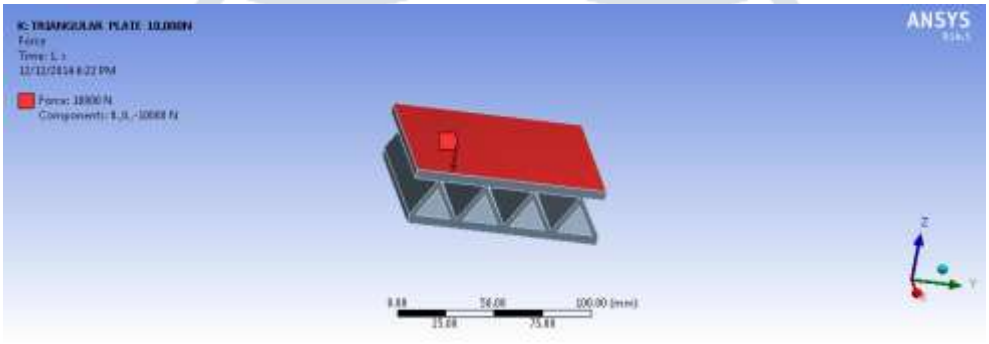

Figure 11. Position of applying force (10000N) on V core steel structure.

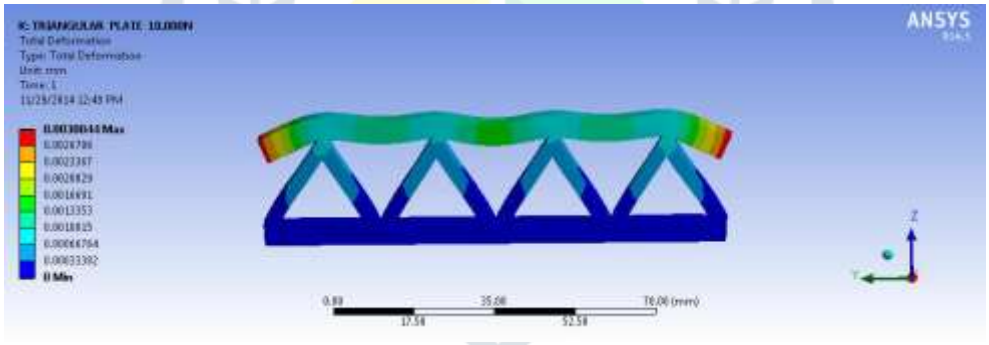

Figure 12. Total deformation of V core steel structure.

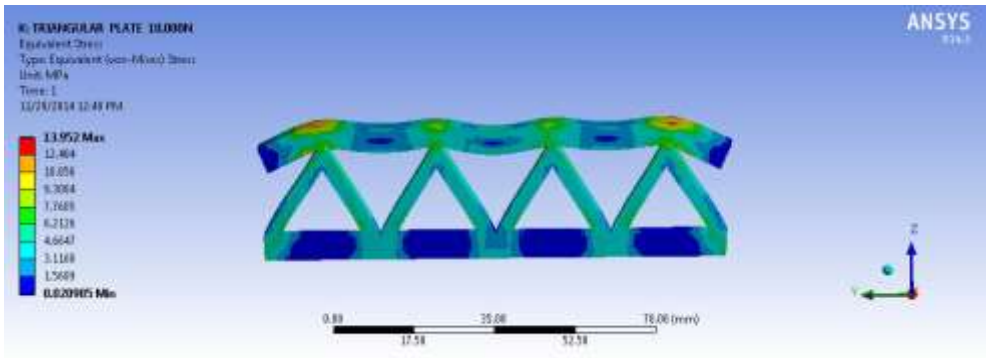

Figure 13. Equivalent stress of V core steel structure.

III. RESULT AND DISCUSSION

The table 1 shows the obtained value of total deformation of the Circular core steel structure and Rectangular core steel structure and V core steel structure for an applied force of 1000N, 5000N, and 10000N. The table 2 shows the obtained value of equivalent stress of the Circular core steel structure and Rectangular core steel structure and V core steel structure for an applied force of 1000N, 5000N, 10000N.

Table 1. Total deformation comparison of all structures

Force (N)	Circular core steel Structure Deformation (mm)	V core steel Structure Deformation (mm)	Rectangular core steel Structure Deformation (mm)
1000	0.00063382	0.00030044	0.00017687
5000	0.0031691	0.0015022	0.00088436
10000	0.0063382	0.0030044	0.0017687

Table 2. Equivalent stress comparison of all structures

Force (N)	Circular core steel Structure Equivalent Stress (Mpa)	V core steel Structure Equivalent Stress (Mpa)	Rectangular core steel Structure Equivalent Stress (Mpa)
1000	2.7377	1.3952	0.99194
5000	13.689	6.9761	4.9597
10000	27.377	13.952	9.9194

Comparative graphs of equivalent stress presented in figure-14. From the graphs, it can be observed that the equivalent stress is always lower in Rectangular core composite structure when compared with circular core steel structure and V core steel structure. At the lowest force, i.e. at 1000N the equivalent stress in circular core steel structure and V core steel structure more than that of Rectangular core steel structure. Figure-15 shows that the weight of rectangular core steel structure is lower than circular core steel structure and v core steel structure.

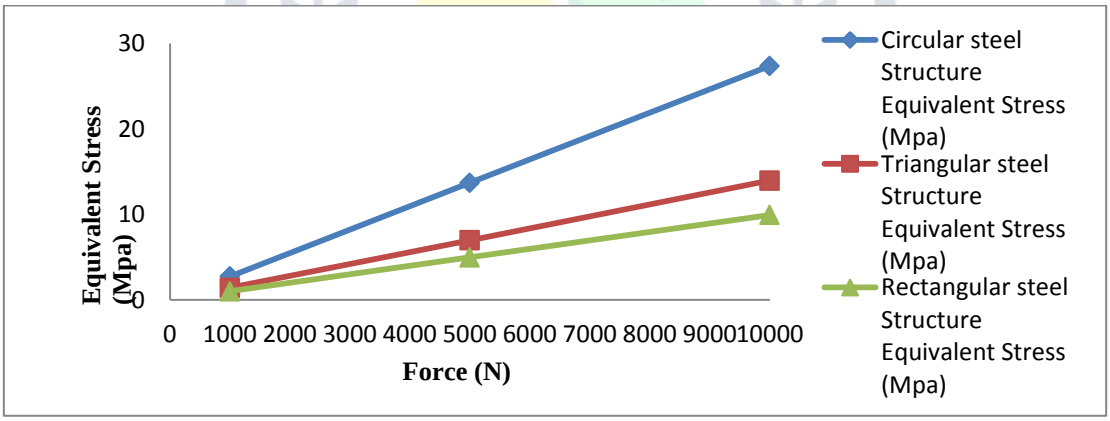

Figure 14. Force V/S Equivalent stress of all structures

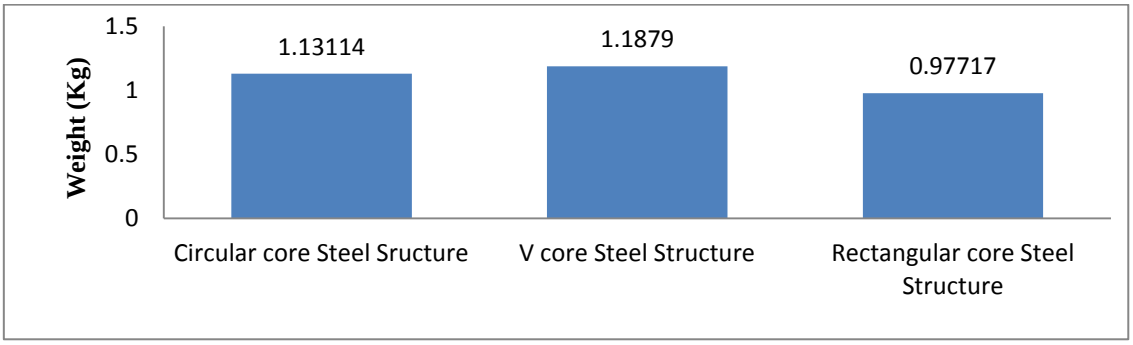

Figure 15. Weight comparison of All Structures

IV. CONCLUSION

The rectangular core steel structure, circular core steel structure and v core steel structure models in Pro-E are efficiently imported into ANSYS workbench and structural analysis is done and equivalent stress and total deformation is observed. In rectangular core steel structure the strength increases and deflection decreases effectively as compare to circular core steel structure and V core steel structure. In rectangular core steel structure equivalent stress decreases by 29-64% and total deflection is a decrease to 41-72% as compare to circular core steel structure and V core steel structure.

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