Design Analysis and Get an Optimized Solution for Lift Body Structure

Mr. Sandip Mali[1] Prof. Hredya Mishra[2]
[1,2]Jaihind College of Engineering A/p-Kuran, India

Abstract— The demand for bigger, faster and lighter moving vehicles as well as material handling systems has increased the importance of efficient structural arrangements. In principle two approaches exist to develop efficient structures: either application of new materials or the use of new structural design. A proven and well-established solution is the use of composite materials and sandwich structures. In this way high strength to weight ratio and minimum weight can be obtained. The sandwich structures have potential to offer a wide range of attractive design solutions. In addition to the obtained weight reduction, these solutions can often bring space savings, fire resistance, noise control and improved heating and cooling performance. Laser-welded metallic sandwich panels offer a number of outstanding properties allowing the designer to develop light and efficient structural configurations for a large variety of applications. These panels have been under active investigations during the last 15 years in the world.

Keywords: Lift Body Structure, FEA

I. Introduction

This construction has often used in lightweight applications such as Lift, EOT crane beam, vehicle body, aircrafts, marine applications, wind turbine blades. In principle two approaches exist to develop efficient structures either application of new materials or the use of new structural design. A proven and well-established solution is the use of composite materials and sandwich structures. In this way high strength to weight ratio and minimum weight can be obtained. The sandwich structures have potential to offer a wide range of attractive design solutions. In addition to the obtained weight reduction, these solutions can often bring space savings, noise control. Laser-welded metallic sandwich panels offer a number of outstanding properties allowing the designer to develop light and efficient structural configurations for a large variety of applications. The choice of the core depends on the application under consideration. The standard cores such as Z-, tube- and hat profiles are easier to get and they are typically accurate enough for the demanding laser welding process. The special cores, such as corrugated core (V-type panel) and I-core, need specific equipment for production, but they usually result with the lightest panels. Typically, normal strength steel is used with steel sandwich panels as buckling or displacement is the dominating failure criteria, therefore high strength steel does not usually give any major benefits. For areas with high demands for corrosion protection or easy maintenance stainless steel can be also applied.

A. *Sandwich Structure*

Sandwich panels in general can be classified as composite sandwich and metallic sandwich panels. Composite sandwich panels consist of non-metallic components such as FRP, PU foam etc.

II. Literature Review

A. Gopichand, Dr. G. Krishnaiah [1], Sandwich structures are used in applications requiring high stiffness to weight ratios because for a given weight, the sandwich structures has a much higher moment of inertia compared to solid or I-beam structures. Sandwich panels with top and bottom plates as well as the core made up of steel are called steel sandwich panels. The core structures are of different types according to core structures the steel sandwich structures are divided some of them are I-core, O- core with rectangular beams, Vf/V-core with hat or corrugated sheets as a core, web core, round O-core and X-core with two hats as a core steel sandwich structure with curved corrugated core made of mild steel and stainless steel face sheets are considered. For given length andheight of the structure increasing the number ofcurved waves (3 waves to 4 waves) the strengthincreases effectively. For increase of 4%weight, the strength is increase to 66% [1]. Kamlesh G. Ambule,Dr. Kishor P. Kolhe[2],Three components are tested by using UTM machine and ANSYS workbench. The geometry of component tested is Triangular, Square, circular component, compressed by giving loads from 1000N to 8000N. Equivalent deformation, equivalent stress & equivalent elastic strain are calculated. From the above result we are concluded that, the maximum deformation is takes place in the Square component than the triangular and the circular component. Hence the Square component is more suitable than other component at maximum loading.

Francois Cote, Russell Biagi b, Hilary Bart-Smith b, Vikram S. Deshpande[3], an experimental and analytical investigation is carried out to examine the in-plane compressive response of pyramidal truss core sandwich columns. they demonstrate via numerical optimisations that the use of a multi-layer pyramidal core can significantly enhance the performance of the pyramidal core sandwich columns and match that of the axially loaded hatstiffenedpanels. Given the transverse isotropy of the pyramidal core we expect that pyramidal core panels are an attractive option of situations where biaxial in-plane loading is significant.

A.Gopichand, Dr.G.Krishnaiah, D.Krishnaveni, Dr.DiwakarReddy.V [4], In this work numerical simulation of SPS floor with all edges clamped, subjected to uniform pressure loading is carried out in ANSYS workbench. The SPS floor simulation results are compared with traditional steel plate of with same weight, same area with same boundary conditions and loading.

JukkaSäynäjäkangas and TeroTaulavuori, Outokumpu Stainless Oy, Finland [5], The results of the studies have indicated that austenitic stainless steel grade 1.4301 (AISI 304) can be used in laser welded sandwich panels offering good mechanical properties and corrosion resistance. The use of higher strength austenitic stainless steel as sandwich panels was shown to be reasonable when substantial weight reduction of load bearing structures is desired. In addition to laser welding the development of resistance and spot welding, adhesive bonding and weld-bonding processes will increase the variety of efficient techniques in manufacturing of stainless steel sandwich structures in the future.

Narayan Pokharel1 and MahenMahendran [6], The finite element model was validated using experimental results and then used to review the current design rules. The results reveal the inadequacy of using the conventional effective width approach. It is concluded that for low b/t ratios (<100) current 23 effective width design rules can be applied, but for slender plates these rules can notbeextended in their present form. Based on the results from this study, an improved design equation has been developed considering the local buckling and postbucklingbehaviour of sandwich panels for a large range of b/t ratios (<600) for design purposes.

Prof. V. B.Ghagare, Mr. JayeshPatil, Mr. RohanPatil, Mr. RupeshPatil, Mr. RadhayPatil [7], A Sandwich panel of structural steel has more strength but it also has more weight, so our main objective is to optimize the weight with keeping the same strength as structural steel. According to our objective we check the different sandwich structure of aluminum alloy by using the ANSYS software. And based on that finally the best suited sandwich structure is selected for the replacement of Structural steel plate.The sandwich panel model into ANSYS workbench structural analysis. We analyses various sandwich structure made of aluminum alloy out of which we found that the vertical cylinder core structure panel has best optimized weight comparatively better strength. So we come to conclusion that the above vertical cylinder core structure is best suited for the replacement of structural sandwich plates.

III. FEA RESULT:

A. Boundary Condition 4000N force rectangular section Panel

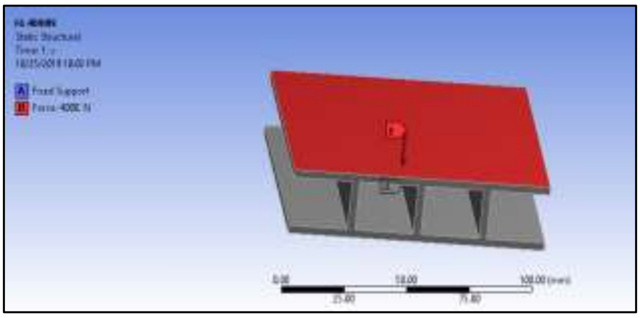

Fig. 1: Show a 4000N force applied to panel.

1) Stress

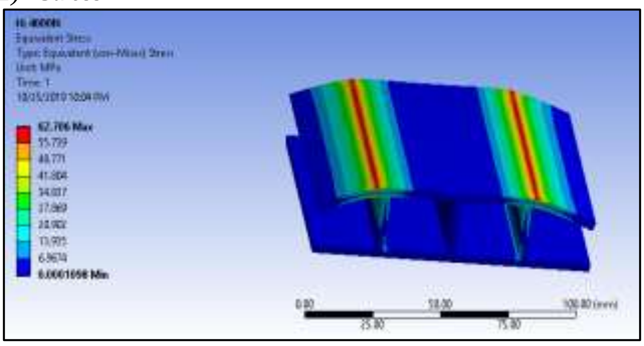

Fig. 2: Show a stress generated in panel

2) Deformation

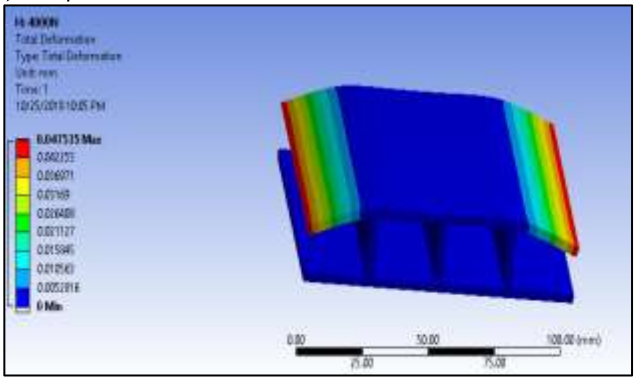

Fig. 3: Show a deformation generated in panel

B. Boundary Condition 4000N applied for Triangular section.

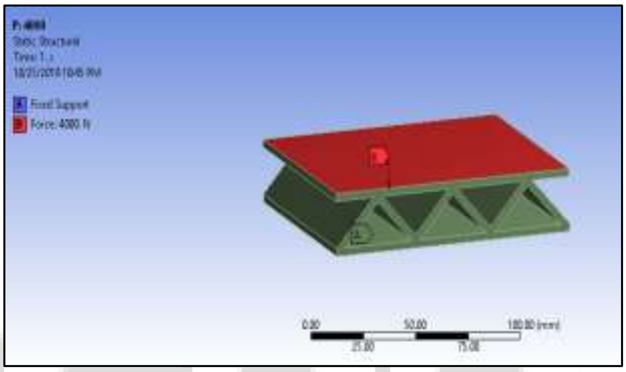

Fig. 4: Show a 4000N force applied to panel.

1) Stress

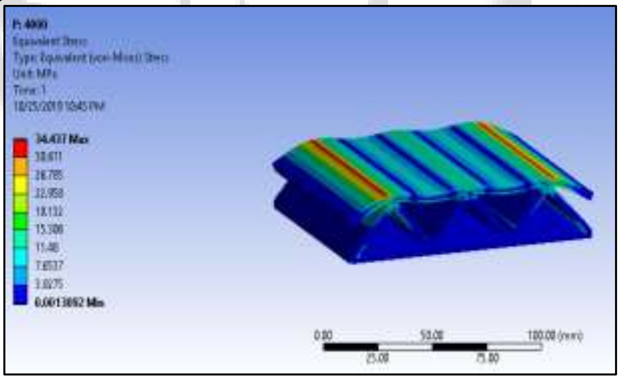

Fig. 5: Show a stress generated in panel

2) Deformation

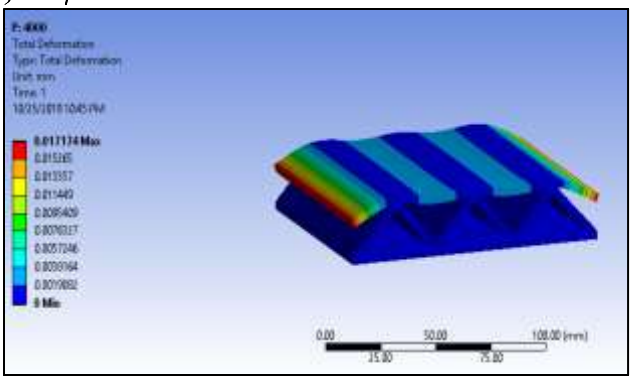

Fig. 6: Show a deformation generated in panel

C. Boundary Condition 4000N applied for circular section panel.

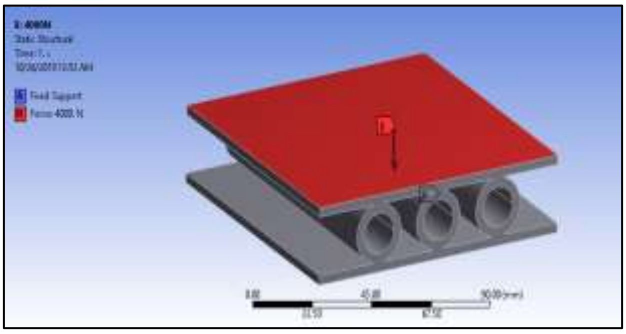

Fig. 7: Show a 4000N force applied to panel.

1) Stress

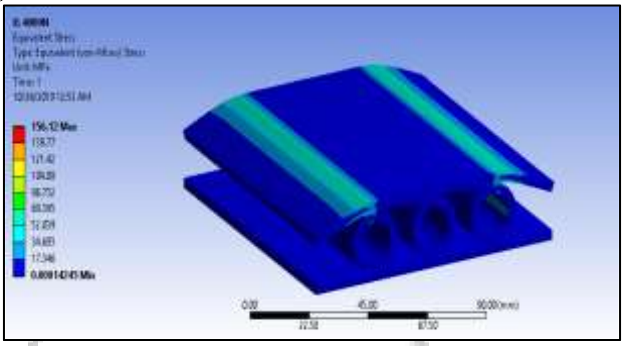

Fig. 8: Show a stress generated in panel

2) Deformation

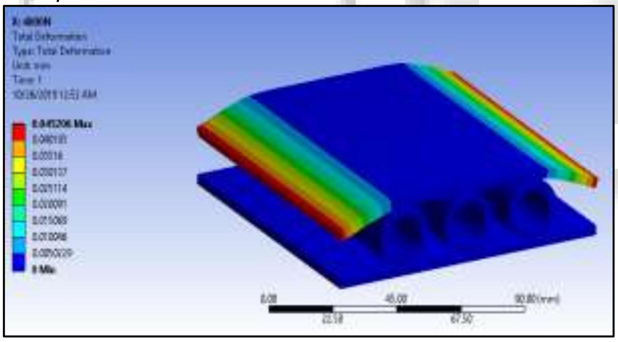

Fig. 9: Show a deformation generated in panel

IV. RESULT TABLE

Sr. No.	Section	Stress (MPa)	Deformation (mm)
1	Rectangular	62.7	0.0475
2	Triangular	34.43	0.01717
3	Circular	156.2	0.0456

Table 1: Result table of stress and deformation in all sections panel

Sr. No.	Section	Weight
1	Rectangular	0.63795 kg
2	Triangular	0.94672 kg
3	Circular	0.86869 kg

Table 2: Result table of weight of all sections panel

V. CONCLUSION

The structural models in CATIA are efficiently imported into ANSYS work bench. Structural analysis is done, maximum stress and total deflection is observed. It is observed that the minimum stress and minimum deformation is observed in Triangular steel structure when it is compare with rectangular and Circular steel structure. Weight of Triangular structure is 0.94672kg and Rectangular structure is 0.63795kg. Hence rectangular steel structure is better as compared to Triangular, circular steel structure.

REFERENCES

[1] Design and Analysis of Corrugated Steel Sandwich Structures Using Ansys Workbench 1A.Gopichand, 2 Dr.G.Krishnaiah, 3B.Mahesh Krishna, 4Dr.Diwakar Reddy.V, 5A.V.N.L. Sharma International Journal of Engineering Research & Technology (IJERT) Vol. 1 Issue 8, October – 2012.
[2] O.T. Thomson et al. (eds), sandwich structures 7; advancing with Sandwich structure and materials, 3-12
[3] Structural response of pyramidal core sandwich columns Francois Cote , Russell Biagi b, Hilary Bart-Smith b,*, Vikram S. Deshpande Department of Engineering, Cambridge University, Trumpington Street, Cambridge CB2 1PZ, UK Department of Mechanical and Aerospace Engineering, University of Virginia, 122 Engineer's Way, Charlottesville, VA 22902, USA.
[4] Numerical simulation of steel sandwich plate system (sps) floor A.Gopichand, 2Dr.G.Krishnaiah, 3D.Krishnaveni, 4Dr.Diwakar Reddy.V International Journal of Innovative Research in Science, Engineering and Technology (An ISO 3297: 2007 Certified Organization) Vol. 2, Issue11, November 2013
[5] Jukka Säynäjäkangas and Tero Taulavuori, Outokumpu Stainless Oy, Finland "A review in design and manufacturing of stainless steel sandwich panels" stainless steel world October 2004.
[6] Finite Element Analysis and Design of Sandwich Panels Subject to Local Buckling Effects. Narayan Pokharel1 and Mahen Mahendran.
[7] Pentti kujala "ultimate strength analysis of all steel sandwich panels"Rakenteiden Makaniikka,vol.31 Nrot1-2,1998,s. 32-45
[8] Tomas Nordstrand," Basic Testing And Strength Design Of Corrugated Board And Containers" Division of Structural Mechanics, LTH, Lund University, Box 118, SE-221 00 Lund, Sweden.