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MODIFICATION AND OPTIMIZATION IN STEEL SANDWICH PANELS USING ANSYS WORKBENCH

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ABSTRACT

The demand for bigger, faster and lighter moving vehicles, such as ships, trains, trucks and buses 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— Structural Analysis, ANSYS 14.5, Sandwich structure.

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 steel sandwich panels can be constructed with various types of cores as summarised in Figure 1. 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,

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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.

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.

FEA RESULT:

FIX THE SUPPORT:

In ANSYS Workbench the STP format is imported and Materials properties are given to the individual part i.e., top and bottom plates are selected and steel properties are given to them.

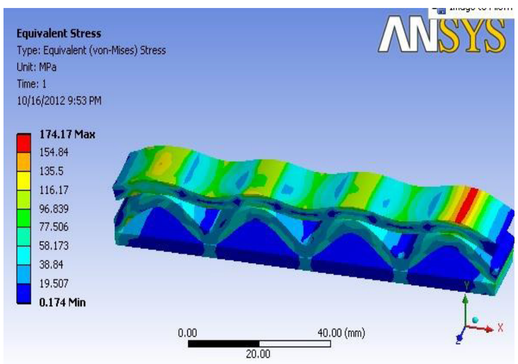

Fig. 01 Eq.stress of triangular section (Existing Model)

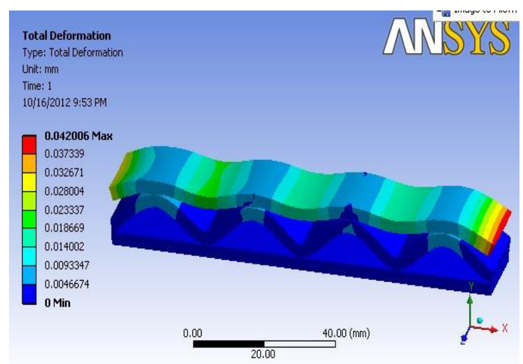

Fig.02 Def. of triangular steel structure (Existing Model)

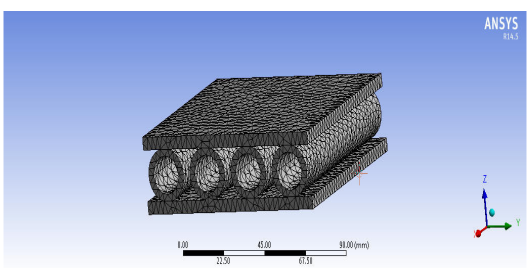

Fig.03 Meshing of circular steel structure

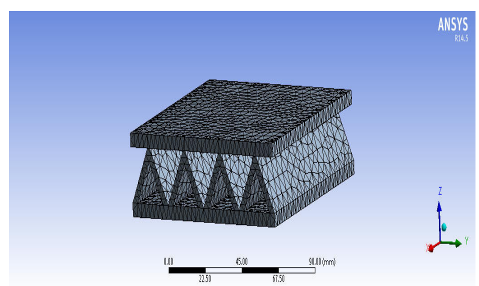

Fig.04 Meshing of Triangular steel structure

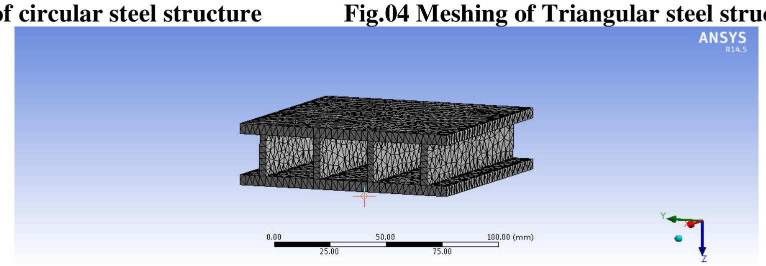

Fig.05 Meshing view of Rectangular steel structure

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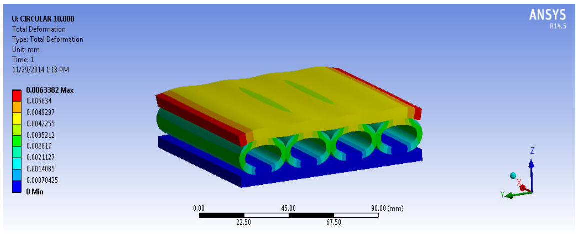


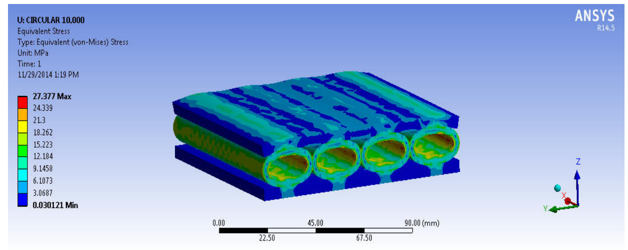
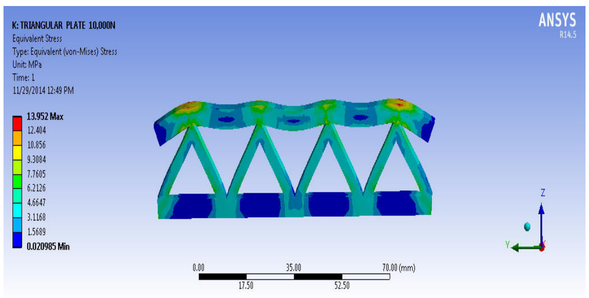


Fig.06 Total Deformation of 'O' Steel Structure Fig.07 Equivalent stress of 'O' steel section



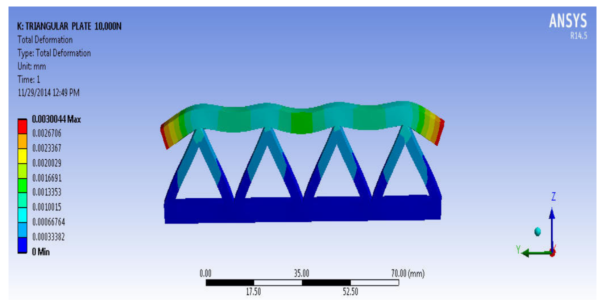
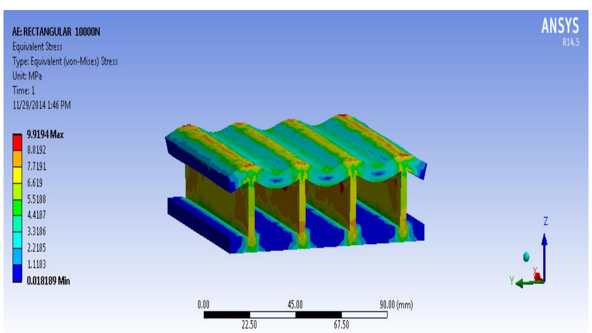


Fig.08 Equivalent stress of Δ steel structure.   Fig.09 Total Deformation of Δ steel structure.



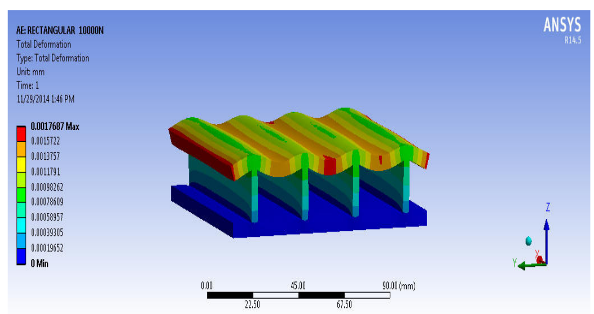


Fig.10 Equivalent Stress of '□'Steel Structure. Fig.11 Total deformation of '□'steel structure

EXPERIMENTATION
EXPERIMENTAL SETUP:

Fig.12 UTM for compression test

Plane Compression Testing of triangular steel structure was performed on universal testing machine (UTM) having capacity of 400KN.Triangular steel structure is placed between hardened end plates in order to protect surface of machine platens. Load is applied uniformly and compression strength is noted.

CALCULATION RESPONSE:-

Rectangular steel structure:
Top Plate width (w): 100mm
Top Plate length (L): 100mm
Top Plate thickness (t): 5 mm
Bottom Plate width (w): 100mm
Bottom Plate length (L): 100mm
Bottom Plate thickness (t): 5 mm
Core Plate width (w): 20.5mm
Core length (L): 100mm
Core Plate thickness (t): 9 mm
Modulus of Elasticity (E): $2.1 * 10^3$ kg/mm^2 (For steel)
Force (F) = 10000N
Top and Bottom plate material: Steel Material: Fe 410 having UTS = 410 MPA &
Syt = 235 MPA
Finding the stress of Rectangular Steel structure by using following formula
Stress = force/ Area

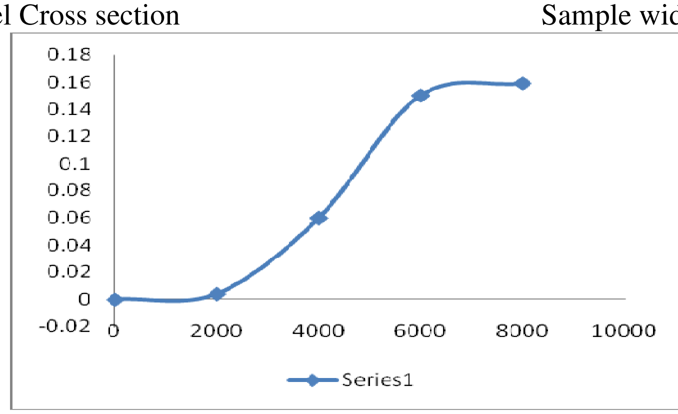
6 = F/A
=10000/1246
= 8.02 N/mm^2

Finding Total deformation of Rectangular Steel structure by using following formula.
Total Deformation (δl) = FL/AE
=10000x100/1245x210x10^3
=0.04mm

TEST REPORT

Sample code – 01 Material –M.S.

Description – Steel Cross section Sample width – 100 mm

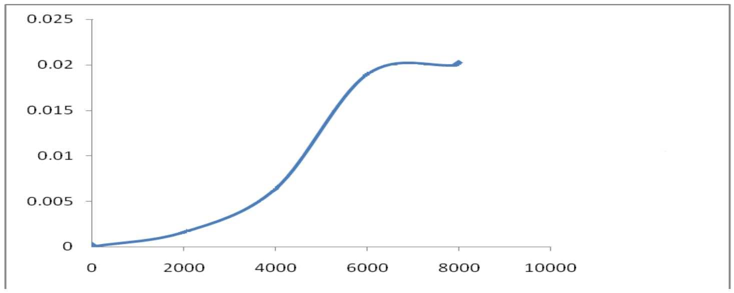


Force v/s deformation of triangular steel Structure

TEST REPORT

Sample code – 02 Material –M.S.

Description – Steel Cross section II Sample width – 100 mm

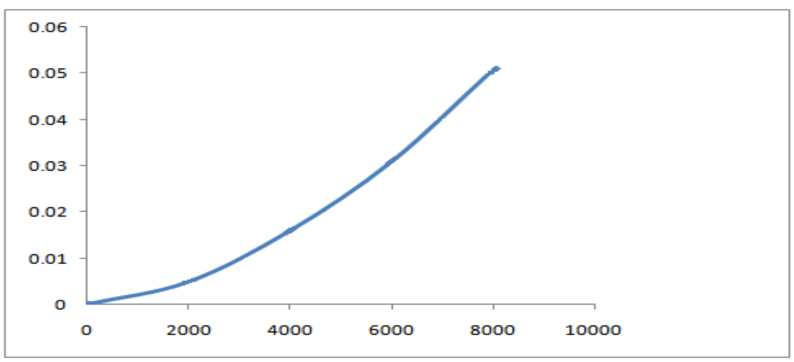


Force v/s deformation of rectangular steel structure

TEST REPORT

Sample code – 03 Material – M.S.

Description – Steel Cross section O Sample width – 100 mm



Force v/s deformation of circular steel structure

CONCLUSION:

The structural models in CATIA are efficiently imported into ANSYS work bench. Structural analysis is done, maximum stress and total deflection is observed. The weight of Rectangular steel structure is 0.97717 kg is small as compared to other two steel structures. It is observed that the minimum stress and minimum deformation is observed in rectangular steel structure when it is compare with Triangular and Circular steel structure. Hence rectangular steel structure is better as compared to Triangular, circular steel structure.

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