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Weight Optimization of Lift Platform by Using Composite Shape Structures

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Abstract: *In this Optimization study, design and analyses of Sandwich structures are investigated for industrial lift platform. Primary goal is to develop a best cross section of structure material model that is a good substitute for the actual Section core. By replacing the actual Section base structure with the other three cross section model in CATIA, during the FEA in ANSYS, we get a advantages can be obtained with 3D modeling and model modification, solution time and hardware resources. To find out the best equivalent or better model among the approximate analytical models that can be found in the literature, a comparison is made. Three models are analyzed under the same loading and the boundary conditions. In finite element analyses, ANSYS finite element program is used. Also we manufacture all models as per sample and test it on UTM. The results are compared to find out the best cross section model. After selection of best model we apply this to lift platform and compared this to original lift platform*

Keywords: CATIA, ANSYS, Optimization, Sandwich Panel

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 structural design. A proven and well-established solution is the use of sandwich structures. In this way high strength to weight ratio and minimum weight can be obtained. The sandwich structures have 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. These panels have been under active investigations during the last 15 years in the world.Light Structures Technology Program, investigated manufacturing, design and design optimization of steel sandwich panels. The European research project SANDWICH joined forces between the main actors in Europe and continued the development based on previous national projects. The project aimed at enlarging the field of applications of sandwich panels in various surface transport sectors, by further improving the sandwich panel properties by implementing local filling material into the panels, developing and validating reliable design formulations within the design tool.This study focuses on steel sandwich panels welded by laser. The steel sandwich panels can be constructed with various types of cores as summarized 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, but they usually result with the lightest panels.

II. LITERATURE REVIEW

Gopichand, Dr. G. Krishnaiah [1] [2012**]**,a structural sandwich consists of two thin face sheets made from stiff and strong relatively dense material such as metal or fiber composite bonded to a thick light weight material called core. This construction has often used in lightweight applications such as aircrafts, marine applications and wind turbine blades. In this study the structural analysis of corrugated sand which panel with stainless steel faces sheets and mild steel as core is done using ANSYS work bench and compressive strength is compared with experimental value. The model of the curved corrugated core is done in pro/E and the effect of wave length on strength to weight ratio is analyzed. The sandwich panel model in PRO/e is efficiently imported into ANSYS work bench structural analysis is done and max stress is observed at top face.

Kamlesh G. Ambule,Dr. Kishor P. Kolhe[2] [2016**],** the demand for bigger, faster and lighter moving vehicles, such as ships, trains, 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 panels. In this way more strength to weight ratio and minimum weight can be obtained. The sandwich structures have potential to offer a many range of attractive design solutions. In addition to the obtained wt. 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 variety of applications. These panels have been under active Investigations during the last lots of years in the world. Out okumpu has been participating in several collaborative projects in this area. In Finland the research related to all steel sandwich structure was initiated in 1988 in the Ship Laboratory of Helsinki University of Technology. 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] [2007**],** an experimental and analytical investigation is carried out to examine the in-plane compressive response of pyramidal truss core sandwich columns. The identified failure mechanisms include Euler buckling, shear buckling and face wrinkling. The operative mechanism is dependent on the properties of the bulk material and geometry of the sandwich columns and analytical formulae are derived for each of these modes. Failure maps are constructed for sandwich columns made from an elastic ideally-plastic material and AISI 304 stainless steel which has a strongly strain hardening response.

A. Gopichand, Dr. G. Krishnaiah, D. Krishnaveni, Dr. Diwakar Reddy.V[4] [2013**]**, steel Sandwich Plate Systems (SPS) have been used for commercial applications during the last 15 years. Stairs & staircase landings, bulkheads and decks are the main application areas of metallic sandwich panels in cruise ships and in other marine applications. In recent years a wide variety of applications of stainless steel sandwich panels are used in civil and mechanical engineering as well as in other industrial sectors. These include floors of buses, walls and floors of elevators, working platforms in industrial applications and balconies of shipyard. The sandwich structures have potential to offer wide range of attractive design solutions. The steel sandwich structure offer high strength to weight ratio, noise control, high stiffness etc if compared to traditional steel plate flows. 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] [2004**],** 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. Outokumpu has been participating in several collaborative projects

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in this area. In Finland the research related to all steel sandwich panels was initiated in 1988 in the Ship Laboratory of Helsinki University of Technology.

Narayan Pokharel1 and MahenMahendran [6] [2004**],** past research into the local buckling behavior of fully profiled sandwich panels has been based on polyurethane foams and thicker lower grade steels. The Australian sandwich panels use polystyrene foam and thinner and high strength steels, which are bonded together using separate adhesives. Therefore a research project on Australian sandwich panels was undertaken using experimental and finite element analyses. The experimental study on 50 foam-supported steel plate elements and associated finite element analyses produced a large database for sandwich panels subject to local buckling effects, but revealed the inadequacy of conventional effective width formulae for panels with slender plates. It confirmed that these design rules could not be extended to slender plates in their present form.

Prof. V. B. Ghagare, Mr. JayeshPatil, Mr. RohanPatil, Mr. RupeshPatil, Mr. RadhayPatil [7] [2017], sandwich plates are composed of face plates which are separated by core material. They are usually designed in such a way that the face plates carry the bending and in-plane loads. The core is designed to carry longitudinal loads. The face plates and core can be selected from metals such as structured steel or aluminum alloy but the core can also possess various sandwich structures such as O-core, I-core, Web Core, I-Core, I-Core etc. Sandwich panels with top and bottom plates as well as the core anavta made up of aluminum are called as aluminum sandwich panel. In this study sandwich structure is made up of aluminum alloy.

Tomas Nordstrand [8] [1998**],** packaging serves a lot of purposes, and would be hard to do without. Packaging protects the goods during transport, saves costs, informs about the product, and extends its durability. A transport package is required to be strong and lightweight in order to be cost effective. Furthermore, it should be recycled because of environmental and economical concerns. Corrugated board has all of these features. This thesis is compiled of seven study that theoretically and experimentally treat the structural properties and behavior of corrugated board and containers during buckling and collapse. The aim was to create a practical tool for strength analysis of boxes that can be used by corrugated board box designers. This tool is based on finite element analysis. The first studies concerned testing and analysis of corrugated board in three-point bending and evaluation of the bending stiffness and the transverse shear stiffness.

Objectives

The major objective of the proposed research work is to enhance the equivalent stress at minimum weight

- To propose a material which sustain maximum possible strength at minimum weight.
- Analyze Effect of equivalent stress on composite structure.
- Analyze Effect of weight on composite structure.
- Compare the numerical, experimental result with FEA analysis result.

IV. METHODOLOGY

FINITE ELEMENT ANALYSIS

Boundary Condition 4000N for rectangular cross section

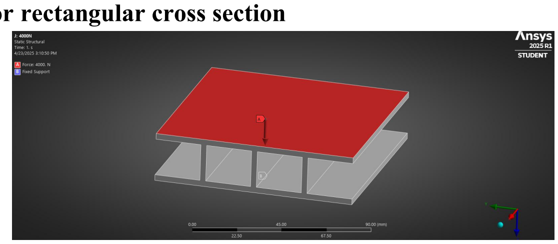

Fig.2. Boundary Condition (4000N) applied on rectangular cross section in ANSYS

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Stress

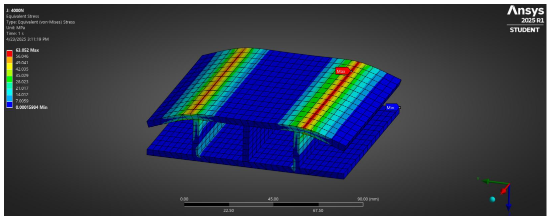

Fig.3. Stress due to applied load of 4000N on rectangular cross section in ANSYS

Deformation

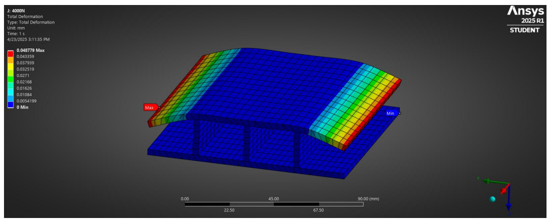

Fig.4. Deformation due to applied load of 4000N on rectangular cross section in ANSYS

Boundary Condition 4000N for triangular cross section

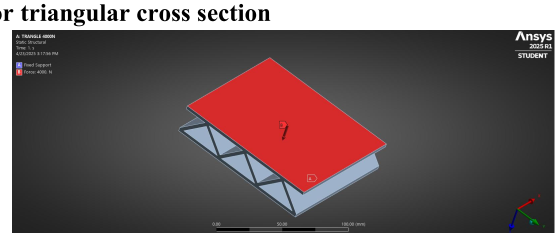

Fig.5. Boundary Condition (4000N) applied on Triangular cross section in ANSYS

Stress

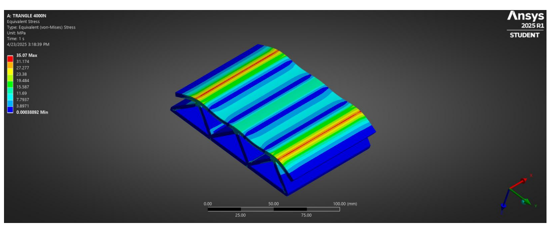

Fig.6. Stress due to applied load of 4000N on Triangular cross section in ANSYS

Deformation

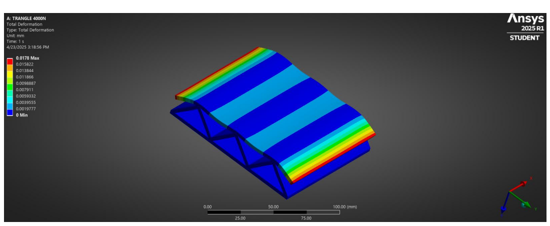

Fig.7. Deformation due to applied load of 4000N on Triangular cross section in ANSYS

Boundary Condition 4000N for Circular cross section

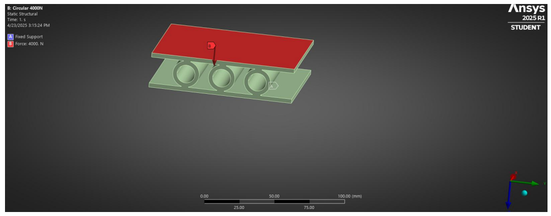

Fig.8. Boundary Condition (4000N) applied on Circular cross section in ANSYS

Stress

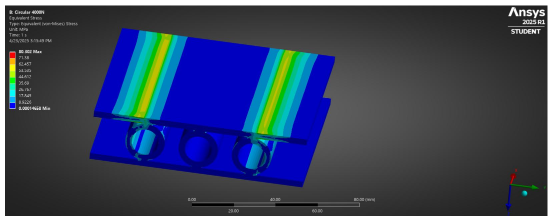

Fig.9. Stress due to applied load of 4000N on Circular cross section in ANSYS

Deformation

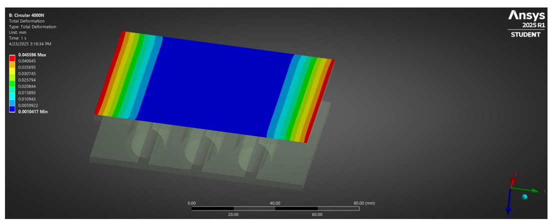

Fig.10. Deformation due to applied load of 4000N on Circular cross section in ANSYS

PRACTICAL TESTING

A universal testing machine (UTM), also known as a universal tester, materials testing machine or materials test frame, is used to test the tensile strength and compressive strength of materials. An earlier name for a tensile testing machine is a tensometer. The "universal" part of the name reflects that it can perform many standard tensile and compression tests on materials, components, and structures.

Fig. 11 UTM Testing Machine

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V. RESULT

Table No.1- UTM test result for stress and deformation

Sr. No.	Shape	Stress (MPa)	Deformation (mm)
1	Rectangular	63.052	0.048779
2	Triangular	35.052	0.0171
3	Circular	80.302	0.04559

UTM Result

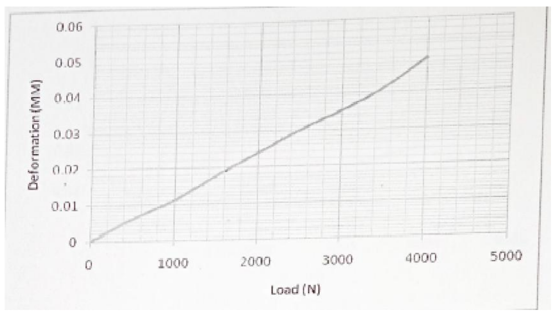

Fig. 12 load Vs Deformation for rectangular cross section

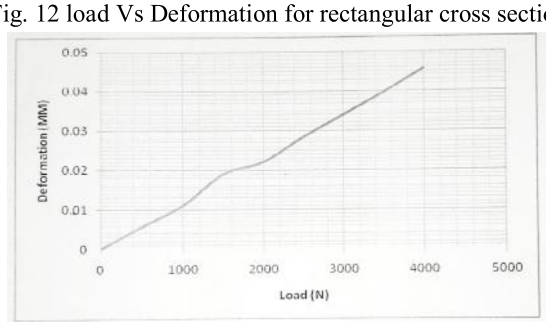

Fig. 13 Load Vs Deformation of Circular cross section

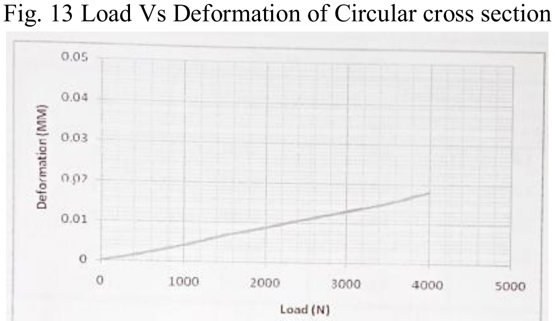

Fig. 14 Load Vs Deformation of Triangular cross section

VI. FUTURE SCOPE

The core with Composite material is to be developed for the light weight applications.

Properties like resistance to heat penetration, fatigue strength and resistance to impact loads may be considered in developing sandwich panels. Stiffness and strength analysis of curved.

The behavior of sandwich panel under the dynamic loading condition is to be done.

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