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A REVIEW PAPER ON WEIGHT OPTIMIZATION OF INDUSTRIAL LIFT PLATFORM BY USING COMPOSITE STRUCTURE

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Abstract- In this project CATIA is used as CAD software while ANSYS is used for analysis of equivalent stress and total deformation. This study different cross section for weight optimization of industrial lift. However, in the mind of the consumers, the products may be too similar and more expensive products may be perceived to be cheaper. The analysis has been performed keeping in mind that usefulness and the necessity of using composite structure. This allows for the use of composite structure within the available space resulting in versatility and economy. A vehicle platform is a general term; the needs of operation vary by the conditions of operation. i. e. the transport fluid properties, operating temperature, operating pressure, etc. The conditions of operation dictate the design of the optimization whereas the environment dictates the material and maintenance requirements. the deflection, equivalent stress and self-weight of investigated Triangular, Rectangular and Circular composite structure and Triangular, Rectangular and Circular Aluminum Alloy structure. The Equivalent Stresses total deformation of Rectangular Aluminum Alloy structure is also small as compare to Triangular, circular Aluminum Alloy structure. The minimum stress and minimum deformation is observed in rectangular composite structure when it is compare with Triangular, Rectangular composite structure

Index Terms- versatility and economy, optimization.

I. INTRODUCTION

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. and are typically applied as load carrying structures in naval vessels and leisure yachts, and mainly as non-load carrying elements on merchant and large cruise ships. For metallic sandwich panels there are basically two types of panels: panels with metallic face plates and bonded core such as SPS panels and panels with both metallic face plates and core welded together. The metal material can be either regular, high tensile or stainless steel, or aluminum alloys. This paper 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. Naturally, during the production process or after welding of faceplates plates and core together, the steel sandwich panels can also be filled with some polymer, mineral or rock wool, concrete etc. to improve the behavior for specific targets. All kinds of sandwich panels have a number of common benefits, like good weight to stiffness ratio, high pre-manufacturing accuracy etc. and problems, e.g. integration in a ship structure, while the various variants also show a number of specific advantages and disadvantages. Steel sandwich is relatively light and the total costs are very competitive to other light structures solutions.

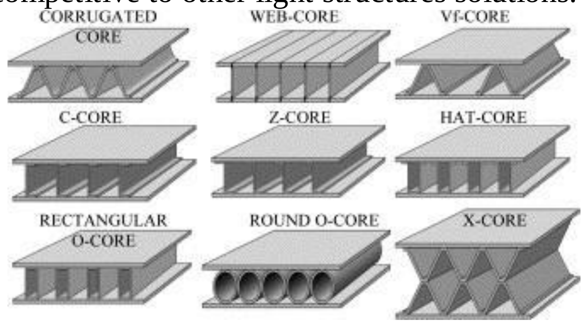

Figure 1: Different sandwich structure with various cores.

1.1 PROBLEM STATEMENT

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 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. Steel sandwich panels can offer 10-25 % weight savings compared to the conventional steel structures. The work carried out includes development of design formulations for the ultimate and impact strength, analysis of strength for the joints, and development of solutions to improve the behavior under fire. A number of research projects both at the national and European level have been ongoing. A summary of the applications, main benefits and problem areas of the panels as well as available design tools are given. For weight and cost optimization is also presented proving some of the described benefits of all steel sandwich panels.

1.2 OBJECTIVE

Following are the major objectives of Project.

1. The major objective of the proposed research work is to enhance the equivalent stress at minimum weight
2. To propose a material which sustain maximum possible strength at minimum weight
3. Analyze Effect of equivalent stress on composite structure.
4. Analyze Effect of weight on composite structure.
5. Compare the numerical, experimental result with FEA analysis result.

II. LITERATURE REVIEW

Gopichand, Dr. G. Krishnaiah [1] [2012], 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. Thecore 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 and height of the structure increasing the number of curved waves (3 waves to 4 waves) the strength increases effectively. For increase of 4%weight, the strength is increase to 66% [1].

Kamlesh G. Ambule,Dr. Kishor P. Kolhe[2] [2016], 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 measured collapse loads are in reasonable agreement with the predictions in most cases. However, significant discrepancies between the measurements and predictions are observed in some cases: these discrepancies are attributed to imperfections in the specimens—the effect of imperfections on the response of the sandwich columns is suggested as a topic for future work. The analytical formulae areemployed to conduct a numerical optimization in order to determine sandwich column designs that carry a given load at minimum weight. The optimizations indicate that the solid material properties, viz. an ideally plastic response versus a strongly strain hardening response strongly influences both the load carrying capacity and optimal design of the columns and the pyramidal core sandwich columns have a performance comparable to axially loaded hat-stiffened panels at low collapse loads. However, the axially loaded hat-stiffened panels out-perform the sandwich columns at high loads due to the weak face wrinkling collapse mode of the sandwich columns. We 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] [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], In this article the results of the earlier mentioned R&D work in steel sandwich structures and applications is summarized from the stainless steel material point of view. The research related to design and design optimization of steel sandwich panels has been summarized by Romanoff and Kujala (2003).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] [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. In this research, experimental and numerical results were used to improve the design rules. This paper presents the details of experimental and finite element analyses, their results and the improved design rules. An extensive series of experiments and finite element analyses was conducted to investigate the local buckling behavior of foam supported steel plate elements. Appropriate finite element models were developed to simulate the behaviorof foam-supported steel plate elements used in the laboratory experiments as well as sandwich panels used in various building structures. 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 cannot be extended in their present form. Based on the results from this study, an improved design equation has been developed considering the local buckling and post buckling behavior 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] [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 made up of aluminum are called as aluminum sandwich panel .In this paper sandwich structure is made up of aluminum alloy. This construction has often used in lightweight applications such as aircrafts, marine applications and wind turbine blades. Sandwiched panels have advanced High stiffness and strength to weight ratio and in this work various sandwiched structure is applied to optimize the weight of lifting platform. 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 outof 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.

Tomas Nordstrand[8] [1998],This is compiled of seven papers that theoretically and experimentally treat the structural properties and behavior of corrugated board and containers during buckling and collapse. It was shown that evaluated bending stiffness agrees with theoretically predicted values. However, evaluation of transverse shear stiffness showed significantly lower values than the predicted values. The predicted values were based on material testing of constituent liners and fluting prior to corrugation. Earlier studies have shown that the fluting sustains considerable damage at its troughs and crests in the corrugation process and this is probably a major contributing factor to the discrepancy. Furthermore, the block shear method seems to constrain the deformation of the board and consistently produces higher values of the transverse shear stiffness than the three-point-bending test. It is recommended to use the latter method. Further experimental studies involved the construction of rigs for testing corrugated board panels under compression and cylinders under combined stresses. The panel test rig, furnishing simply supported boundary conditions on all edges, was used to study the buckling behavior of corrugated board

Aydıncak, İlke[9] [2012],Sandwich theory will be introduced and the material properties of the honeycombs will be investigated. Geometric and finite element modeling of the honeycomb structures will be explained and the different approaches in modeling will also be discussed. In addition, honeycomb cores that are subjected to analyses are introduced here. Information on equivalent modeling, candidate equivalent models, and meshing, loading and boundary conditions is given. Results of the analyses performed for the determination of the study will be supplied, alongside the problems encountered and solutions proposed, and finally the “best” equivalent model will be chosen. Chapter, a case study is performed in order to demonstrate the application of equivalent model; subsequently, the results are supplied. Finally, in the last chapter, conclusion of the studies is given and researchers interested in the subject matter are encouraged to do further work.

Pentti Kujala[10] [1998],the research related to ultimate strength of all steel sandwich panels at the ship laboratory of HUT is reviewed in this paper. The studies include laboratory strength testing, numerical FEM analysis and development of design formulation for this panels the ultimate strength is analyzed under the hydrostatic loading and under local point Loading. Three cases be classified for the collapse mode for large loading areas and for small core plate thickness elastic buckling of the core plate is dominating collapse modes for thicker plate core welding and buckling are causing the failure the third type of collapse mode occurs when the face plate is thin, then the applied ultimate load causes high compressive bending stress on the face plate causing face plate buckling before the collapse of the core plate.

III. LIMITATIONS OF COMPOSITES

Some of the associated disadvantages of advanced composites are as follows:

1. Transverse properties may be weak.
2. Matrix is weak, therefore, low toughness.
3. Reuse and disposal may be difficult.
4. Difficult to attach.
5. Repair introduces new problems, for the following reasons:
6. Hot curing is necessary in many cases requiring special tooling.

IV. CONCLUSIONS

A welded Mild steel sandwich panels have big potential in wide range of attractive design solutions. The correct design of the details of the sandwich constructions is of great importance as well as the analysis of deflections, stresses and buckling loads. Joint of sandwich panel to other sandwich panels or to other structures is one of the key elements in the practical applications of these constructions

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