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STUDY ANALYSIS OF METAL BENDING IN A SHEET METAL USING FINITE ELEMENT METHOD

S. Anil Kumar[1], T. Mohan Kumar[2], D. Dhanasekar[3], K. Chidhambaram[4]

[1,2,3,4]*Assistant Professor, Department of Mechanical Engineering, Adhiparasakthi College of Engineering, Vellore, Tamilnadu, India*

Abstract - *This dissertation deals with the bending analysis of Aluminium sheet metal and Aluminium Sandwich panels. Such Sandwich materials are recently increasingly used in airplane and automobile structures. Laminates of varying material with Aluminium sheet metal is analyzed using Finite Element Method using ANSYS workbench. The deformation and stress distribution are analyzed using simulation. The Sandwich panels has been found to exhibit better bending resistance to bending force and damage resistance than the unidirectional Aluminium plate from bird aircraft strike hazard. In Addition to Aluminium, materials like Polypropylene, Polystyrene, Carbon fiber and Glass fiber are added as a core. On an overall basis, the Sandwich panels exhibited better resistance to external force than the Monolithic Aluminium. The Sandwich materials of same thickness are recommended in place of Aluminium sheet due to their better resistance.*

Key Words: Aluminium Sandwich panels, Bending analysis.

1. INTRODUCTION

Bending is a metal forming process in which a force is applied to a piece of sheet metal causing bending and forming the desired shape. Bending is typically performed in the sheet metal and sandwich panels. The sheet metal is located between the fixed end. In centre of the sheet metal the force of 5000 Newton is acted and the stress distribution, deformation is analyzed in the ANSYS workbench is formulated for total deformation and stress and the results are compared.

Bending is a process by which metal can be deformed by plastically deforming the material and changing its shape. The material is stressed beyond the yield strength but below the ultimate tensile strength. The surface area of the material does not change much. Bending usually refers to deformation about one axis. In engineering mechanics, bending (also known as flexure) characterizes the behavior of a slender structural elements subjected to an external load applied perpendicularly to a longitudinal axis of the element. The structural element is assumed to be such that at least one of its dimensions is a small fraction, typically 1/10 or less, of the other two. When the length is considerably longer than the width and the thickness, the element is called a beam. For example, a closet rod sagging under the weight of clothes on clothes hangers is an example of a beam experiencing bending. On the other hand, a shell is a structure of any geometric form where the Length and the width are of the same order of magnitude but the thickness of the structure (known as the 'wall') is considerably smaller. A large diameter, but thin-walled, short tube supported at its ends and loaded laterally is an example of a shell experiencing bending. In the absence of a qualifier, the term bending is ambiguous because bending can occur locally in all objects. To make the usage of the term more precise, engineers refer to the bending of rods, the bending of beams, the bending of plates, the bending of shells and so on. In this project we are going to analyze aluminum sheet metal and its sandwich panels of aluminum in which core are changed as polystyrene, polypropylene, glass fiber, carbon fiber.

2. SANDWICH PANEL

A sandwich panel is any structure made of three layers: a low-density core, and a thin skin-layer bonded to each side. Sandwich panels are used in applications where a combination of high structural rigidity and low weight is required.

Sandwich panels are an example of a sandwich structured composites: The strength and lightness of this technology makes it popular and widespread. Its versatility means that the panels have many applications and come in many forms: the core and skin materials can vary widely and the core may be a honeycomb or a solid filling.

3. LITERATURE REVIEW

S.M. Bapat and Dessai Yusufali (2014) have investigated on the design and optimization of a 30 ton hydraulic forming press machine. The work done in this paper shows that analysis of the frame structure in terms of its material, geometry and stressed induced in it. Metal forming is one of the manufacturing processes which are almost chip less. In this paper they focused on the causes of structural failure problem in the machine because hydraulic press continuously deals with the stress that may be

compressive or tensile for that press machine always works under impact load condition and because of impact load the hydraulic press always experienced continuous stress .it is studied that different components of the machine are subjected to different types of loading condition and are analyzed by using FEM tool ANSYS. Weight optimization of press frame and upper head is done, which in turn reduces in thickness of the frame structure and material.

Rajesh et. al. (2017) analyzed the thermal properties by varying geometry, material (Cu and Al alloy 6082), distance between the fins and thickness of cylinder fins. The Fins models are created by varying the geometry circular and also by varying thickness of the fins for both geometries.

Jain et. al. (2017) analyzed the thermal heat dissipation of fins by varying its geometry. Parametric models of fins have been developed to predict the transient thermal behavior. There after models were created by varying the geometry such as rectangular, circular.

4. CORE MATERIALS

The core materials used are polypropylene, polystyrene, carbon fibre and glass fibre.

5. OBJECTIVE

It is observed Hand lay-up methods used widely in fabrication of Polymer composite. Also, some researcher used Centrifugal molding, Pultrusion molding, etc. Inorganic filler used as reinforcing particles in development of natural filler reinforced epoxy based composite. Cost and quality control of natural filler reinforced composite is the major stone to use as alternative material by product designer and manufacturers. Application of natural filler reinforced composite is very wide like as aerospace, automobile, construction, decking, etc. This study deals with the optimization problem concerning with sandwich panels is investigated by simultaneously considering the two objectives of the project is to find an alternate for aluminum sheet and analyzing the stress distribution in sandwich panels. first of all strongest polymer are recommended as a core material and deformation is carried out and best alternative is recommended. Focus on unsteady heat analysis of fin model.

6. GLASS FIBER:

Bidirectional glass fibers have been the standard within the aerospace industry for many years, the fiber is typically impregnated with thermosetting resins. Tape products have high strength in the fiber direction and virtually no strength across the fibers.

7. MATERIAL PROPERTIES:

Mechanical strength: Fiberglass has a specific resistance greater than steel. So, it is used to make high-performance.

Electrical characteristics: Fiberglass is a good electrical insulator even at low thickness.

Incombustibility: Since fiberglass is a mineral material, it is naturally incombustible. It does not propagate or support a flame. It does not emit smoke or toxic products when exposed to heat.

Dimensional stability: Fiberglass is not sensitive to variations in temperature and hygrometry. It has a low coefficient of linear expansion.

Compatibility with organic matrices: Fiberglass can have varying sizes and has the ability to combine with many synthetic resins and certain mineral matrices like cement.

Non-rotting: Fiberglass does not rot and remains unaffected by the action of rodents and insects.

Thermal conductivity: Fiberglass has low thermal conductivity making it highly useful in the building industry.

Dielectric permeability: This property of fiberglass makes it suitable for electromagnetic windows.

8. PROBLEM DEFINING

A bird strike sometimes called bird strike, bird ingestion (for an engine), bird hit, or bird aircraft strike hazard (BASH) is a collision between an airborne animal (usually a bird or bat) and a manmade vehicle, especially an body of the aircraft. It affects the body of the aircraft badly. Monolithic Aluminium 6061 sheet metal of thickness 6.35 mm is used in the body for aircraft due to non corrosive properties.

Alternating material of sandwich panels made of Al6061/polypropylene/Al6061, Al6061/polystyrene/Al6061, Al6061/glassfibre/Al6061, Al6061/carbonfibre/Al6061 of same thickness are analysed using ANSYS WORKBENCH.

9. METHEDOLOGY

Software used: ANSYS workbench 15.

As it is a finite element analysis the pre-processing, simulation and post-processing steps are carried out.

Sheet metal, fixed at two ends and dimensions of their geometry are set and meshed and eventually simulation process is carried out.

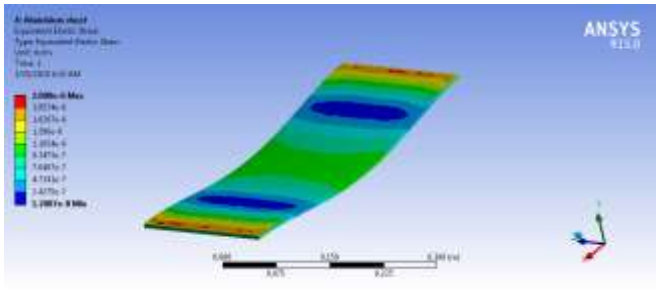
SOLIDWORKS 15.0 used for 3D modelling of IC engine fins ANSYS workbench 15.0 software used for analysing the thermal properties of ic engine fins.

Temperature distribution, total heat flux, directional heat fluxes are to be calculated using ANSYS software.

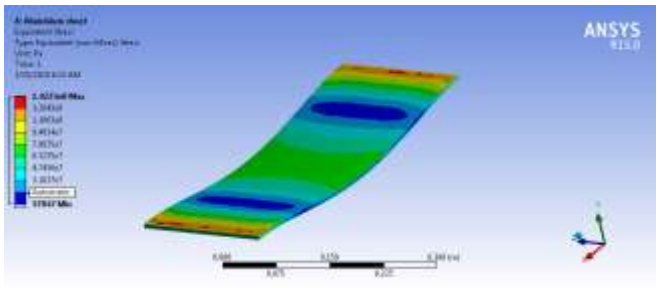
10. RESULT

10.1 For Aluminium:

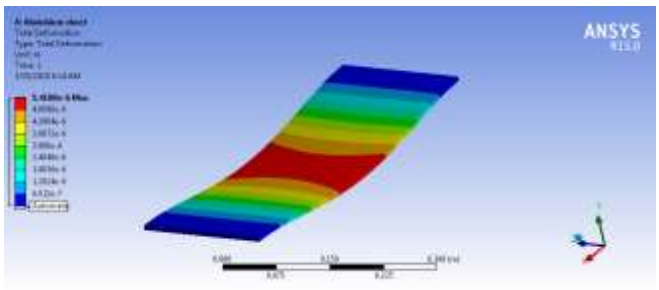
Strain distribution



Stress distribution

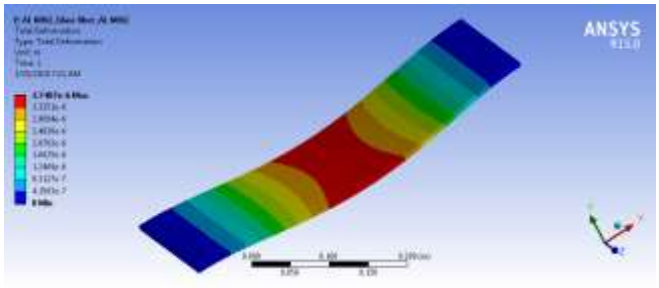


Total deformation

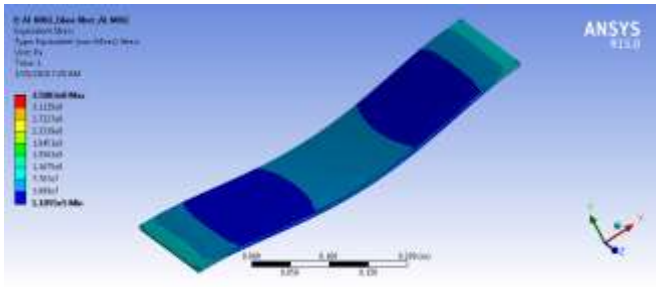


10.2 For Al/Glass/Fibre:

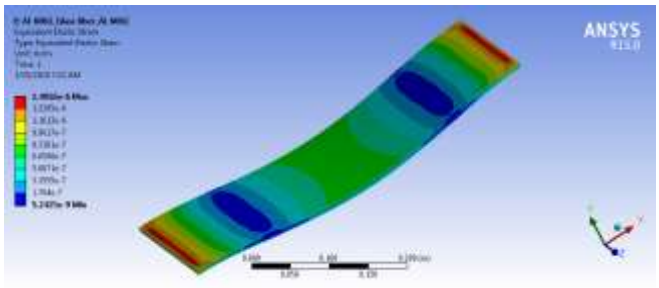
Total deformation



Stress distribution



Strain distribution



11. CONCLUSION

Bending analysis of different sandwich panel has been done. A 500kg of load is acting in the centre of the sandwich panels. It is observed that Al/glassfibre/Al has less deformation. Therefore it is recommended for body of aircraft.

REFERENCES

[1] K.Kantha Rao, K. Jayathirtha Rao, A.G. Sarwade, B. Madhava Varma, "Bending Behaviour of Aluminium Honey Comb Sandwich Panels", International Journal of Engineering and Advanced Technology (IJEAT), ISSN: 2249 – 8958, 2002.

[2] G.A.O. Davies, D. Hitchings, T. Besant, A. Clarke, C. Morgan, "Compression after impact strength of composite sandwich panels", Composites Science and Technology, vol. 69, pp 2231–2240, 2009.

[3] Vitaly Koissin, Andrey Shipsha, Vitaly Skvortsov, "Compression strength of sandwich panels with sub-interface damage in the foam core", Composites Science and Technology, vol. 69, pp 2231–2240, 2009.

[4] Salih N. Akour, Hussein Z. Maaitah, "Effect of Core Material Stiffness on Sandwich Panel Behaviour Beyond the Yield Limit", Proceedings of the World Congress on Engineering, 2010.

[5] X. Frank Xu, Pizhong Qiao, "Homogenized elastic properties of honeycomb sandwich with skin effect", International Journal of Solids and Structures, vol. 39, pp 2153–2188, 2002.

[6] Kujala, P, Metsa, A and Nallikari, M, "All steel sandwich panels for ship applications", Helsinki University of Technology, 2000.

[7] Ji-Hyun Lim, Ki-Ju Kang, "Mechanical behaviour of sandwich panels with tetrahedral and Kagome truss cores fabricated from wires", International Journal of Solids and Structures, vol. 43, pp. 5228–5246, 2006.

[8] F. Meraghni, F. Desrumaux, M.L. Benzeggagh, "Mechanical behaviour of cellular core for structural sandwich panels", Composites: Part A, vol.30, pp. 767–779, 1999.

[9] Bhagwan D. Agarwal, Lawrence J. Broutman, K. Chandrashekhara, "Analysis and performance of fiber composites", ISBN: 978-81-265-3636-8, 2006.

[10] M.D Banea, L.F.M Da Silva, "Proceedings of the Institution of Mechanical Engineers", Journal of Materials Design and Applications, 2009.