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A Brief Review Of Using Corrugated Composite Sandwich And Hexagonal Honeycomb Plates For Helmets

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Abstract–The purpose of this study is to perform a multidisciplinary design and analysis of the materials such as Corrugated Composite Sandwich and Hexagonal Honeycomb Plates used for providing the comfort and protective padding in most of general engineering application.The primary goal of using these sandwich systems is to provide the proper absorption capacity and required safety of the system duringimpact load or pressure applications, thus preventing or reducing the failure of any engineering mechanism. The Corrugated composite sandwich structure and Hexagonal Honeycomb plates can also be used in automotive engineering. By implanting the padding using these materials the weight of the device can be reduced and highest safety concern can be optimized.

In the present work, detailed finite element models for honeycomb panels and corrugated composite structure are studied and analysed for using as the shell padding materials from various literature journals.In a sandwich structure, the strong and stiff skins carry most of the in-plane and bending loads while the core mainly bears the transverse shear and normal loads.Honeycomb sandwich panels are increasingly used in the construction of space vehicles because of their outstanding strength, stiffness and light weight properties.

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Introduction:

In mechanical structures where stiffness, strength and weight efficiency are required there the sandwich construction is commonly employed. Honeycomb plates and corrugated composite and sandwich panels constructed from light face sheet and relatively low density cores are famous for the powerful ability to support bending load and to save structural weight. The potential advantages of sandwich structures for shock mitigation in any system's protective shells are to reduce the failure due to heavy impact. The most common type of sandwich structure consist of two thin, stiff and strong sheets of dense material separated by a low density material which have a lower stiffness and strength compared to the materials used as top and bottom faces. As a rough guide to the proportions, an efficient sandwich is obtained when the weight of the core is close to the combined weight of the both faces. Sandwich panels having both top and bottom plates as well as the core made of steel are called steel sandwich panels. Basically, the function of the implemented composite sandwich plates or say core is to absorb most of the impact energy, while the function of the shell of any system is to resist penetration of any foreign object from touching the impact load on a wider foam area thus increasing the foam linear energy absorption capacity.

In all areas of mechanical structures, the impact of good design of a mechanical part is very important to its strength, durability and its use in service. This challenge is daily in high-tech sectors such as space research, aerospace, automotive, shipbuilding competition, precision engineering, precision mechanics or structures in civil engineering. The development the engineering art requires considerable effort to constantly improve the technical design of structures. Optimization intervenes paramount in increasing performance and reducing the weight of aerospace and automotive engines, resulting in substantial energy savings. Aerospace structures generally require light designs. The purpose of these designs is to maximize strength by weight, or effectiveness of the design. Satellite structural design has evolved considerably over the past four decades. The first step in designing a sandwich structure is the choice of the different constituents, depending on the application: the face, the core and the adhesive joint to bond the faces to the core. Different choice criteria are of course the mechanical properties of the constituents, but also the processing and the price which can vary over several orders of magnitude. Sandwich structures are often used in skin-frame designs. Traditionally, the efficiency was achieved using a combination of various designs and structural materials.

Literature Survey:

Syed Mufeez Ahmed performed study on Fibre composite sandwich which has become the new generation of material used in civil infrastructure in the last decade. A structural sandwich is a special form of a laminated composite fabricated by attaching two thin but stiff skins to the lightweight but thick core. Because of this special feature, the sectional area is increased and consequently an increase in its flexural rigidity. The strength of this type of construction results from the combination of properties from the skin, core and interface. In a sandwich structure, the strong and stiff skins carry most of the in-plane and bending loads while the core mainly bears the transverse shear and normal loads.

Palanivelrajan .V described sandwich panels with high modulus/high strength skin material and low density/low modulus core material have higher stiffness-to-weight ratio than monolithic panels. In his paper, sandwich panels with corrugated core are explored as a light weighting concept for improved stiffness. The skin and the core materials are a high strength stainless steel, aluminum alloy or carbon fiber-epoxy composite. Corrugated open metallic sandwich structures are novel type of structures. Flexural modulus is a basic property of the material in such fabricated open core structures welding by spot welding. In the present work spot welded metallic panels are used to optimize the geometry. Based on the analysis, panel structure parameters considered are Thickness of the sheet, Core height, Core shape, Panel size and Material constituents of panel face sheet, bottom sheet and core. The parameters are analysed by Taguchi design of experiments by considering orthogonal array of L9.

According to **Surya SatishAdapa**, the Honey Comb Sandwich construction is one of the most valued structural engineering innovations developed in the composite industry. It finds its applications in industries like aerospace, aero plane, transportation, rails etc. In the current application static three points bending tests were carried out in order to investigate load and deflection variations in honey comb sandwich structure. In this paper, an analytical analysis, a numerical model and an experimental investigation of a 3-point bending test on copper honeycomb with multi-layer sandwich panel are proposed. Here the copper honeycomb is developed as a single solid and multilayer of equivalent properties. In order to compute the effective properties of the single honeycomb core and analytical homogenization of the multi-layer one analytical and numerical (finite element) homogenization approaches are used. The experimental results obtained for the copper honeycomb core with stainless steel face sheets and copper core are compared with the results obtained from the numerical simulation (finite element) of 3-point bending test. Sandwich structure consists of copper honey comb core with stainless steel facing 2mm thick and copper sheet are used for sample preparations. Numerical simulations are carried out to study the deflection for various loads and for various core heights and compared with experimental values Mostly honeycombs are an array of hollow hexagonal cells with thin vertical walls. Copper honey comb has numerous applications and it is low density permeable material.

Pan Zhang stated in his study that 3D fully coupled simulation is conducted to analyse the dynamic response of sandwich panels comprising equal thicknesses face sheets sandwich in corrugated core when subjected to localized impulse created by the detonation of cylindrical explosive. A large number of computational cases have been calculated to comprehensively investigate the performance of sandwich panels under near-field air blast loading. Results show that the deformation / failure modes of panels depend strongly on stand-off distance. The beneficial FSI effect can be enhanced by decreasing the thickness of front face sheet. The core configuration has a negligible in fluency on the peak reflected pressure, but it has an effect on the deflection of a panel. It is found that the benefits of a sandwich panel over an equivalent weight solid plate to withstand near-field air blast loading are more evident at lower stand-off distance.

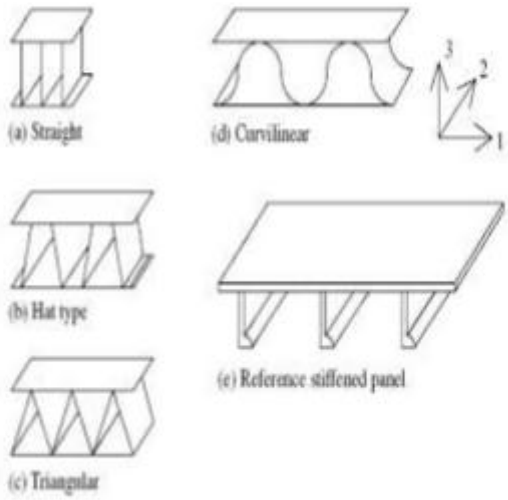
A. Zafranepresented his study on honeycomb sandwich panels that are increasingly used in the construction of space vehicles because of their outstanding strength, stiffness and light weight properties. However, the use of honeycomb sandwich plates comes with difficulties in the design process as a result of the large number of design variables involved, including composite material design, shape and geometry. Hence, the work deals with the presentation of an optimal design of hexagonal honeycomb sandwich structures subjected to space environment. The optimization process is performed using a set of algorithms including the gravitational search algorithm (GSA). Numerical results are obtained and presented for a set of algorithms. The results obtained by the GSA algorithm are much better compared to other algorithms used in this study.

A. Boudjemai stated that the purpose of his paper is to perform a multidisciplinary design and analysis (MDA) of honeycomb panels used in the satellites structural design. All the analysis is based on clamped-free boundary conditions. In the present work, detailed finite element models for honeycomb panels are developed and analysed. Experimental tests were carried out on a honeycomb specimen of which the goal is to compare the previous modal analysis made by the finite element method as well as the existing equivalent approaches. The obtained results show a good agreement between the finite element analysis, equivalent and tests results; the difference in the first two frequencies is less than 4% and less than 10% for the third frequency. The results of the equivalent model presented in this analysis are obtained with a good accuracy. Moreover, investigations carried out in this research relate to the honeycomb plate modal analysis under several aspects including the structural geometrical variation by studying the various influences of the dimension parameters on the modal frequency, the variation of core and skin material of the honeycomb. The various results obtained in this paper are promising and show that the geometry parameters and the type of material have an effect on the value of the honeycomb plate modal frequency.

Materials:

1. **Corrugated Composite Sandwich:**

   Some researches about mechanical properties of corrugated sandwich structures have been performed. The study of the effect of corrugation geometry on the crushing behaviour, energy absorption, failure mechanism is carried out. Composite sandwich structure has been identified as a very interesting alternative to traditional construction materials.



Various types of Corrugated sandwich structures.

In core made out of foam it increases moment of inertia and improves the bending stiffness without increasing the weight. Hence the foam core does not have excellent mechanical properties and its function is limited. Corrugated cores have high energy absorbing capacity since stable crushing occurs instead of catastrophic failure at relatively high loads.

The skin or the face sheets are thin, most of the out-of-plane shear load is carried by the core, and it therefore should be stiff and strong in shear. The skin may be made of aluminium,

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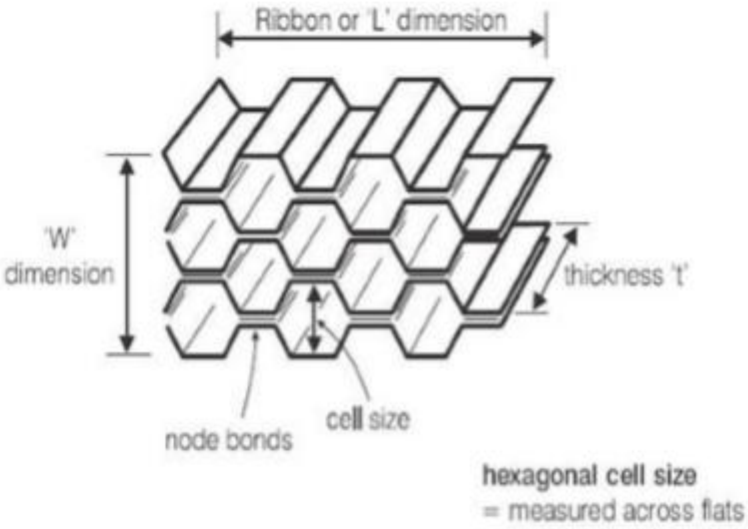
steel, woven glass fibre or carbon fibre with polymer such as epoxy or polyester. If a sandwich panel is bent downward, the part of the sandwich above the neutral axis will stretch, and the part below the neutral axis will compress. Although the skin and core stretch and compress evenly at the location of the bond, the core and the skins have different material properties. Glass fibre – epoxy, Glass fibre – polyester have a low density and high specific strength hence they are widely used for skin in a sandwich structure which are bonded to the core using a strong adhesive.

2. **Honeycomb Sandwich Structure -**In applications where the loading conditions are conductive to buckling there the sandwich is particularly well suited, since the rigidity is required to prevent structural instability. In applications such as thermal insulation, adsorption, lowering in the weight and cost is achieved by the minimization of the material used in the geometric construction of copper honey comb. The ratio of strength-to-weight is high for honeycomb pattern. The behaviour of honeycomb sandwich material will be applied in the impact simulations and found out the corresponding changes in the global stiffness changes in the load displacement.



Honeycomb Structure

Honeycomb sandwich structures have been widely used in the manufacture of the aerospace structures due to their lightweight, high specific bending stiffness and strength under distributed loads in addition to their good energy-absorbing capacity.

Conclusion- In this review report two different materials structures are described in detail, such as honeycomb sandwich structure and corrugated composite sandwich structure which have great potential on absorbing the shock and strength and the light weight property. These systems can be particularly advantageous and both the sandwich structures often are the part of any engineering mechanism which is usually undergoes through constant load and vibrations.

These structures are able to provide a safety barrier for personnel and critical equipment against accidental explosions and are designed to be efficient energy absorbing systems. Both the sandwich systems provide compatible helmet and light weight structure. After applying required mechanical tests the deformation and stress analysis is also performed on both the structure and this system provide all the desired mechanical strength.

After following and studied so many technical journals about these systems it can be possible to implant these systems for the protective padding mechanism of helmets. Helmets should be made of some materials which can sustain the sudden impact of high stress and these systems are able to provide the desired output. Now days the helmets are made of plastic and carbon fibres which are comparatively heavy while using this as the protective padding under the outer shell of the helmets the weight of the helmet can be reduced to the half of the existing design.

By using honeycomb and corrugated composite sandwich systems under the shell of helmets the compatible design and effective shock absorption capacity can be generated without implementing the major changes of the designs. Using these systems in helmet mechanism the performance of stress handling and shock absorption will only increase comparatively the existing helmet mechanism and will provide the light weight system also. This life saving device called helmet will improved by applying this technique in order to sustain the shock of heavy and sudden impact of stress loading. These systems need to be implant under the helmet mechanisms.

REFERENCES

1. Syed Mufeez Ahmed – "A Brief Review on Corrugated Composite Sandwich Structure" International Journal of Engineering Trends and Technology (IJETT) – Volume-40 Number-4 - October 2016.

2. Palanivelrajan .V Selvakumar.A.S. – "Design and analysis of corrugated sandwich Panel for structural applications" Volume : 5 | Issue : 6 | June 2015 | ISSN - 2249-555.
3. Surya SatishAdapa, JanardhanJaggavarapu and VijaykumarVedangi – "STRUCTURAL ANALYSIS OF COPPER HONEYCOMB STRUCTURES" International Journal of Advances in Engineering & Technology, Dec., 2015.
4. Pan Zhang Yuan sheng Cheng, and Jun Liu – "Numerical Analysis of Dynamic Response of Corrugated Core Sandwich Panels Subjected to Near-Field Air Blast Loading" Hindawi Publishing CorporationPublished27October2014.
5. A. Boudjemai, A. Zafrane, R. Hocine – "Hexagonal Honeycomb Sandwich Plate Optimization Using Gravitational Search Algorithm" World Academy of Science, Engineering and Technology International Journal of Mechanical, Aerospace, Industrial, Mechatronic and Manufacturing Engineering Vol:8, No:6, 2014.
6. A. Boudjemai , M.H. Bouanane, Mankour, R. Amri, H. Salem, B. Chouchaoui – "MDA of Hexagonal Honeycomb Plates used for Space Applications" World Academy of Science, Engineering and Technology International Journal of Mechanical, Aerospace, Industrial, Mechatronic and Manufacturing Engineering Vol:6, No:6, 2012.