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STRUCTURAL ANALYSIS OF HYBRID REINFORCED COMPOSITE FOR INDUSTRIAL SAFETY HELMET

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ABSTRACT: Recently, the utilization of fiber built up polymer in each field of designing (car, industry and aviation) and clinical has expanded because of its unmistakable mechanical properties. The fiber based polymer composites are more mainstream on the grounds that these have high strength, light in weight, minimal expense and effectively accessible. In the current work, the finite element analysis investigation (FEA) of fiber/epoxy composite based modern security cap has been performed utilizing strong works recreation programming. The demonstrating results show that glass fiber supported epoxy composite can be utilized as a material for creation of modern security cap which has great mechanical properties than the current head protector material. The hybrid composite is prepared by Jute, Bamboo, E-Glass and Coconut shell powder as filler materials. This paper based on structural analysis by using ANSYS work bench. The outcome results of the simulation are included.

Keywords: Jute/Bamboo fiber, Safety Helmet, Structural Analysis, Coconut Shell Power (CSP)

1. INTRODUCTION

A composite material is gotten when at least two materials are consolidated together to frame another material which has preferred properties over the individual one. A composite has fundamentally two parts grid and the support. The principle capacity of grid to move the heap to the support and restricting the support together and the primary capacity of support is to hold the heap. Contingent on the lattice material, composites are delegated metal framework, polymer grid, and earthenware network composite. Contingent on the support, composites are particulate composite and fiber composite [1-2]. Filaments are named engineered and normal strands. Engineered filaments are the man-made strands that are set up by crude materials acquired from nature. Engineered filaments incorporate glass, carbon, aramid, rayon, nylon, metallic strands and so forth The most regularly utilized fiber is glass fiber which enjoys a few benefits like high strength, high synthetic obstruction, great protecting properties and minimal expense.

Caps are utilized to ensure head by engrossing effect energy and secure against harm. Different kinds of caps that are utilized to shield head from wounds rely on its uses like ballistic caps, bike/bike protective caps and mechanical caps. The primary property of a head protector is to retain the effect energy. Alongside this property, a wellbeing cap ought to be light in weight and low volume since light in weight and low volume don't make any torment or issue the laborers head and neck. V. Kostopoulos et al. [3] researched the effect harm reaction of a composite bike wellbeing head protector utilizing hydrodynamic limited component code on LS-DYNA3D programming.

CATIA and ANSYS were utilized for limited component examination and contrasted the mechanical properties and existing wellbeing head protector material which was extended polystyrene Styrofoam (EPS). The creators inferred that created coconut fiber supported epoxy composite shell would do well to pressure ingestion ability, eco-accommodating in nature and it had minimal expense when contrasted with extended polystyrene Styrofoam (EPS) . Murali et al. [5] created the modern wellbeing cap utilizing jute/banana/sisal fiber supported epoxy composite by hand layup method. The creators presumed that the created jute/banana/sisal fiber built up epoxy composite would do well to strength (53.06 J/m) and less weight (252 gm) when contrasted with acronytrile butadiene styrene (ABS) which has sway strength of 50J/m and weight 370 gm. Natsa et al. [6] manufactured a tactical head protector utilizing coir fiber supported epoxy sap composite. Seven examples were created having 20%, 40%, half, 60%, 70%, 80% and 85% coir fiber content in the composite and their mechanical properties were explored. The examples having a fiber substance of 70% and 28% sap offered wonderful properties having sway strength of 8.733 J/mm2. Bernd et al [7] explore the head protector shell created by utilizing carbon fiber. Four distinctive cap shells was created utilizing same carbon fiber. The quantity of fiber layers and fiber design was varying. The investigation of effect conduct of protective cap shell was performed utilizing the Gaussian curve and the mean ebb and flow technique in CATIA V5. The

2-wire drop test was showed that two-designed shell with five layers has the best effect conduct then other three head protector shells. Satish Gandhi et al. [8] completed the exhibition investigation of engine cycle cap under static and dynamic stacking. The head protector model was planned utilizing Pro-E programming and the reproduction was performed utilizing ANSYS programming.

Under various circumstances like base fixed burden on top surface, base fixed-load on top line, side fixed-load on inverse surface, side fixed-load on inverse line. For static investigation the greatest twisting was 6.2263 mm and most extreme strain energy was 111.94 joules and for dynamic examination the absolute deformity was 12.147 mm. The creators presumed that circumstances as base fixed burden on top surface and side fixed-load on inverse line has gone through less strain energy and misshapening. Alessandro Cernicchi [9] did displaying of composite shell of protective cap utilizing Finite Element Model. The creator explores the Mechanical properties of composite cap shell utilizing Halpin-Tsai condition. The trial results are good when contrast and hypothetical outcomes. In the current work, the reenactment of modern security cap made of S-Glass/epoxy composite has been completed utilizing the solidworks reproduction programming.

2. MATERIAL AND METHODS

In the current work, CAD-inserted solidworks adaptation 12 recreation programming has been utilized to display mechanical wellbeing cap. Material for protective cap has been taken as S-glass supported epoxy composite. As the fundamental burden in protective cap is sway load, the drop test has been reproduced in the product climate. Various surfaces of the security cap have been reenacted independently. Every one of the surfaces were discretized with fine lattice. The reenactment results were contrasted and the consequences of existing protective cap material (for example polypropylene). ANSYS work bench is used to simulate the results.

Analysis Input Parameters

Fixed Support : In the Top Head of Helmet

Force: 4000N Along Z-Direction

Mesh Element Size : 0.001

Density – 1115 Kg/m^3

Youngs Modulus - $\frac{\text{Tensile Strength}}{\text{Tensile Strain}}$ MPa

% Elongation = $\frac{\text{Final Length at Fracture} - \text{Initial Length}}{\text{Intial Length}}$ X 100

Strain = $\frac{\text{Final Length at Fracture} - \text{Initial Length}}{\text{Intial Length}}$

Actual Length = 57 mm, Final Length After Fracture = 62mm

Poisson Ration = 0.3

3. RESULT AND DISCUSSION

First, the model of industrial safety helmet shown in figure 3 has been imported to the solidworks simulation software environment. The helmet model is drawn in four surface parts. The protective cap model is attracted four surface parts. In solidworks surface has been chosen and the material of cap as s-glass and entered the properties of s-glass appeared in figure 4. The drop test is performed to break down the modern security protective cap and the cross section component was taken in three-sided structure with network size 4.4472 mm. More modest the cross section size better the recreation results got. The Generated network components, Von-misses stresses and strain created during reproduction are appeared in figure 3, figure 4 and figure separately.

The ANSYS Workbench platform is the backbone for delivering a comprehensive and integrated simulation system. Using Workbench for our product development simulations will result in higher productivity from integrated applications and access to Multiphysics and systems level capabilities.

1. Structural Analysis Total Deformation: -

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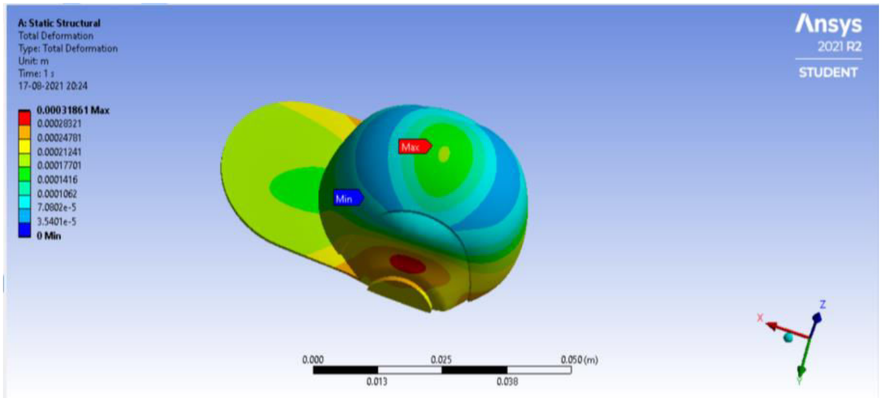
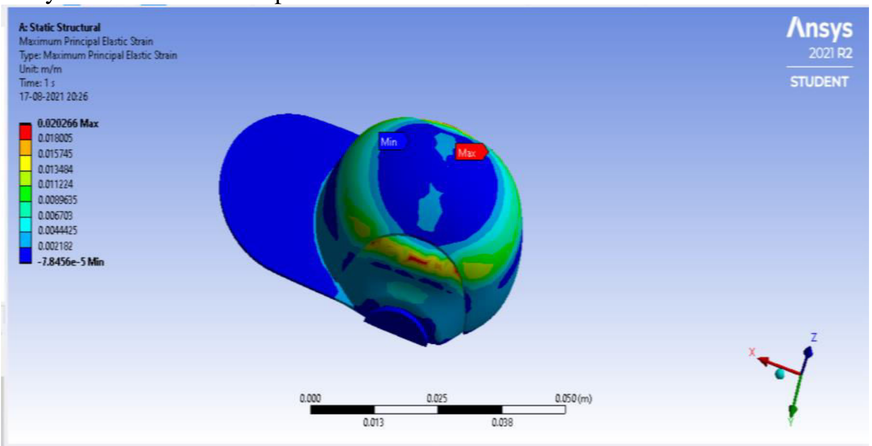
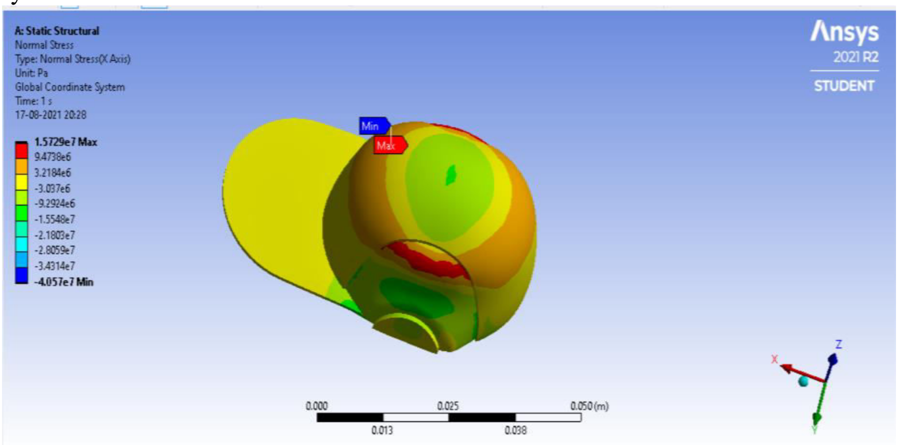


Structural Analysis Maximum Principal Elastic Strain



Structural Analysis Normal Stress



Structural Analysis Shear Stress

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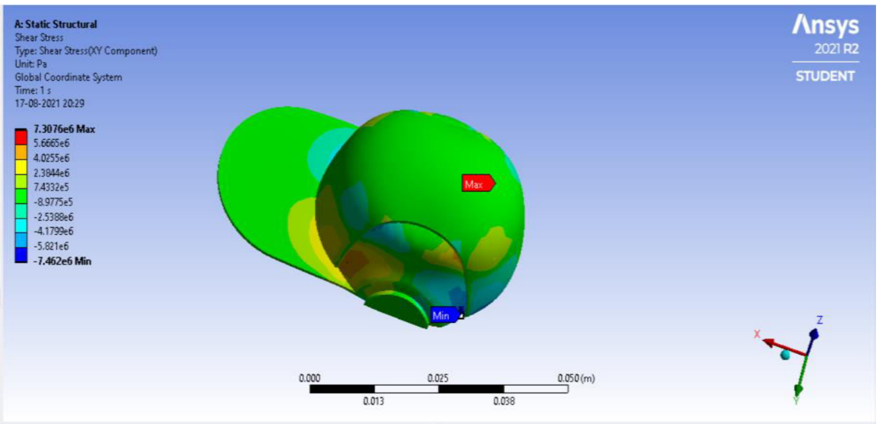
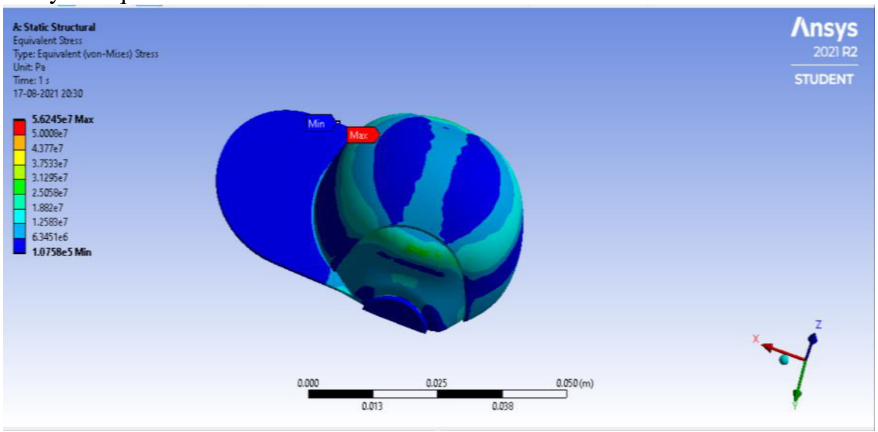


Structural Analysis Equivalent Stress



4. CONCLUSION

In the present study, the simulation has been carried out using solidworks simulation for the industrial safety helmet. The conclusions drawn from the study are as:

- The Jute/Bamboo, E-Glass and CSP and epoxy reinforced composite has more capacity to absorb the stresses than the polypropylene and acrylonitrile butadiene styrene (ABS).
- The maximum stress reached is 194.4 N/mm2 which is within permissible limit of yield stress of the material used for helmet i.e. fiber/epoxy composite. At this maximum stress, the maximum displacements produced are 1.172 mm.
- Simulation results show the Jute/Bamboo, E-Glass and CSP and epoxy reinforced composite can be used to replace the existing industrial safety helmet because of its better mechanical properties and less in weight characteristic.

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