Analysis of cylindrical shaped component using composite(GFRP) material

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ABSTRACT

A composite material is a combination of two materials with different physical and chemical properties. When they are combined they create a material for instance to become stronger, lighter or resistant to electricity. Composites are one of the most advanced and adaptable engineering materials. Composite materials have properties such as high strength to weight ratio. Structural analysis of non-circular shaped had already done. So there was necessity of work on cylindrical shaped composite materials. This report give idea about why composite materials are better than non-composite material.

INTRODUCTION

A composite is a basic material that comprises of at least two consolidated con- stituents that are joined at a perceptible level and are not solvent in one another. One constituent is known as the reinforcing phase and the one in which it is inserted is known as the matrix . The strengthening stage material might be as fibers, particles, or flakes. The matrix stage materials are commonly ceaseless.

Unique Features of Composites are as per the following:

a) Composite materials have a high stiffness. (stiffness to-density proportion).

b) The explicit strength of a composite material is exceptionally high. Due to this, aeroplanes and autos move quicker and with better fuel efficiency. The explicit quality is regularly in the scope of 3 to multiple times that of steel and aluminum composites.

c) Net-shape or close net-shape parts can be delivered with composite materials. This component takes out a few machining activities and along these lines decreases measure process duration and cost.

d) Composite materials give capacities to part incorporation. A few metallic segments can be supplanted by a single composite segment.

e) Composite structures give in-administration checking or online cycle observing with the assistance of installed sensors Materials known as ”smart materials”.

Classification of Composite Materials:-

1. Particulate composites
2. Flake composites
3. Fiber composites
4. laminated composites
5. Filled composites

Laminated Composites:-

They are made with restricting number of layers of at least two distinct materials together. The succession of different directions of a fiber fortified compositelayer in a cover is named as the overlay plot or stacking plan. By cover, one can accomplish two constituent layers, so as to improve the material quality.

LITERATURE REVIEW

A. Hocine et al, D. Chapelle et al, Barbara Surowska et al. [1] have studied , Interface of fiber metal laminates. After reading this paper I comes to know that Fiber metal laminate (FMLs) are the mixture overlays comprising of exchanging slender layers of metal sheets and fiber-fortified composite material. Interface among metal and

polymer layer assumes a significant job. FMLs have both low thickness and high relative strength, and other great properties as high damage resilience: fatigue and effect attributes, consumption, and fire obstruction. In present work, the miniature structure of the aluminum-epoxy/glass and aluminum- epoxy/carbon composites is described. The interface among metal and polymer composites with surface treatment and without surface treatment at various weights was inspected. Pei Geng et al, Jingzhong Xing et al, Qizhi Wang et al [2] have studied Analytical model for stress and deformation of multiple-winding-angle filament-wound composite pipes/vessels under multiple combine loads. In this paper a 3d elastic analytical model was developed to calculate the stress and deformations of FW pipes/vessels subjected to multiple combined loads then obtained results by the proposed formulae are very close to FEM results and the proposed theory is not only suitable for engineering applications but also provides a theoretical foundation for the damage analysis of FW pipes/vessels. Francesco Naddeo et al, Nicola cappetti et al, Alessandro Naddeo et al [3] have studied Automatic versatile parametric procedure for a complete FEM structural analysis of composites having cylinder shaped reinforcing fibers. In this paper the realisation of an algorithm for creating a parametric easily manageable and fully automatic FEM model to predict the mechanical properties of composites having cylinder shaped reinforced fibers characterized by a complex morphology. He first release the algorithm and has implemented for the prediction of effective elastic properties(Young's moduli) of polymer nanocomposite films(copolyimide-6/nanoclay) compairing the result with 3d analytical model test(based on Mori-Tanaka theory) and with experimental results obtained for nanocomposite films produced by a means of a pilot-scale film blowing equipment and collected different draw ratios. In this case, comparison of simulation results with experimental data has confirmed the reliability of both the analytical and numerical models. L. X. Peng et al, K. M. Liew et al and S. Kitipornchai et al [4] have studied Bending Analysis of Folded Laminated Plates by the FSDT Meshfree Method. In this paper This paper proposes a meshfree method based on FSDT for the elastic bending analysis of folded laminated plate structures. The folded laminated plates are considered to be assemblies of flat symmetrical laminates. The global stiffness equation of the folded plate is formed by superposing the stiffness equations of the laminates derived with the meshfree method. The convergence and accuracy of the proposed method are demonstrated by a comparison of the solutions of several examples with those given by ANSYS. Good agreement between the two sets of results is observed. The proposed method can also be employed to analyze box beams and closed structures. agreement between the two sets of results is observed. The proposed method can also be employed to analyze box beams and closed structures. agreement between the two sets of results is observed. The proposed method can also be employed to analyze box beams and closed structures. agreement between the two sets of results is observed. The proposed method can also be employed to analyze box beams and closed structures. J. Jerold John Britto et al, R. Venkatesh et al, K. Amudhan et al, A. Vasanthanathan et al, N. Gokulakrishnan et al, M. Manikandan et al [5] have studied Micromechanics study on FRP composite cylinder under finite element simulation COMSOL Multiphysics. In this paper the Kevlar Fiber Reinforced Polymer(KFRP) has considerable buckling load stability factor compared with other material combinations so that's why KFRP is best and it is suitable for Armored vehicle for impact load protection. Catalin I. Pruncu et al, Dipen Kumar Rajak, Durgesh D. Pagar, Ravinder Kumar [6] have studied Recent progress of reinforcement materials: a comprehensive overview of composite materials. In this paper to fuse different variety of constituent elements to fabricate composites and several tests were carried out to study their properties and phase change and another is scope to develop advance manufacturing techniques in conjuction to automation that allows increasing the productivity of material.

PROBLEM STATEMENT

Composite material is light in weight to most metals. Their light weight property is important in most of applications. On the other hand, composite material can be designed to strong as well as light. Before substituting composite material to strengthen the component it is essential to analyze it for different test to avoid failure. Problem statement can be defined as "Structural analysis of cylindrical shaped component using composite material".

OBJECTIVES

a) To prove why composite materials are superior than non-composite.
b) To design cylindrical shaped component of laminate composite material by using finite element analysis.
c) To manufacture laminate composite (GFRP) material by hand lay method
d) To examine composite material under compression test.
e) To validate experimental results

METHODOLOGY

a) TO Design and optimization of laminated composite material with finite element analysis.
b) Fabrication of component and it is used by hand-lay method. After fabrication experimental testing for different loading condition had carried out.
c) Validation of results

MANUFACTURING TECHNOLOGY

Hand lay-up process:-

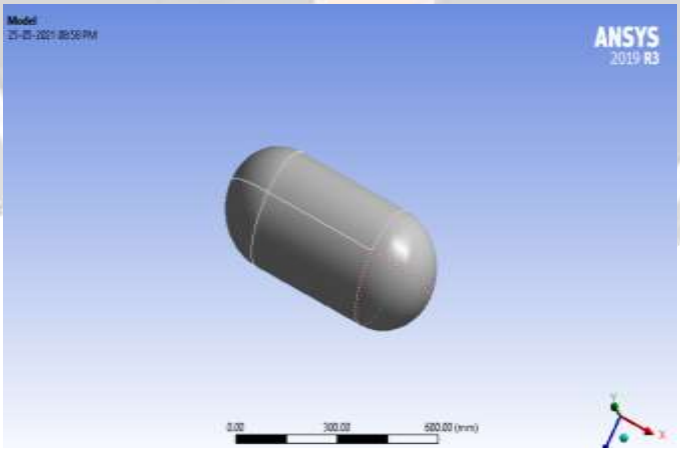
Gel coat is first applied to mould the form utilizing a spray gun for excellent surface . At the point when gel coat has restored adequately fiberglass fortification is physically positioned on molds . The overlaying rasin is applied by pouring , brushing ,splashing or utilizing paint roller. Resulting layers of reinforcement are added to construct cover thickness . Basic ,single cavity molds of fiberglass are commonly utilized. Molds can extend from little to exceptionally enormous and of minimal effort..

Process

DESIGN

After intense study of literature we made design for proposed work. Then we optimize the design for limiting condition. At the end I have selected following design to fulfill our second objective which is stated as– To prove why composite materials are beneficial over traditional material by using finite element analysis.

INITIAL MODEL



GEOMETRIC MODEL

Analytical Calculation:-

We have ,

P = 1.2 MPa , D = 320 mm, t=2.5mm

1) Cylindrical portion hoop stress (h)

(h) = PD/2t

= (1.2×320)/(2×2.5)

=76.8 Mpa

2) Longitudinal Stress(L)

(l) = PD/4t

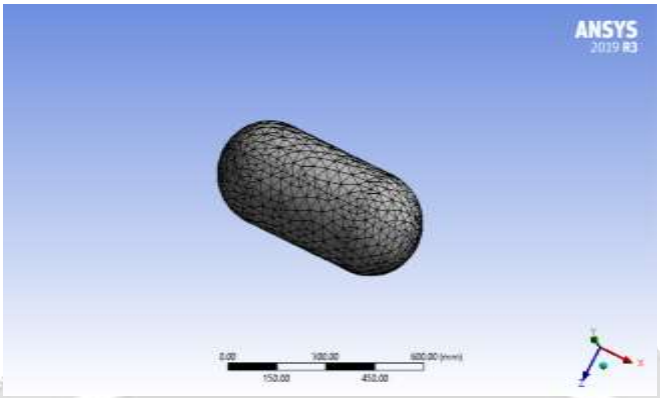
= (1.2×320)/(4×2.5)
= 38.4

3) Von mises stress (v)

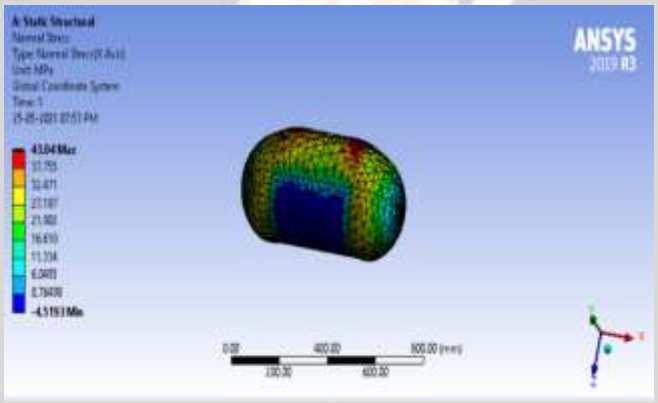
(v) = √{(h)(h)+(L)(L)-(h)(L)}

$= \sqrt{\{(76.8 \times 76.8) + (38.4 \times 38.4) - (76.8 \times 38.4)\}}$

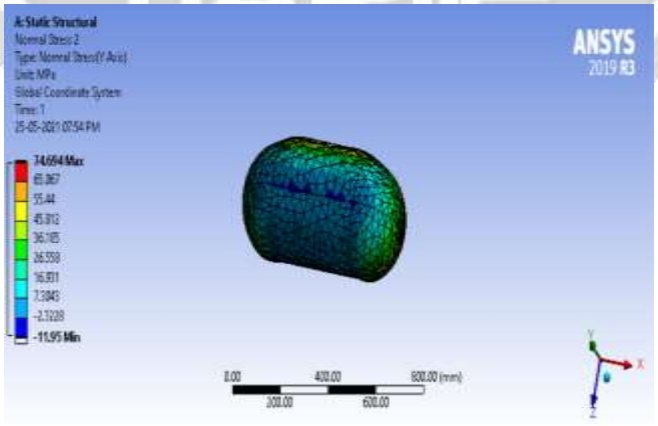
= 66.5 Mpa



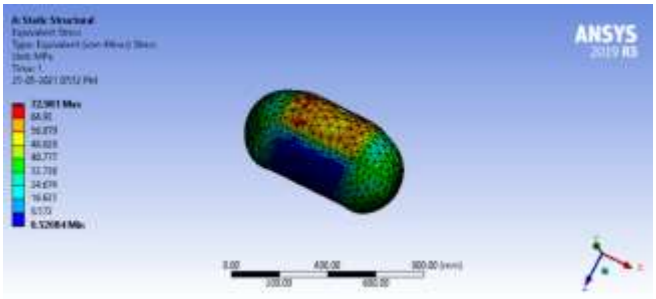
Case 1:- Cylindrical component made up of steel



1.1 Longitudinal stress



1.2 Hoop stress



1.3 Von-mises stress

RESULT TABLE

Stress Result (MPa)	STEEL	Analytical method
longitudinal stress	43.03	38.4
hoop stress	74.694	76.8
Von-mises stress	72.98	66.5

CONCLUSION

Modern era we always look to modify and upgrade technology as change with time. Composite material is light in weight to most metals. On the other hand, composite material can be designed to be both strong and light. Before substituting composite material to strengthen the component it is essential to analyze it for different test to avoid failure. Before going to test it was necessary to prove why composite materials can be used as substitute to non-composite materials . For that I had carried out comparison between composite and non-composite component of same dimension via finite element analysis. From FEA analysis we can conclude that composite materials are superior than non-composite materials. Also weight of material can be reduced without affecting performance. Because of reduction in weight cost of material can be reduced. So composite materials are preferable over non composite materials.

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