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Experimental Stress Analysis of Fibre Reinforced Polymer Plates using ANSYS

Chippada Srinivas[1] and P Aruna[2]

[1]Chippada Srinivas, M.Tech, Andhra Pradesh, INDIA
[2]P Aruna, B.Tech, Andhra Pradesh, INDIA

Abstract

Fiber reinforced Polymer plates are composite elements used in various streams of engineering. They are applied to structural components like columns, beams etc for physical strengthening. Previous researches had proved that Finite element method can easily analyze such FRP plates under different load and boundary conditions. ANSYS is the FEM based software which can interpret engineering problems approximately. In this research work, stresses of 4 layered Graphite reinforced Epoxy FRP plate were compared by changing graphite fiber orientation angles in ANSYS software. The plates are fixed on all the four sides and uniform load is applied transversally. Load - stress behavior of these plates is analyzed under material linearity conditions. In Anti-symmetric angular system, [0°,-60°,60°,0°] pattern had induced higher stresses than [0°,-30°,30°,0°].

Key words: FRP Plates 1, ANSYS software 2.

1. INTRODUCTION:

Beams, columns and slabs which are physically weakened can be strengthened by attaching Fiber reinforced polymer plates in possible directions . As these plates are acting as component of structure, it is desirable to study their load - stress behavior under various fiber orientation angles in all layers. This research aims to compare load

stress behavior of a 4 layered Graphite- Epoxy plate by varying the following Anti-symmetric angular patterns of graphite fibres in 4 layers.

Anti-symmetric patterns
[0°,-30°,30°,0°]
[0°,-60°,60°,0°]

Von Mises stress is maximum stress where yielding or failure of a material is expected. Due to orthogonal nature, study on Von Mises stress on FRP plates is much needed. Hence, normal and Von Mises stress parameters were compared in the work. Kesavarao et al [1] had investigated Graphite-Epoxy FRP plate for stress analysis under different loading conditions. Mehta et al [2] had experimented on stress-strain results of a Graphite-Epoxy FRP plate under normal loadings by changing number of layers. Deepanshu et al [3] conducted experiment for vibrational analysis of Graphite-Epoxy FRP plates by using finite element techniques. Subramani et al [4] had investigated a reinforced concrete column by comparing non-linear analysis with and without FRP plates.

2. EXPERIMENTAL PROCEDURE:

A linear model of four layered Graphite-Epoxy FRP plate is constructed by specifying the below linear orthotropic properties in ANSYS software.

$$E_X = 156GPa,\ E_Y = E_Z = 14.5GPa,$$

$$G_{XY} = G_{YZ} = G_{XZ} = 5.4GPa,$$

$$\mu_{XY} = \mu_{YZ} = \mu_{ZX} = 0.34$$

where, E= Youngs Modulus

G= Shear Modulus and

μ= Poissons Ratio

The plate is constructed so that fiber bars may be arranged at required orientation angles in 4 layers by using SHELL 181 element (shell 181 is a four noded shell element selected from ANSYS element library). The plate is fixed on all the sides and uniform load is applied transversally. The resultant Normal and Von Mises stresses were compared by changing fiber orientation patterns.

3. RESULTS AND DISCUSSIONS:

The Normal and Von Mises stresses of 4 layered Graphite -Epoxy FRP plate are compared by changing graphite fiber angles in 4 layers.

Size of the plate taken is 200mm×100mm×10mm with fixed condition on all possible sides. An assumed magnitude of uniform load is applied in transversal direction of plate. SHELL 181 is the element selected from ANSYS element library to perform FEM analysis.

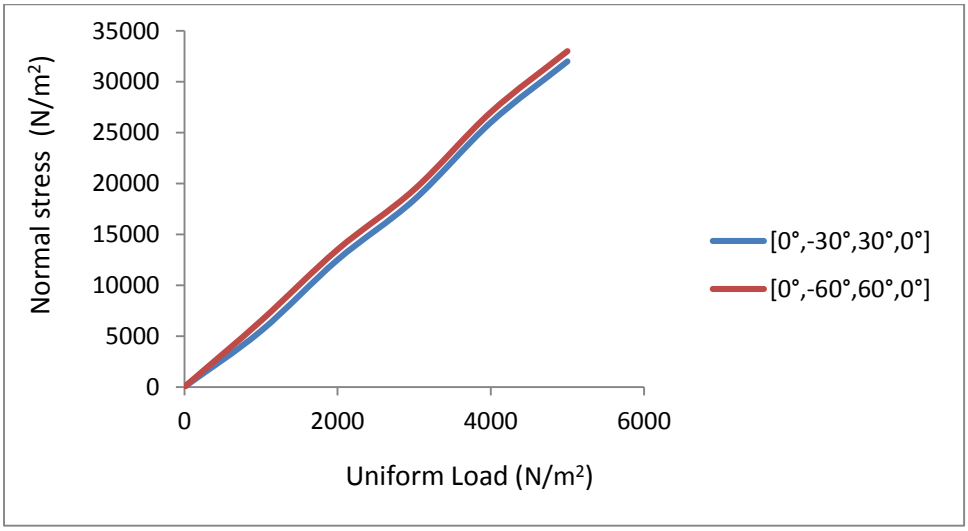

Fig:1- Normal stress vs Uniform Load

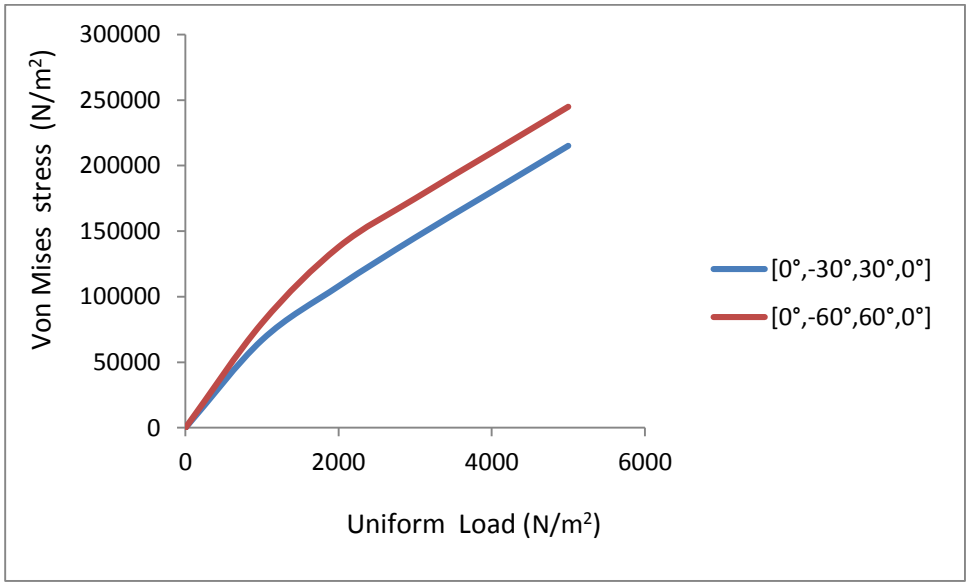

Fig:2- Von Mises stress vs Uniform Load

From above graphs, it can be noted that [0°,-60°,60°,0°] pattern had induced higher stresses than [0°,-30°,30°,0°] pattern. Also, Von Mises stress had shown greater variation between two angular patterns considered.

4. CONCLUSIONS:

1) Both Normal and Von Mises stresses are higher at [0°,-60°,60°,0°] than [0°,-30°,30°,0°] angular pattern of graphite fibre in a four layered Graphite-Epoxy FRP plate.

2) Von Mises stresses had shown greater deviation between [0°,-60°,60°,0°] and [0°,-30°,30°,0°] fibre angular patterns in a four layered Graphite-Epoxy FRP plate.

5. REFERENCES:

[1] 'Stress Analysis of Laminated Graphite/Epoxy Composite Plate using FEM', Yenda Kesavarao , Ch. Siva Ramakrishna, Saineelkamal Arji , International Journal of Mechanical Engineering, ISSN(P): 2319-2240, Vol. 4, Issue 5, Aug - Sep 2015, PP:9-16.

[2] 'Comparison of Ply-wise Stress-Strain results for Graphite/Epoxy laminated plate subjected to in-plane normal loads using CLT and ANSYS', Mihir A. Mehta, Satyen D. Ramani, Journal of Emerging Technologies and Innovative Research , ISSN-2349-5162, May 2016, Volume 3, Issue 5, PP:119-126.

[3] 'A Review of Static and Free Vibration Analysis of Laminated Composite Plate by using Finite Element Method', Deepanshu Bhatt , Yogesh Mishra , Dr. P.K. Sharma, International Journal of Advanced Engineering and Global Technology, Vol-2, ISSN No: 2309-4893, Issue-10, October 2014, PP:01-04.

[4] 'Nonlinear Analysis of Reinforced Concrete Column with Fiber Reinforced Polymer Bars', T. Subramani Reni Kuruvilla , J. Jayalakshmi, International Journal of Engineering Research and Applications, ISSN : 2248-9622, Vol. 4, Issue 6(Version 5), June 2014, PP:306-316.