Effect on Bumper Strength by Optimizing Orientation Angle of Laminated Composite

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Abstract —Five types of configurations of laminated composite orientation angle were used i.e. 0, 2, 5, 8, 10 degrees. An optimized model of bumper has been developed as stated configurations of laminated composite i.e. PLA, PET – G and KEVLAR. The simulations have been performed at a standard applied load that is the load generated during impact in bumpers. The simulation of the optimized model gives lower value of stress distribution, force and deformation. The results are validated with reported existing previous work. The configuration of orientation angle between 5 to 10 of laminated composite material exhibits converged results compared to other optimized laminated composite bumpers.
Keywords— *Bumper, Force, Stress, Deformation, PLA, PET - G, KEVLAR, Laminated composite.*

I. INTRODUCTION

Reinforcement (fibres, nanoparticles, particles, and/or fillers) is embedded in a cured resin, also known as a matrix, in a composite material (polymers, metals, or ceramics). The reinforcement binds the matrix together to produce the desired shape, while the reinforcement enhances the matrix's overall mechanical qualities. When properly developed, the new composite material outperforms each component constituent in terms of strength. A fibre-reinforced composite is a material system that consists largely of various quantities of fibre reinforcement inserted in a matrix, A coupling agent is added to the fibre to increase its adherence to the matrix material. Unlike steel and aluminium, FRP composites are anisotropic (properties differ in various directions), whereas steel and aluminium are isotropic (uniform properties in all directions, independent of applied load). As a result, the mechanical characteristics of FRP composites are directional, i.e., the optimum mechanical qualities are in the direction of Fiber placement. The physical and mechanical qualities of such composites determine their scope of use. Standard ASTM techniques can be used to assess these qualities.

II. Objective of the Work

- The main objective of the proposed research work is to validate the FEM analysis of simulations result of different configurations of bumper models by comparing the results of research reported in the literature.
- To optimize the different configurations of laminated composites models with orientation angle ranging between 0 - 10 mm.
- To analyze the performance parameters stress distribution of laminated composite bumper models.
- To predict the force, stress and deformation on optimized laminated composite bumper along the influences of different laminated composite orientation angle.
- To analyze the effect of output parameters with different materials i.e. PLA, PET – G and KEVLAR.

III. Problem Formulation

The survey of different previous works we predict the stress is maximum as compared to present study is shown in our base paper. The purposes of this study enhance the strength and decrease the deformation with different orientation angle of laminated composite bumper.

IV. Material Properties:

KEVLAR (Poly – Paraphenylene tetraphthalamide)

Properties	
Young’ s Modulus (E)	76000 MPa
Poission’s Ratio	0.37

PLA (Polylactic Acid)

Properties	
Young' s Modulus (E)	4.107 GPa
Poission's Ratio	0.3

PET - G (Polyethylene terephthalate glycol)

Properties	
Young' s Modulus (E)	2950 Mpa
Poission's Ratio	0.4

V. Details of CAD model

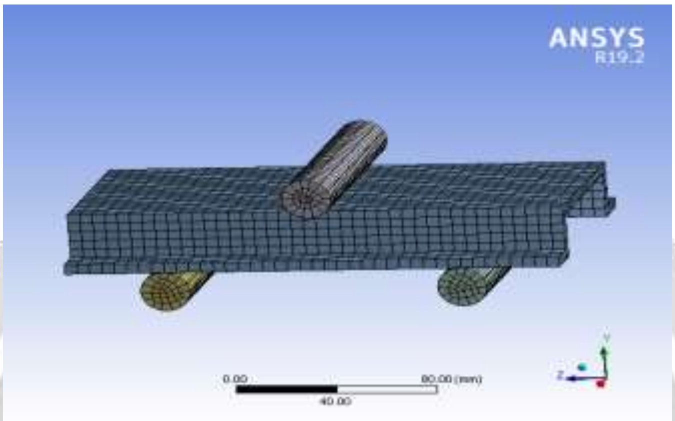


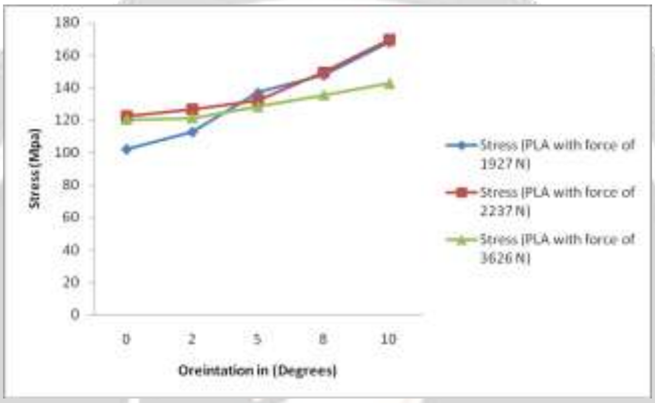
Figure1.3: Meshed model of composite bumper

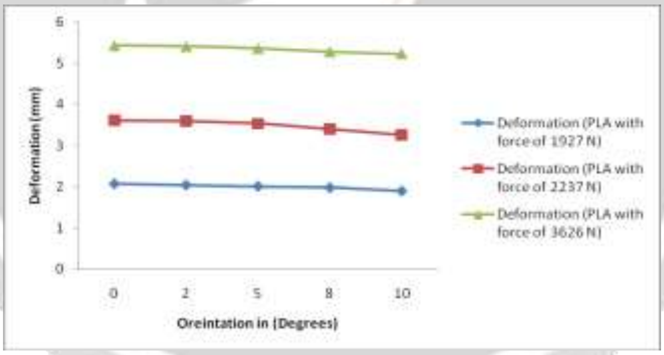
VI. RESULT AND DISCUSSION

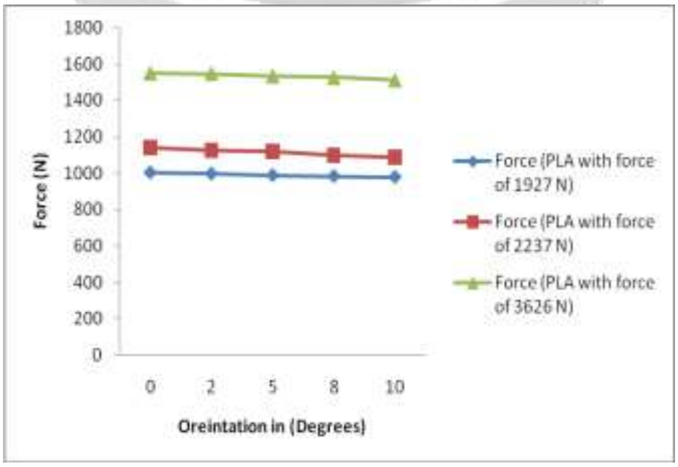
PLA with force of 1927 N			
Orientation in (Degrees)	**Stress (PLA with force of 1927 N)**	**Deformation (PLA with force of 1927 N)**	**Force (PLA with force of 1927 N)**
0	102	2.07	1003.5
2	112.6	2.04	996.8
5	136.8	2.01	988.33
8	147.66	1.98	983.74
10	167.89	1.90	978.5

PLA with force of 2237 N			
Orientation in (Degrees)	**Stress (PLA with force of 2237 N)**	**Deformation (PLA with force of 2237 N)**	**Force (PLA with force of 2237 N)**
0	122.46	3.62	1139.8
2	126.78	3.60	1126
5	132.33	3.54	1118.9
8	149.56	3.41	1096.8
10	169.63	3.26	1087.9

PLA with force of 3626 N			
Orientation in (Degrees)	Stress (PLA with force of 3626 N)	Deformation (PLA with force of 3626 N)	Force (PLA with force of 3626 N)
0	120.25	5.43	1551.4
2	121.36	5.41	1548.6
5	128.33	5.36	1534.9
8	135.45	5.28	1526.8
10	142.66	5.23	1512.7







CONCLUSION

- The simulation model was developed on ANSYS design modeler and analysis was done using the ANSYS software static structural R19.2 domain.
- Stress is the fundamental parameter in the performance of laminated composite bumper. The effect of stress in frontal of the bumper will decrease as the orientation of composite is increased.
- In the study, the orientation angle of composite between 5 to 10 exhibits better convergence in each output parameters.
- PET – G material have maximum deformation resistibility in every orientation angle.
- The effect of force is found to less in PET – G material in every orientation angle.

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