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Modeling & Testing Of Hybrid Composite Laminate

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Abstract: *Composite materials consists of more than one material or component where each component retains its basic properties and at the same time produces a material with a new set of properties that are different from each of component. This increase in use of composite materials in various applications has generated considerable interest for the development of reliable techniques and methods to predict the structural response under various loading conditions. With this advantage we can develop a material useful for the required application. Aim of this project is to study the behavior of a hybrid composite laminate with the change in orientation of fiber from layer to layer, i.e., preparation of hybrid FRP composite laminate sample (ASTM specimen) using glass wool and epoxy as binder and test the prepared sample for its mechanical properties as per ASTM Standards. Modeling and Analysis by using ansys . Validation of Analytical experimental results.*

I. Introduction

The role of engineering materials in the development of modern technology need not be emphasized. It is materials through which a designer puts forward his ideas into practice. We use a wide variety of materials for our needs and comfort and have been developing new materials for meeting our technological requirement. As the levels of technology have become more and more sophisticated, the materials used also have to be correspondingly made more efficient and effective. Several performance characteristics are expected from these materials.

Litrature Survey

The applications of composite materials have recently increased in the field of aerospace, automobile, nuclear, marine, biomedical and other engineering due to the following reasons: high strength/stiffness, for lower weight, superior fatigue characteristics, facility to change fiber orientations, etc. At the same time, these materials pose new problems such as inter ply cracking, interlaminar delamination and fibre cracking.

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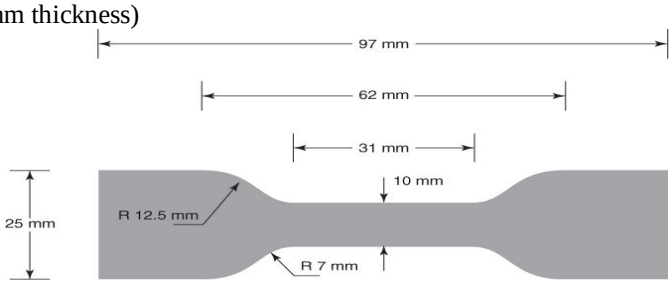
II. Materials Required

1. Glass fiber (unidirectional woven glass fiber)
2. Resin (general purpose polyester resin)
3. Accelerator
4. Catalyst
5. Release sheet (0.6 mm thickness)



MECHANICAL DEPARTMENT

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ANATHASAGAR
WARANGAL

Test Report

Batch Information			Date:18 Mar 2014
Client:	-	Graph:	**Load Vs Displacement**
Batch:	-	Test Type:	**Tensile**
Material:	**unidirectional woven glass fiber**	Specimen:	**Flat**
Operator:	**VIJAY**	Sample no:	**234**

Load:kN | Displacement:mm | Stress:kN/mm² | Yield is Calculated By Graph Method

Load Vs Displacement

Test Information		Results	
Pre Load	**0.1%**	Ultimate Load :	**49.9 kN**
» Initial Parameters		Displacement @FMax :	**17.100 mm**
Guage Length	**70 mm**	Breaking Load :	**27.36 kN**
Width	**10 mm**	Breaking Stress :	**0.342 kN/mm²**
Thickness	**8 mm**	Ultimate Tensile Strength :	**0.624 kN/mm²**
Area C/S	**80.00 mm²**	Gauge Elongate :	**-58.7 mm**
» Final Parameters		%Elongation :	**-83.9 %**
Guage Length	**11.3 mm**	%Area Reduction :	**12.5 %**
Width	**10 mm**	Yield Load :	**kN**
Thickness	**7 mm**	Displacement @Yield :	**mm**
Area C/S	**70.00 mm²**	Yield Stress :	**kN/mm²**

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Table 1: Average Ultimate Strength of all the tested samples

Type of laminate	Ultimate Strength of sample 01	Ultimate Strength of sample 02	Average Ultimate strength
Type 01	**440.37 N/sq.mm**	**551.4 N/sq.mm**	**496 N/sq.mm**
Type 02	**1237 N/sq.mm**	**1268 N/sq.mm**	**1252.5 N/sq.mm**
Type 03	**336.36 N/sq.mm**	**297.845 N/sq.mm**	**317 N/sq.mm**
Type 04	**624 N/sq.mm**	**677 N/sq.mm**	**650.5 N/sq.mm**

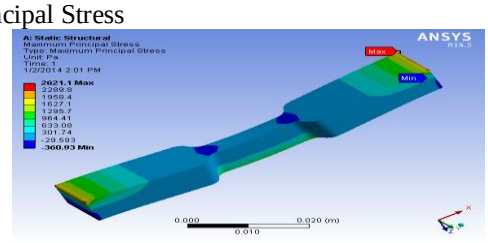
Table 2: Average weight specimens

Specimen	Average Weight (gms)
Type 1	**90**
Type 2	**88**
Type 3	**110**
Type 4	**112**
MS Steel	**855**

Table 3: Weight to strength ratios of specimens

Specimen	Average weight	Average strength	Weight to strength ratio
Type 1	**90**	**496**	**0.18**
Type 2	**88**	**1252.5**	**0.0702**
Type 3	**110**	**317**	**0.34**
Type 4	**112**	**650.5**	**0.172**
MS Steel	**855**	**982**	**0.901**

Ansys Analysys: Maximum Principal Stress



Length X	7.e-002 m		
Length Y	1.e-002 m		
Length Z	8.e-003 m		
Properties			
Volume	4.62e-006 m³		
Mass	1.0875e-002 kg		
Results			
Minimum	-360.93 Pa	6.1163e-002 m/m	0. m
Maximum	2621.1 Pa	30.635 m/m	0.9647 m

Density	2354 kg m^-3

Temperature C	Young's Modulus Pa	Poisson's Ratio	Bulk Modulus Pa	Shear Modulus Pa
	80	0.2	44.444	33.333

III. Conclusions

Glass fiber composite materials are widely used for a many number of applications like engineering structures, aerospace and marine application, automotive bumpers, sporting goods and so on.

From our work we found that with the increase in the time given for curing the bonding of the fiber and the matrix is becoming stronger and the strength of the laminate is increasing

We also found that with the change in the orientation of layers of the fiber in the laminate, the strength of the laminate is decreased. And this decrease in the strength is due to delamination of the layers as the fiber used is unidirectional woven fiber

The weight by strength ratio of the prepared laminate is found to be very much less than that of MS Steel indicating more strength of the prepared laminate. The weight by strength ratio of m.s steel is 15.4% more than that of prepared hybrid FRP composite laminates. This indicates that the composite material is having less weight and more strength; it is very much useful in practical application.

Acknowledgements

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[6]. Chamis [6] presented the difference between fiber composites and traditional materials. Any predictive approach for simulating structural fracture in fiber composites needs to formally quantify: (1) all possible fracture modes, (2) the types of flaws they initiate, and (3) the coalescing and propagation of these flaws to critical dimensions for imminent structural fracture.