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Experimental and Static Analysis of Ford Vehicle FRP platform

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Abstract - *Composites are widely used in the automobile, aerospace, and athletics industry. Examples of composites include bumpers, wings, bicycle frames, and downhill skis. Combined with the low weight and high strength characteristics of composite materials, the ability to optimize a composite structure for a specific property is useful to a design engineer. Properties of the structure, such as stiffness, stress distribution, and modes of vibration are affected by fiber and matrix material, fiber orientation, and the number of lamina. This paper describes the investigation and development of displacement modeling techniques for fiber reinforced matrix composites. The objective of the work was to develop and validate predictive models for the Ford Vehicle FRP platform displacement behavior of these materials, with the aim of applying the results to an industrial demonstrator component.*

Key Words: *Ford Vehicle, FRP platform, experimental work, volume fraction, Orientation of Fibers*

1. INTRODUCTION

Composites are one of the most widely used materials because of their adaptability to different situations and the relative ease of combination with other materials to serve specific purposes and exhibit desirable properties.
In surface transportation, reinforced plastics are the kind of composites used because of their huge size. They provide ample scope and receptiveness to design changes, materials and processes. The strength-weight ratio is higher than other materials. Their stiffness and cost effectiveness offered, apart from easy availability of raw materials, make them the obvious choice for applications in surface transportation. In heavy transport vehicles, the composites are used in processing of component parts with cost-effectiveness. Good reproductively and resilience handling by semi-skilled workers are the basic requirements of a good composite material. While the costs of achieving advanced composites may not justify the savings obtained in terms of weight vis-a-vis vehicle production, carbon fibres reinforced epoxies have been used in racing cars and recently for the safety of cars. Polyester resin with suitable fillers and reinforcements were the first applications of composites in road transportation. The choice was dictated by properties like low cost, ease in designing and production of functional parts etc. Using a variety of reinforcements, polyester has continued to be used in improving the system and other applications. Most of the thermoplastics are combined with reinforcing fibres in various proportions. Several methods are used to produce vehicle parts from thermo plastics. Selection of the material is made from the final nature of the component, the volume required, apart from cost-effectiveness and mechanical strength. Components that need conventional paint finishing are generally made with thermosetting resins, while thermoplastics are used to build parts that are moulded and can be pigmented. Press moulded reinforced polyester possess the capability to produce large parts in considerable volume with cost-effectiveness.

2. Manufacturing process: Hand lay-up technique

Hand lay-up technique is the simplest method of composite processing. The infrastructural requirement for this method is also minimal. The processing steps are quite simple. First of all, a release gel is sprayed on the mold surface to avoid the sticking of polymer to the surface. Thin plastic sheets are used at the top and bottom of the mold plate to get good surface finish of the product. Reinforcement in the form of woven mats or chopped strand mats are cut as per the mold size and placed at the surface of mold after Perspex sheet. Then thermosetting polymer in liquid form is mixed thoroughly in suitable proportion with a, prescribed hardener (curing agent) and poured onto the surface of mat already placed in the mold. The polymer is uniformly spread with the help of brush. Second layer of mat is then placed on the polymer surface and a roller is moved with a mild pressure on the mat-polymer layer to remove any air trapped as well as the excess polymer present. The process is repeated for each layer of polymer and mat, till the required layers are stacked. After placing the plastic sheet, release gel is sprayed on the inner surface of the top mold plate which is then kept on the stacked layers and the pressure is applied. After curing either at room temperature or at some specific temperature, mold is opened and the developed composite part is taken out and further processed. The schematic of hand lay-up is shown in figure 1. The time of curing depends on type of polymer used for composite processing. For example, for epoxy based system, normal curing time at room temperature is 24-48 hours. This method is mainly suitable for thermosetting polymer based composites. Capital and infrastructural requirement is less as compared to other methods. Production rate is less and high volume fraction of reinforcement is difficult to achieve in the processed

composites. Hand lay-up method finds application in many areas like aircraft components, automotive parts, boat hulls, diase board, deck etc.

Hand Lay-Up Method

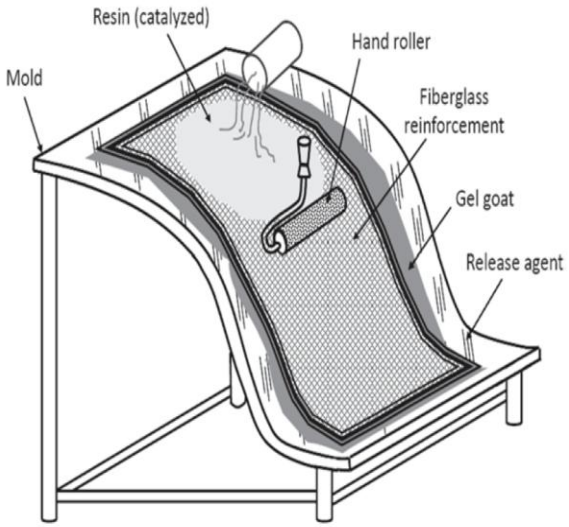
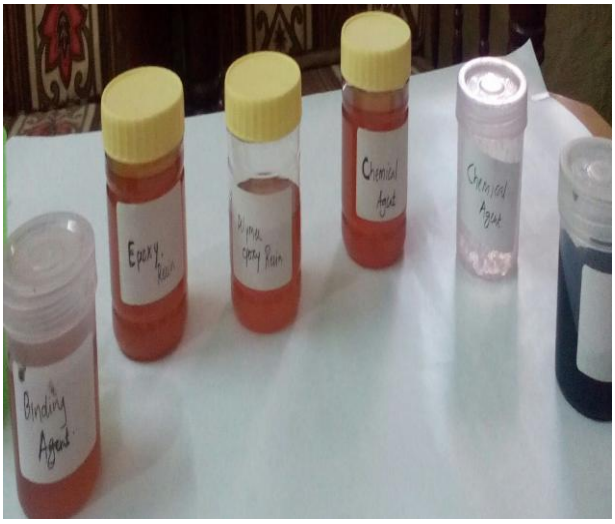


Fig:1



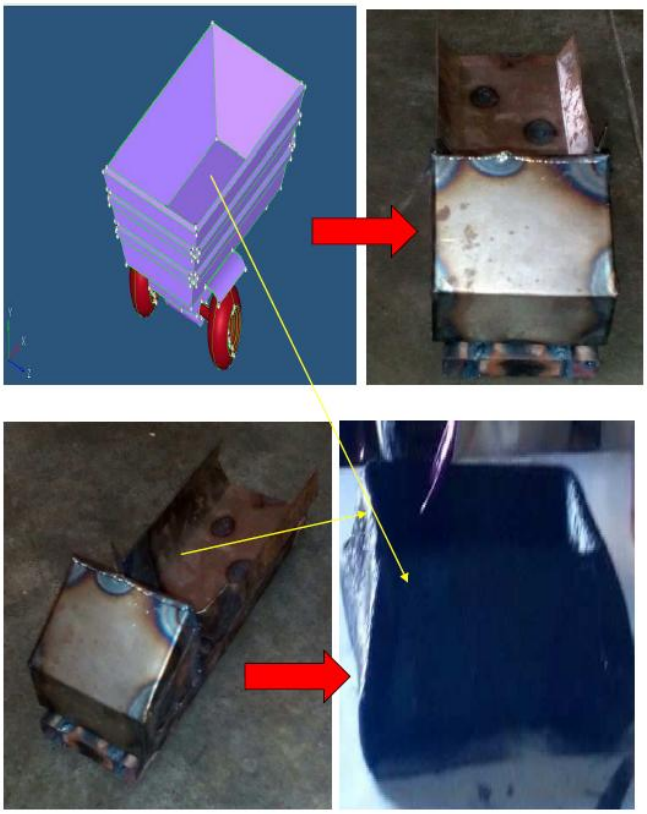


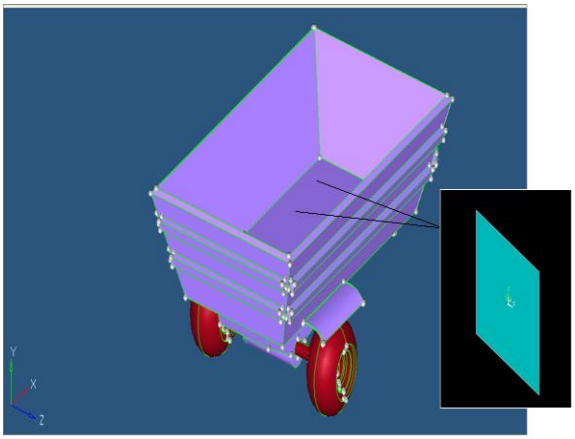
Fig: Hand LAY-UP

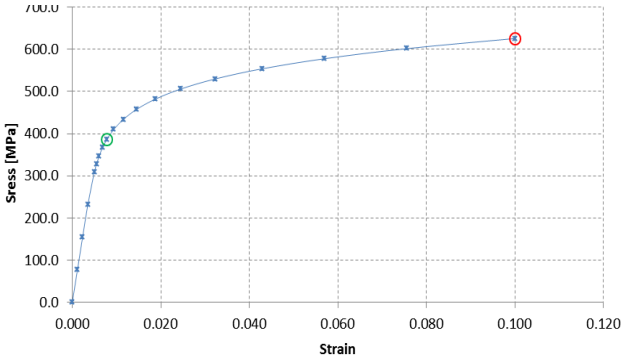
3. Experimental set-up

The following equipment shown in fig. below was used to perform a tensile test: Instron 1195 test machine used for tensile tests. Truck Box- Tail Gate composite plate,Tensile test specimen with extensometer mounted to compute FRF's,Post-processing software to find the displaced in the composite plate.

Material Specifications	
Material	Polyethylene
Structure	Plate shape
Size	Length=84mm,Height=133.5mm,Width =6mm
Weight	135.6gm

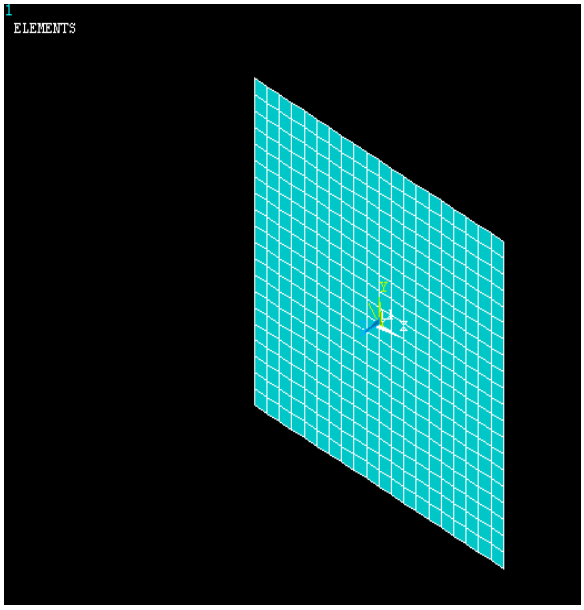
Table -1: Material Specifications



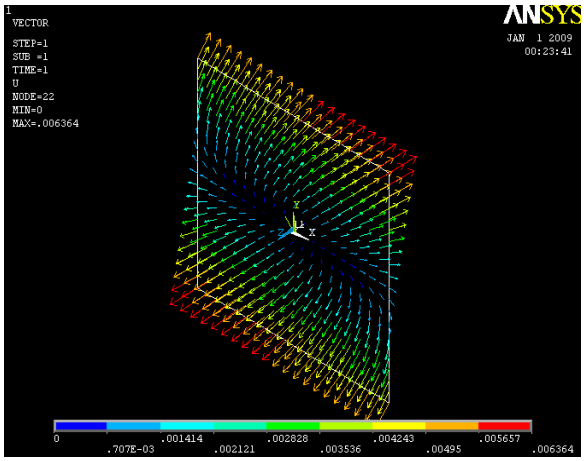


FINITE ELEMENT ANALYSIS : FORD VEHICLE FRP PLATFORM

The finite element method is numerical analysis technique for obtaining approximate solutions to a wide variety of engineering problems. Because of its diversity and flexibility as an analysis tool, it is receiving much attention in almost every industry. In more and more engineering situations today, we find that it is necessary to obtain approximate solutions to problem rather than exact closed form solution. It is not possible to obtain analytical mathematical solutions for many engineering problems. An analytical solutions is a mathematical expression that gives the values of the desired unknown quantity at any location in the body, as consequence it is valid for infinite number of location in the body. For problems involving complex material properties and boundary conditions, the engineer resorts to numerical methods that provide approximate, but acceptable solutions.



The finite element method has become a powerful tool for the numerical solutions of a wide range of engineering problems. It has been developed simultaneously with the increasing use of the high-speed electronic digital computers and with the growing emphasis on numerical methods for engineering analysis.



This method started as a generalization of the structural idea to some problems of elastic continuum problem, started in terms of different equations.Finite element model of composite laminated structure discretizes the entire thickness along the linear direction into number of elements. Often 2D-modeling is sufficient for getting accurate results. The shell elements are the famous 2D discretisation elements. A shell element has n nodes with each node having 6 DOFs. The present work FEM is merely employed for the verification of elastic constants obtained from classical beam theory. In addition the stresses and strain at the each layer and the interfaces can be addressed. An eight-nodded quadrilateral C0 continuous isoparametric shell element (SHELL 281) with six-degrees-of-freedom per node (ux, uy, uz, θx, θy, θz) is employed.

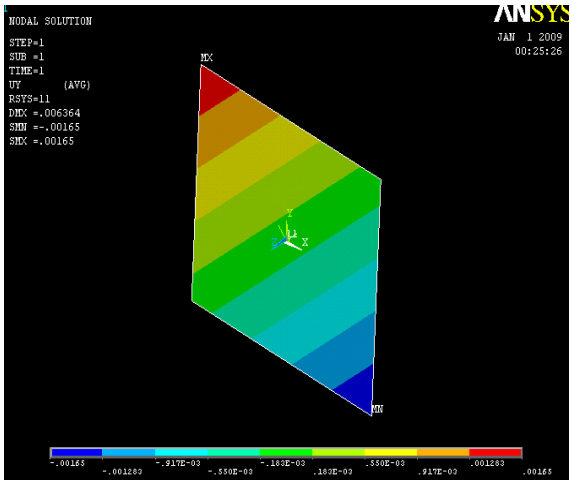
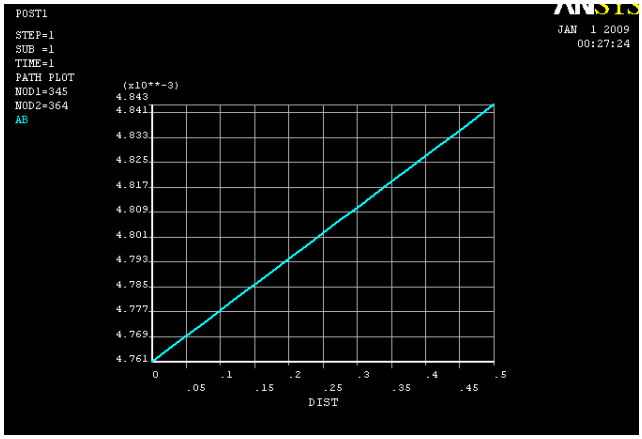


Fig: Nodal Solution for Y Displacement



CONCLUSIONS

In the current work, Ford Vehicle FRP platform reinforced polymer resin a matrix composites were manufacturing using layer by layer methods. The specimen will be testing machines and results are analyzed by ANSYS software

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