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Static Structural Analysis of Automobile Hood using Natural Hybrid Fiber Composite

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Abstract: *Natural fibres are a kind of renewable source and a replacement generation of reinforcements and supplements for polymer-based materials. The event of natural fibres composite materials or environmentally friendly composites has been a hot topic recently because of the increasing environmental awareness. Natural fibres are one such skilful material that replaces the artificial materials and its connected product for the less weight and energy conservation applications. the appliance of natural fibres bolstered compound composites and natural-based resins for replacement existing synthetic polymer or glass fibres reinforced materials in large. Automotive and aircrafts industries are actively developing different styles of natural fibres, primarily on hemp, flax and sisal and bio resins systems for their interior components. High specific properties with lower costs of natural fibres composites are making it attractive for various applications. within the gift study automobile hood is analysed for hybrid material. From the analysis it's evident that the material is maintaining its structural integrity for given loading condition.*

Keywords: Natural Fibres, Composites, Hybrid, Automobile Hood, Static Analysis, etc.

I. INTRODUCTION

FRC is superior fiber composite achieved and created doable by cross-linking plastic fiber molecules with resins within the FRC material matrix through a proprietary molecular re-engineering method, yielding a product of remarkable structural properties. Through this effort of molecular re-engineering hand-picked physical and structural properties of wood are with success cloned and unconditional within the FRC product, additionally to different important attributes to yield performance properties superior to up-to-date wood. This material, not like different composites, will be recycled up to twenty times, permitting scrap FRC to be reused once more and once more. The failure mechanisms in FRC materials embody laminating, intralaminar matrix cracking, longitudinal matrix cacophonous, fiber/matrix debonding, fiber pull-out, and fiber fracture.

There are mainly 2 sorts in material one is natural fiber material and artificial material. Composites will be natural or artificial. Wood, a natural composite, may be a combination of polyacrylamide or wood fibers and a substance referred to as polymer. The fibers offer wood its strength; polymer is the matrix or natural glue that binds and stabilizes them. different composites are synthetic (man-made). laminate may be a man-made composite that mixes natural and artificial materials. skinny layers of wood veneer are warranted together with adhesive to create flat sheets of laminated wood that are stronger than natural wood.

Hybrid materials are accustomed to achieve optimum ratio between the performances and also the costs of the material. costs chemical compositions, completely different weights, and mechanical properties will be applied among identical materials. Therefore, a material will be designed in the needed specification with low value. As an example, a mixture of carbon fibers and aramid within the yarn and warp arrangement is feasible, leading to a composite with various elastic properties within the main directions of stress.

The main objective is to use hybrid composite for automobile hoods. The auto hood is mainly factory-made using steel and metal. The hood (North american English) or bonnet (Commonwealth English) is the hinged cowl over the engine of automobiles. Hoods will open to allow access to the engine compartment, or trunk (boot in Commonwealth English) on rear-engine and some mid-engine vehicles for maintenance and repair.

Figure 1: Existing Automobile Hood

So, we replace the car hood material with the natural composite hybrid material and perform FEA on both existing model and optimized hybrid composite model to check out stress distribution and maximum deformation generated on bonnet. The tool use for analysis is static structural tool and the software used for project is CATIA and ANSYS software.

II. LITERATUREREVIEW

Changduk Kong, Haseung Lee, Hyunbum Park [1]: This article essentially centers around regular composite use to foster the auto hood. There has been a developing interest in the utilization of normally sourced filaments for use in composites plan and assembling. In this work, an underlying model on vehicle hood utilizing regular flax fiber composite was performed. The foundational layout consequences of flax/vinyl ester composite hood were contrasted and the plan aftereffects of metal hood structure.In this work, an examination on mechanical properties of flax/vinyl ester regular fiber composite is performed for the plan of eco-accommodating design utilizing flax/vinyl ester composite. The Vacuum Assisted Resin Transfer Molding (VARTM) fabricating strategy is embraced for assembling the flax fiber composite construction.

The mechanical properties of flax/vinyl ester examples were tried. At last, the underlying model and assembling of the car hood was performed utilizing mechanical properties. Through the underlying examinations, it is affirmed that the planned model utilizing regular flax composite is satisfactory for primary security and strength. The full-scale static primary test was performed under the recreated streamlined burdens. From the test results, it is tracked down that the planned hood has the primary respectability. Moreover, the deliberate outcomes are very much concurred with the logical outcomes like avoidances, strains.

Sodisetty V N B Prasad, G. Akhil Kumar, K. V. PrudhviSai, B. Nagarjuna[2]: The regular fiber supported polymer (NFRP) composites are as a rule broadly utilized as trade for traditional materials in different car and aviation applications. Regular fiber has properties like high explicit strength, lighter weight, biodegradable, minimal expense and promptly accessible. The principal objective of utilizing NFRPs in this examination is to upgrade the strength and lessen the heaviness of auto parts. Curved guard in a bike is given to forestall mud, water and flotsam and jetsam to fall on the rider and vehicle from the turning tire. In this current examination, Mudguard was manufactured utilizing regular fiber built up epoxy composite. Regular filaments, for example, Sisal, Ramie and Pineapple were utilized as fortifications for the Epoxy grid.

The current investigation manages the plan and improvement of normal fiber supported epoxy composites for the bike mud monitor segment. Regular strands like ramie, sisal and pineapple are chosen because of their properties like less weight, low thickness, minimal expense and high explicit strength. It likewise helps in diminishing ecological effects by utilizing regular filaments rather than glass strands as glass strands produce contamination while creating. Best blend of filaments isassessed from mechanical testing, PSRS composite example has the high rigidity of 24.43 MPa with pressure heap of 0.32 KN and effect heap of 6J. Trial investigation was completed to appraise the best boundaries for boring the PSRS example.

Taguchi strategy with L9 symmetrical exhibit was chosen by differing the shaft speed, boring tool measurement and feed rate. Feed rate was observed to be the principle affecting variables while boring this example. The

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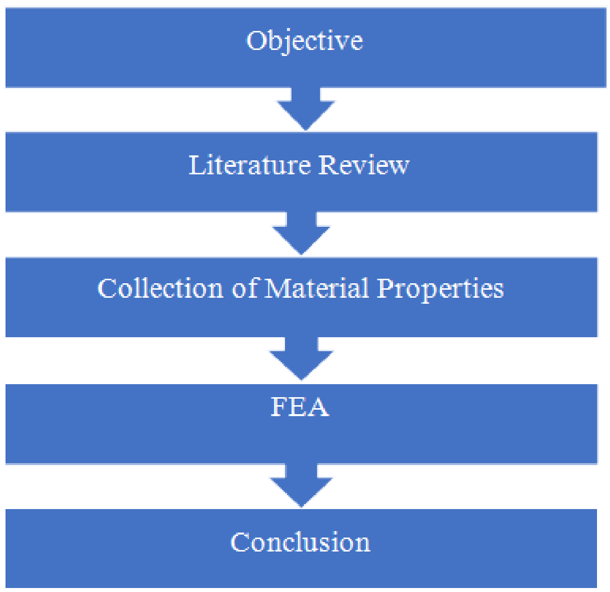
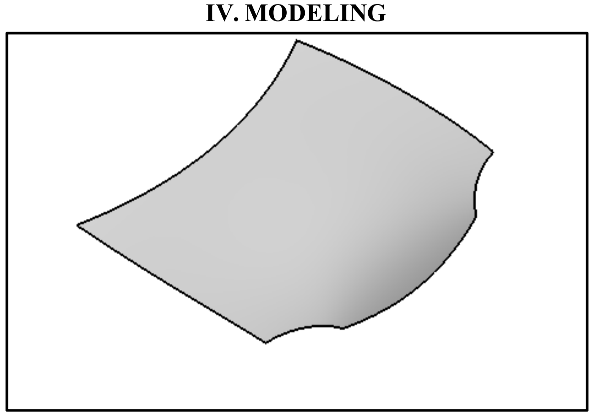
upsides of drill measurement of 5mm, feed pace of 50mm/min and speed of 3000 rpm were chosen as the best boundaries from relapse investigation.

Enrico Mangino, Joe Carruthers, Giuseppe Pitarresi[3]: In this writing, the writer clarifies about utilization of composite material in the car industry. The car business' utilization of underlying composite materials started during the 1950s. Since those early days, it has been shown that composites are lightweight, weariness safe and effectively formed to shape – at the end of the day, an apparently alluring option in contrast to metals. In any case, there has been no broad change from metals to composites in the auto area. This is on the grounds that there are various specialized issues identifying with the utilization of composite materials that actually should be settled including precise material characterisation, assembling and joining. This paper reports the discoveries of a new European drive that analyzed the future utilization of composite materials in the car area.

III. METHODOLOGY



IV. MODELING



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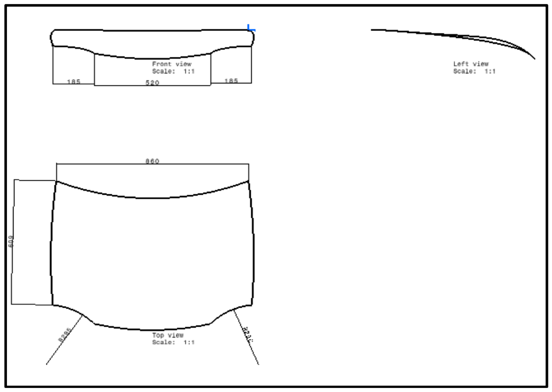


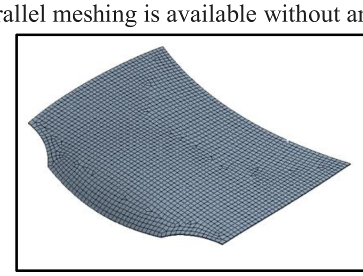
Figure 2: Automobile Hood Concept CAD Model

V. MESHING

ANSYS Meshing is a general-purpose, intelligent, automated high-performance product. It produces the most appropriate mesh for accurate, efficient multi-physics solutions. A mesh well suited for a specific analysis can be generated with a single mouse click for all parts in a model. Full controls over the options used to generate the mesh are available for the expert user who wants to fine-tune it. The power of parallel processing is automatically used to reduce the time you have to wait for mesh generation.

Creating the most appropriate mesh is the foundation of engineering simulations. ANSYS Meshing is aware of the type of solutions that will be used in the project and has the appropriate criteria to create the best suited mesh. ANSYS Meshing is automatically integrated with each solver within the ANSYS Workbench environment.

For a quick analysis or for the new and infrequent user, a usable mesh can be created with one click of the mouse. ANSYS Meshing chooses the most appropriate options based on the analysis type and the geometry of the model. Especially convenient is the ability of ANSYS Meshing to automatically take advantage of the available cores in the computer to use parallel processing and thus significantly reduce the time to create a mesh. Parallel meshing is available without any additional cost or license requirements.



Details of "Face Sizing" - Sizing	
Scope	
Scoping Method	Geometry Selection
Geometry	2 Faces
Definition	
Suppressed	No
Type	Element Size
Element Size	15.0 mm

Statistics	
Nodes	2556
Elements	2463

Figure 3: Meshing of Automobile hood

VI. BOUNDARY CONDITIONS

A boundary condition for the model is the setting of a known value for a displacement or an associated load. For a particular node you can set either the load or the displacement but not both.The main types of loading available in FEA include force, pressure and temperature. These can be applied to points, surfaces, edges, nodes and elements or remotely offset from a feature. The way that the model is constrained can significantly affect the results and requires special consideration. Over or under constrained models can give stress that is so inaccurate that it is worthless to the engineer.In an ideal world we could have massive assemblies of components all connected to each other with contact elements but this is beyond the budget and resource of most people. We can however, use the computing hardware we have available to its full potential and this means understanding how to apply realistic boundary conditions.

Boundary Condition for Conventional Material

Fixed support is applied on the three sides back side, left side and right side as shown in figure.

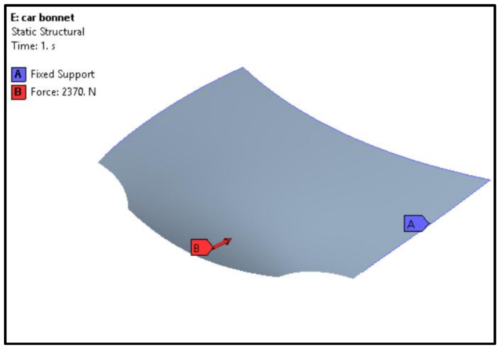


Figure 4: Boundary Condition for Conventional Material

Force acting on the body is from front side on the hood and the load value is considered from literature [3] which 2370 N. The force is uniformly distributed at whole front surface of hood as shown in figure

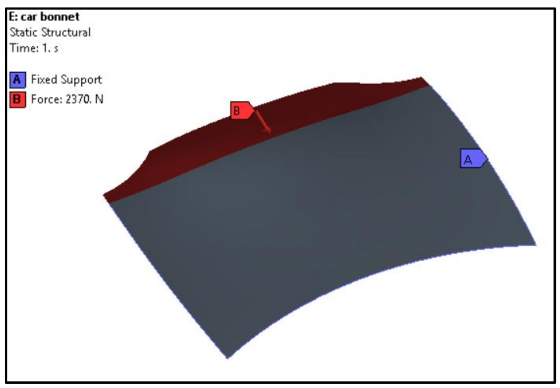


Figure 5: Loading Condition for Conventional Material

Boundary Condition for Hybrid Material

Fixed support is applied on the three sides back side, left side and right side as shown in figure.

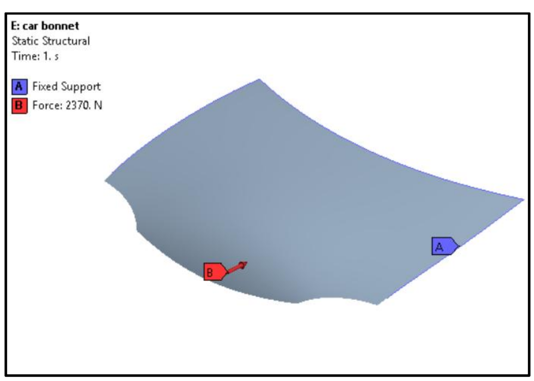


Figure 6: Boundary Condition for Hybrid Material

Force acting on the body is from front side on the hood and the load value is considered from literature [3] which 2370 N. The force is uniformly distributed at whole front surface of hood as shown in figure

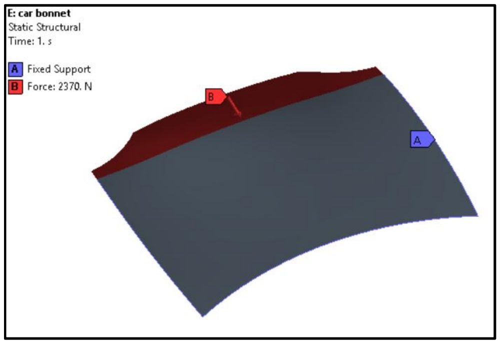


Figure 7: Boundary Conditions

VII. ANALYSIS OF AUTOMOBILE HOOD

Automobile hood is analysed under applied boundary condition and equivalent stress and deformation has been determined

For Aluminium

Deformation and stress analysis is done for automobile hood with aluminium

Total deformation- The total deformation & directional deformation are general terms in finite element methods irrespective of software being used. Directional deformation can be put as the displacement of the system in a particular axis or user defined direction. Total deformation is the vector sums all directional displacements of the systems.

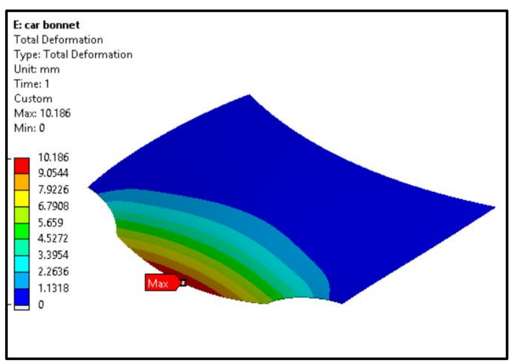


Figure 8: Total deformation of Aluminium

Equivalent Stress -

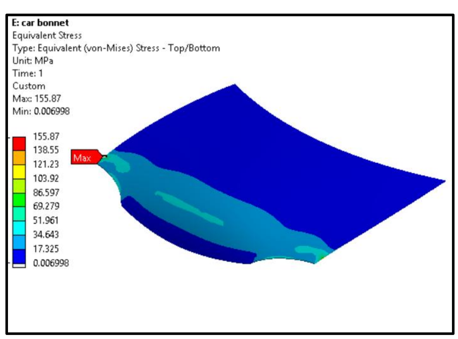


Figure 9: Equivalent Stress of Aluminium

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For Hybrid Composite

For analysis of hybrid composite layer selection and lamina formation is done. The best possible combination and orientation has been selected for the composite laminate

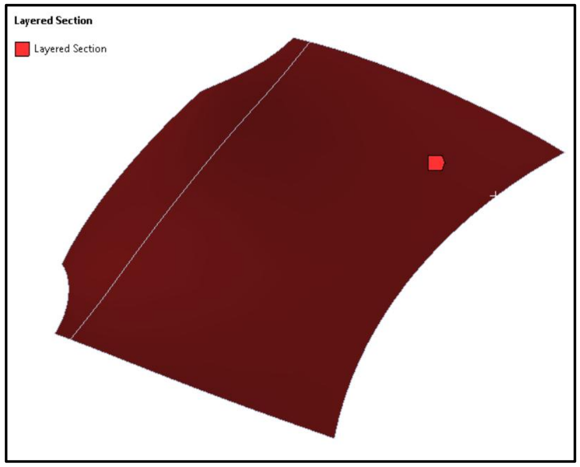

Figure 10: Hybrid Composite

Laminate scheme and orientation is as follows:

Layer	Material	Thickness (mm)	Angle (°)
(+Z)			
4	BAMBOO FIBER COMPOSITE	0.5	0
3	JUTE FIBER COMPOSITE	0.5	0
2	BAMBOO FIBER COMPOSITE	1	0
1	JUTE FIBER COMPOSITE	1	0
(-Z)			

Total Deformation- The deformation results are as shown in the analysis result. It has been observed that the deformation is quite high in composite material as compared to conventional material

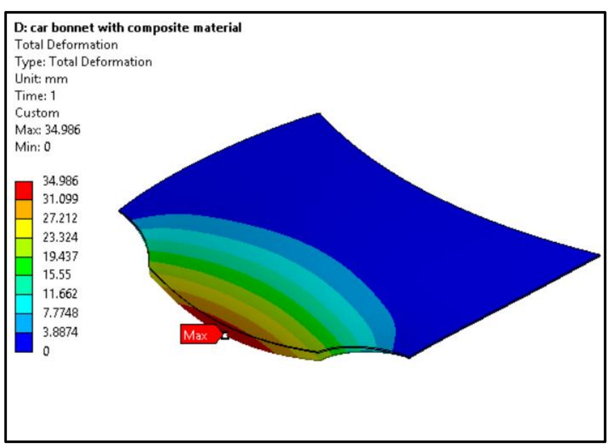

Figure 11: Total deformation of Hybrid Composite

Equivalent Stress – Equivalent stress for the composite is as shown in figure. It has been observed that the material is maintaining its structural integrity as the equivalent stress is less than allowable stress for the given material.

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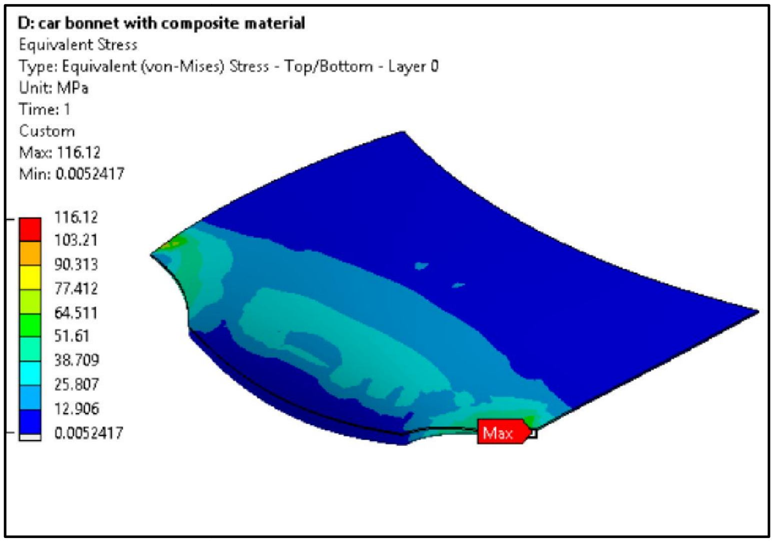


Figure 12: Equivalent Stress of Hybrid Composite

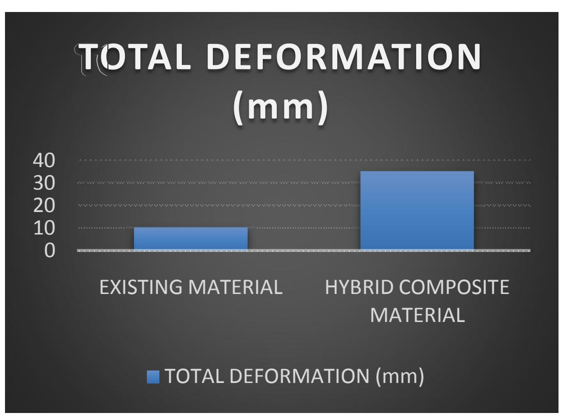
VIII. RESULT AND DISCUSSION

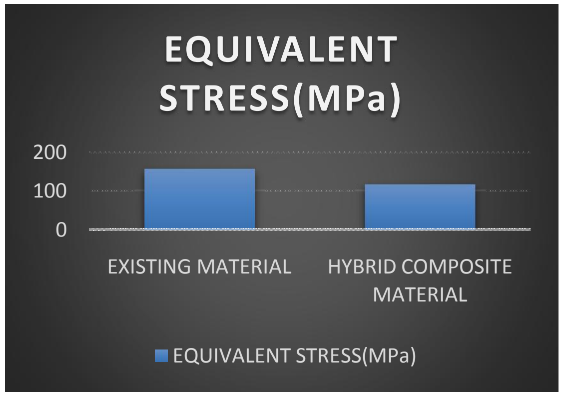
The static analysis performed on automobile hood with the help of ANSYS software. Perform Static structural analysis to find out total deformation and equivalent stress.

Table 1: Structural analysis of total deformation and equivalent stress

Sr No	Material	Totsl Deformation (Mm)	Equivalent Stress (Mpa)
1	Existing Material	10.18	155.87
2	Hybrid Composite Material	34.98	116.12

In existing material total deformation and equivalent stress is 10.18 mm and 155.87 MPa.In hybrid material total deformation and equivalent stress is 34.98 mm and 116.12 MPa. The graphical comparison of results is as below:





The stress observed on the optimized model is 116.2 MPa which is less than the material allowable stress. This shows that the material is maintaining its structural integrity for the given load condition.

IX. CONCLUSION

In this work the modelling of automobile hood is done. The automobile hood is then analyzed for conventional material which is aluminium, and hybrid composite of jute fiber and bamboo fiber. For given loading conditions the deformation and equivalent stress has been determined. As it was evident from the results that composite material was showing higher deformation than the conventional material. But as the equivalent stress of the composite material is less than the allowable stress for material hence it is maintaining its structural integrity.

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