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Design and Analysis of Scooty Front Panel By Using Natural Fiber Reinforced Composites

B Venkatesh[1],U Anil Kamar[2]
M.Tech Student[1], Assistant Professor[2], Department of Mechanical Engineering, Malla Reddy Engineering College, Hyderabad, Telangana, India[1,2].
Email: venkatesh.bandam@gmail.com[1], anilkumar_u@ymail.com[2].

Abstract::The materials and products developed using natural fibers will have enhanced properties compared to the conventional thermoplastics, These fibers have vast applications in automotive industries.In this proposed project the mechanical properties of ARE fiber, like density, modulus of elasticity, poison's ratio are obtained by using flexural and tensile testing as per the ASTM standards. In this work, the scooty front panel is replaced by means of composite material and it modeled in CREO 3.0 and then it is analyzed in ANSYS 15.0 for the deformation, structural stress analysis and pressure distribution, and compared with the existed material whether proposed material is suitable or not to the application.

Keywords: Bauhinia racemosa(are), Natural fiber, reinforced, CREO,ANSYS

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1. INTRODUCTION

Fiber-reinforced composite materials are an important class of engineering materials that offer outstanding mechanical properties with flexibility in design and ease of 0fabrication. The advanced composites have the advantages of light weight, corrosion resistance, impact resistance and excellent fatigue strength. Today fiber composites are widely used in diverse applications such as automobiles, aircraft, containers and piping, sporting goods, electronics and appliances. These composites are fabricated using various reinforcing materials like glass fiber, carbon fibers, graphite, kevlar fibers, etc. These fibers are non-biodegradable and offer environmental problems in disposing the scrap. The present trend of development of any technology should comply with the sustainable development and preserve the biodiversity. In view of this global concern, natural fiber reinforced composites are being envisaged that offer least problems to the environment at the same time offer new and better materials to the society The materials and products developed using natural fibers will not only have enhanced properties compared to the conventional thermoplastics or complete wood based products but also will be cost effective. The use of green composite materials is predicted to have tremendous market potential because of the increasing awareness of environmental issues such as biodegradation, renewable resources, Co2 emission reduction through promotion of plantations. The researchers are exploring theapplication of various natural fibers like sisal, jute, kenaf, palmyra, etc., with polyester and epoxy resins as matrix materials.

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2. LITERATURE REVIEW

Thi-Thu-loan Doan, Hanna Broadowsky. Edith madder[1] have studied laminates thermal, hydrothermal and mechanical behavior and these laminates are made out of jute fiber and poly propylene resin

G. Adinarayana, Ch. Ashok Kumar, M. Ramakrishna[2] The desigining of the bus panel and analyzing it in the ansys has done in this paper

Elisazini and Maria Letizia Focareta[3] have studied laminates thermal properties which are made out of flax fiber and bacterial poly resin.

Execute Rooriguez, RopertoPetruceetal [4], have studied the mechanical properties of composites made up of jute and flax fibers and Unsaturated polyester & modified acrylic

V. Alvarez, A. Vazquez and C.Benal[5] have studied the fracture behavior of Laminates made out of sisal fiber-reinforced starch based composites

ElintonS.demedeiros, Kuruvilla Joseph [6] have studied the Mechanical properties of phenolic composites reinforced with Jute/cotton hybrid fabrics

V. R. Raman Bharath, B. Vijaya Ramnath and N. Manoharan[7]Hence, this paper aimed to review the works done using kenaf fibers as reinforcements for making composites with various resins. Also, this paper gave an overview of the applications of kenaf reinforce polymer composites

3. TOOLS USED

3.1Creo

Creo is latest version of pro-engineer and it is a 3d modelling tool which is more helpful to create models and render, by using this tool we can design individual models and assemblies also, and it is reduces human efforts while creating complicating structures.

3.2Ansys workbench

Ansys is a cae tool which runs based on numerical methods and here numerical methods are FEM/FEA concepts and this tool helps to know the values of deformation and stress and strength values for particular boundary conditions, by this tool we can avoid sudden breakages in real time.

4. MODELLING

CAD modeling of scooty front panel

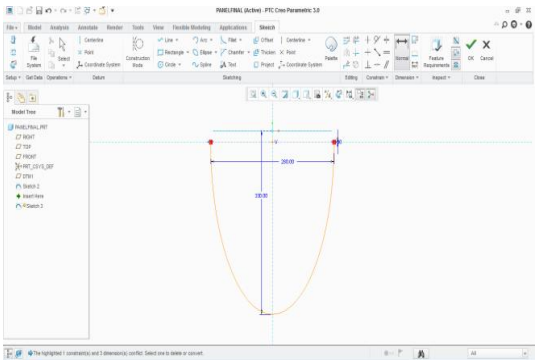


Figure 1 : 2D sketch of front view

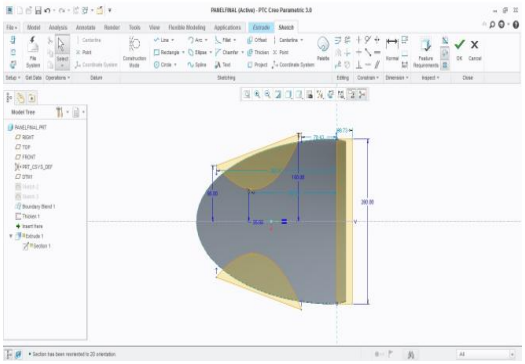


Figure 2 : Extruding of side curves

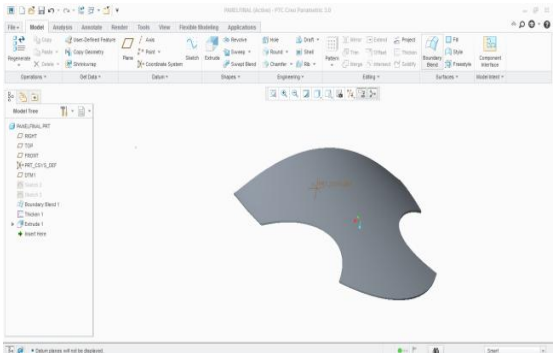


Figure 3 : Final 3D modal of panel

5. MATERIAL PROPERTIES

The materials including Bauhinia Racemosa (ARE)andAluminiumalloy, are considered in this study. These materials are selected by comparing their properties with already existing material properties i.e., Poly Vinyl Chloride.

5.1 Material properties of Bauhinia Racemosa (ARE)

Density	: 1.11 g/cm^3
Young's Modulus	: 2.17 GPa
Poisson's Ratio	: 0.21

5.2Material properties of Aluminium alloy

Density	2.7g/cm^3
Young's Modulus	68.9 GPa
Poisson's Ratio	0.33

6. ANALYSIS OF SCOOTY FRONTPANEL USING ANSYS

Now open Ansys workbench and import IGES model which we were designed in pro-e/ creo tool

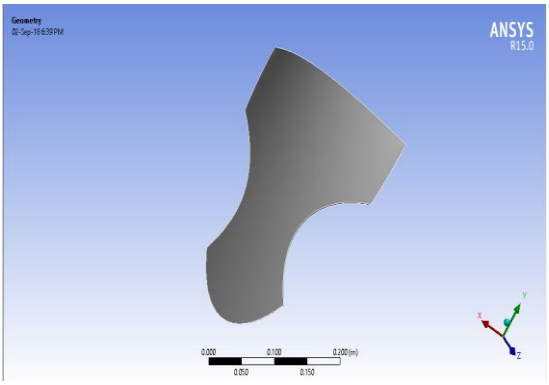


Figure 3 : Imported view of panel

And the above image is shows imported model in Ansys window

6.1 Meshing:

Meshing is concept which helps and solves the problem and gives solution in Ansys workbench, this meshing transfer the loads throughout the body with nodes and elements

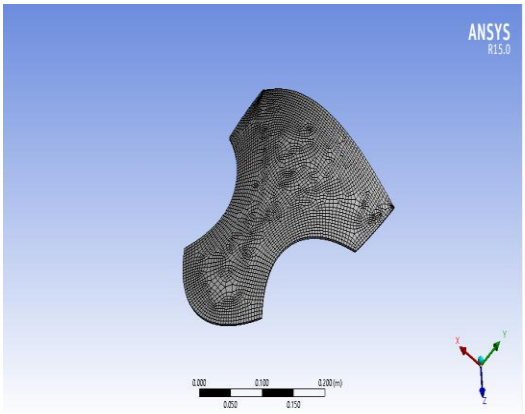


Figure 4: Meshed component

6.2 Boundary conditions:

Here the model analyzed with several boundary conditions finally here showing the maximum efficiency of our model,

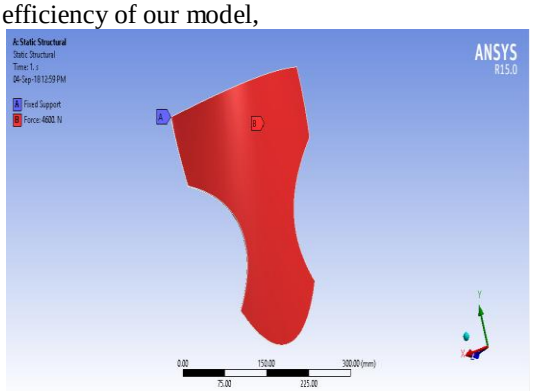


Figure 5 : Boundary conditions

6.3Apply loads:

Static structural→ supports → fixed support → select edges
Loads→ force→ select surface → ok→ enter value 4600N→ ok.
Solution → solve→ deformation, stress, shear stress, strain

6.4 Ansys results for PVC Material

6.4.1 Total Deformation

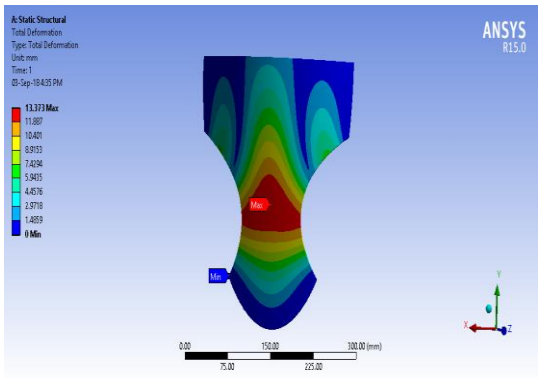


Figure 6 : Total deformation of panel

6.4.2 Equivalent Stress

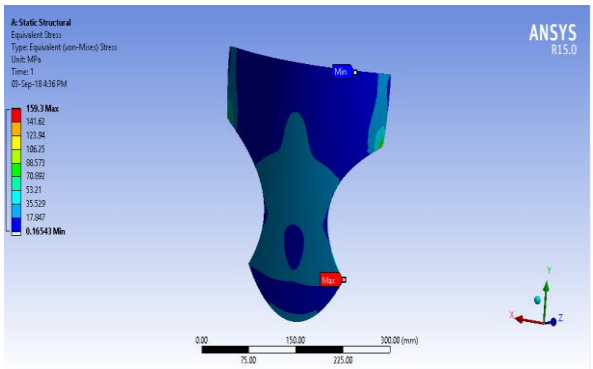


Figure 7: Equivalent Stress of panel

6.4.3 Equivalent Shear Stress

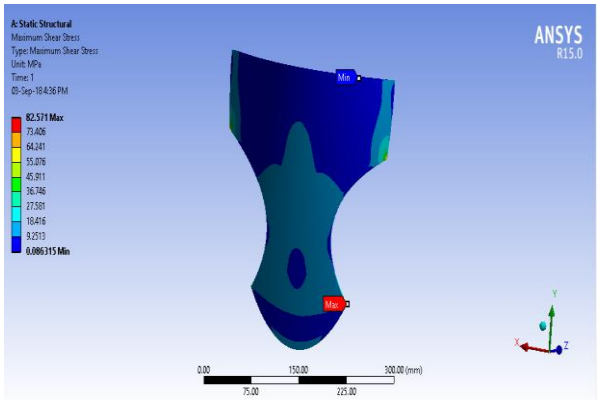


Figure 8 : Equivalent Shear stress of panel

6.4.4 Equivalent Elastic Strain

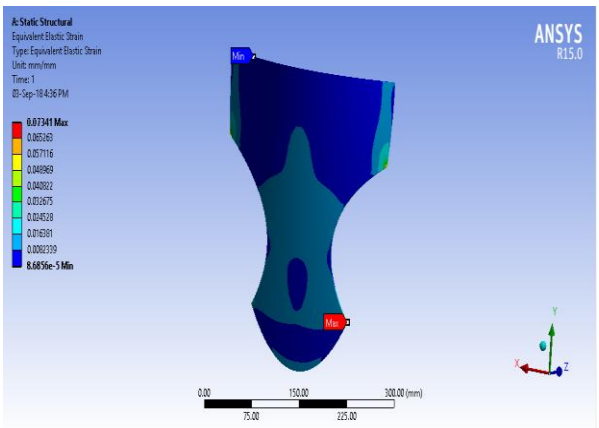


Figure 8 : Equivalent Elastic Strain of panel

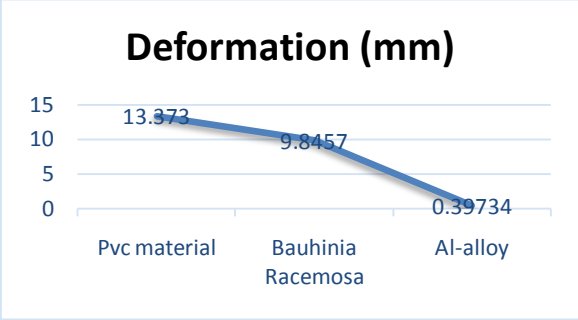
7. COMPARING RESULTS

	PVC material	Bauhinia Racemosa	Al-alloy
Deformation (mm)	13.373	9.8457	0.39734
Shear stress (MPa)	85.571	73.714	77.091
Stress (MPa)	159.3	142.5	144.41
strain	0.07341	0.052231	0.002034

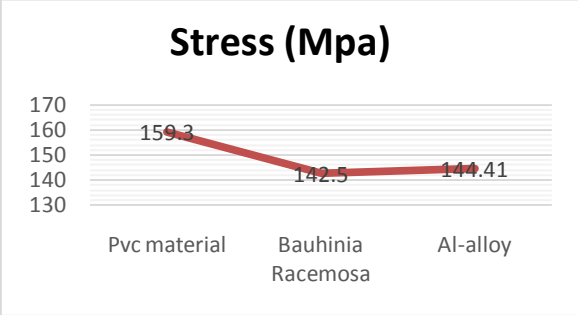
Table I :Comparision of obtained values of three materials

From the above table here pvc material has nearly 160Mpa stress and 13.373mm deformation when we compare these results with other materials al-alloy has 144.41Mpa stress and 0.39734mm deformation and Bauhinia Racemosa has less stress than other two materials 142.5Mpa and 9.8457mm deformation which is less than PVC and greater than al-alloy, this high deformation values doesn't effect our body until its exceed their yield limit, by single analysis results we cannot replace one material with another material, to get more proper and accurate results here need to becheck dynamic results which are useful to know avoid resonance by this results and comparing both static and dynamic values then replacement of material can suggest.

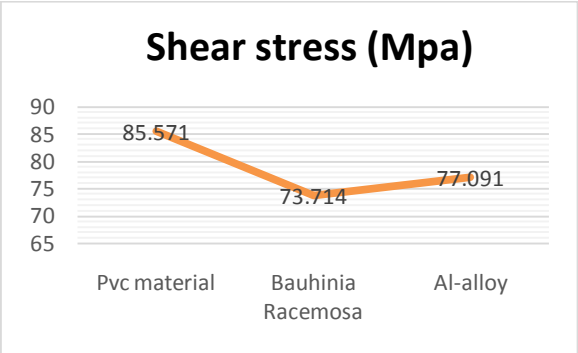
7.1 Graphs of obtained results:



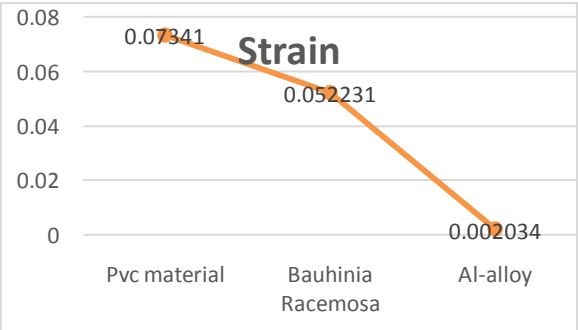
Graph 1 : Total Deformation



Graph 2 : Equivalent Stress



Graph 3 : Equivalent Shear stress



Graph 4 : Equivalent elastic Strain

8.MODAL ANALYSIS (Dynamic Analysis):

8.1 *Natural frequency*

A sound wave is created as a result of a vibrating object. The vibrating object is the source of the disturbance that moves through the medium. The vibrating object that creates the disturbance could be the vocal cords of a person, any object that vibrates will create a sound. The sound could be musical or it could be noisy; but regardless of its quality, the sound wave is created by a vibrating object.If you know how an object vibrates, you know what kinds of waves it will create.If you want to make specific kinds of waves, you need to create objects with natural frequencies that match the waves you want.
All bodies have natural frequencies because all bodies have mass and stiffness's. And mechanical vibration is essentially a play between inertial and elastic forces.

Import geometry→Assign material properties→
Static structural→fixed support→select side edges
Analysis settings→no of modes→6
Solution→deformation

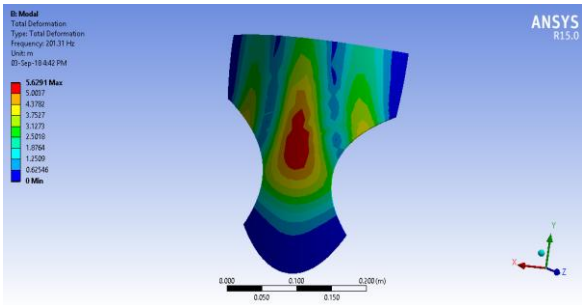


Figure 9 : Dynamic analysis of panel Mode1

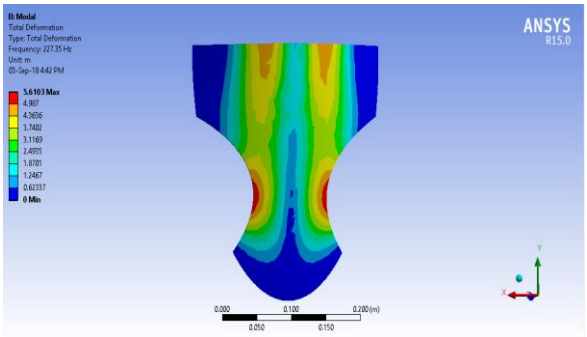


Figure 10 : Dynamic analysis of panel Mode3

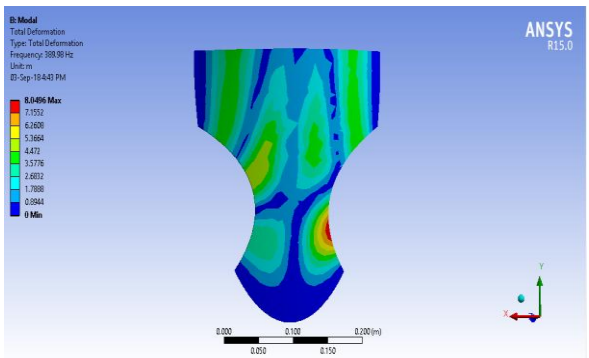


Figure 11 : Dynamic analysis of panel Mode5

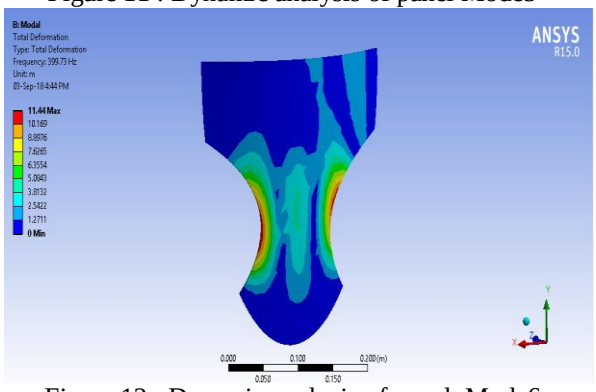


Figure 12 : Dynamic analysis of panel Mode6

8.2 Frequency Comparison

Mode	PVC material (Hz)	Bauhinia Racemosa (Hz)	Al-alloy (Hz)
Mode1	201.31	746.18	212.18
Mode2	227.35	823.69	229.94
Mode3	255.93	933.58	261.9
Mode4	316.56	1154.9	323.03
Mode5	389.98	1448	407.97
Mode6	399.73	1466.4	418.08

Table 2 : Dynamic analysis values of three materials

From the table and results for each material here shown, natural frequency values are given for each mode. From the results Bauhinia Racemosa got high frequency range values and al-alloy got better results than pvc material less than Bauhinia Racemosa.

8.3 Flow Analysis:

Flow analysis results are useful to show how the velocity flow and pressure distribution on the model. Selected inlet velocity as 25m/s.

8.3.1 Pressure Analysis

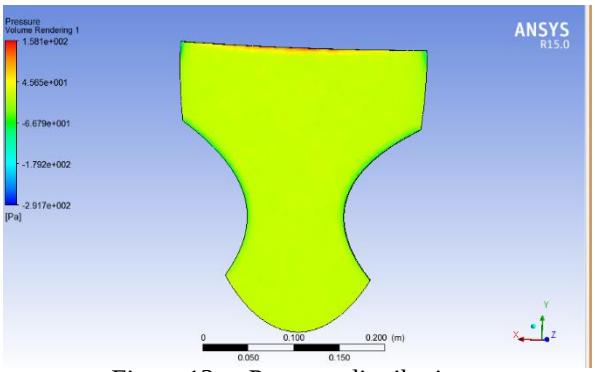


Figure 13 : Pressure distribution

8.3.2 Velocity Flow Analysis

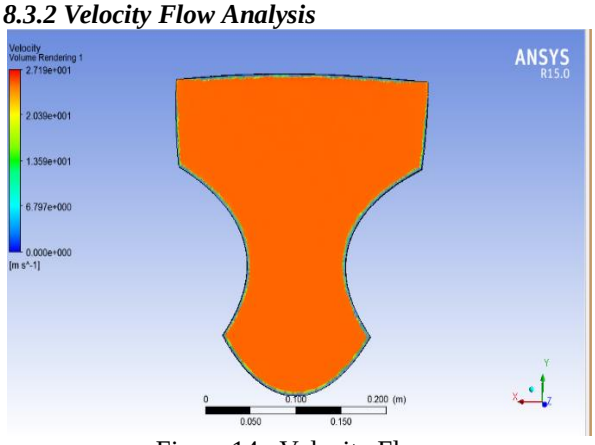


Figure 14 : Velocity Flow

From the images we can find pressure distribution and maximum velocities values.

9. CONCLUSION:

In this project scooty front panel model was designed by using cad tool creo-3.0 and then analyzing their maximum stress and deformation values,by using CAE tool Ansys workbench, here PVC considering as existing material , Bauhinia Racemosa and al-alloy are as new material, here boundary conditions applied for each material is same.

In static analysis Bauhinia Racemosa got 142.5Mpa stress value where pvc material got 159.3Mpa stress value and al-alloy got 144.41Mpa, from this al-alloy and Bauhinia Racemosa materials can reduce the overall stress values on the body. By knowing single analysis results its not a good decision to replace a material with another one. To get more accurate and efficient values here dynamic analysis also done and here pvc material got very less frequency range than other two materials which means our materials are satisfying both static and dynamic loading conditions and proves both materials were best compare to existing pvc material.

Even though both materials are satisfying our requirements but here we suggest Bauhinia Racemosa material than al-alloy because it reduce the overall structure weight and increases strength and also it is environment eco-friendly material.

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