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Design and Analysis of Air less Tires

Dr. R. Ramachandra
[1] *Principal and Professor*
Department of Mechanical Engineering
Sri Krishnadevaraya Engineering College, Gooty, Andra Pradesh
rrcrepana@gmail.com

Abstract: An airless tire is a solitary unit supplanting the pneumatic tire, in getting assembly. It replaces every one of the segments of a regular outspread tire and is comprised of an unbending center point, associated with a shear band by methods for adaptable, deformable polyurethane spokes and a tread band, all working as a solitary unit. The Tweel, a sort of airless tire, however, discovers its nonspecific application in military and earth moving applicant particles because of its level confirmation configuration can render the pneumatic tire out of date in do mastic autos. Our project includes outline an investigation of an airless tire for doing mastic autos; this will be followed by an anxiety examination contemplate. The model will be done in Pro E and investigation will do in Ansys.

Keywords: Airless tire, Ansys, Pro. E

1.1 INTRODUCTION

The airless tire is tires that are not upheld by air pressure. They are used in small vehicles, for example, riding yard cutters and mechanized golf trucks. They are additionally used in overwhelming hardware, for example, excavators, which are required to work on locales, for example, building obliteration, where the danger of tire punctures is high. Tires made out of shutting cell polyurethane froth are additionally made for bikes and wheelchairs.

1.2 Pneumatic Tires

Pneumatic tires have a hollow center, but they are not pressurized. They are light-weight, low-cost, puncture proof, and provide cushioning.[1] These tires often come as a complete assembly with the wheel and even integral ball bearings. They are used on lawn mowers, wheelchairs, and wheelbarrows. They can also be rugged, typically used in industrial applications,[2] and are designed to not pull off their rim under use.

Tires that are hollow but are not pressurized have also been designed for automotive use, such as the Tweel (a portmanteau of tire and wheel), which is an experimental tire design being developed at Michelin. The outer casing is rubber as in ordinary radial tires, but the interior has special compressible polyurethane springs to contribute to a comfortable ride. Besides the impossibility of going flat, the tires are intended to combine the comfort offered by higher-profile tires (with tall sidewalls) with the resistance to cornering forces offered by low profile tires. They have not yet been delivered for broad market use.

1.2 Airless Tires

Although each company has a different design approach to the airless tire, most share the same basic concepts. The main concept that must be considered when trying to design a non-pneumatic tire is the issue of deformation. The tire must be strong enough to hold the car and withstand a large amount of abuse, as well as be able to deform slightly when it comes in contact with the road.

Fig 1.1 Types of tires

Active Wheel from Michelin includes in-wheel electric motors and a motorised suspension to free up space in the front or rear of the vehicle. This model also eliminates the need for other notorious space hogs like transmissions and exhaust systems. The wheels already have a vehicle ready to receive them, the Heuliez Will from Opel, and are also expected to come standard on the Venturi Volage sometime in 2012.[3]

Fig 1.2: Micheling – Use&Application

2.1 MODELING

The model is developed using Solid modeling software by using Pro-E (creo-parametric).

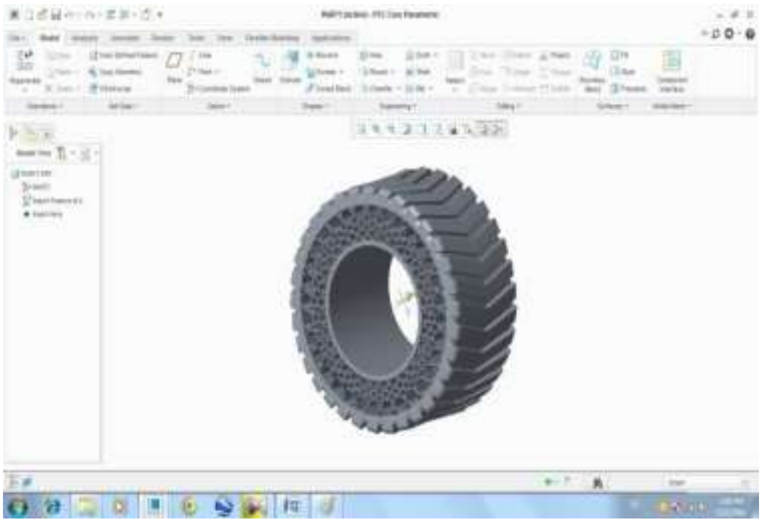


Fig 2.1: Outer rubber portion (tire)

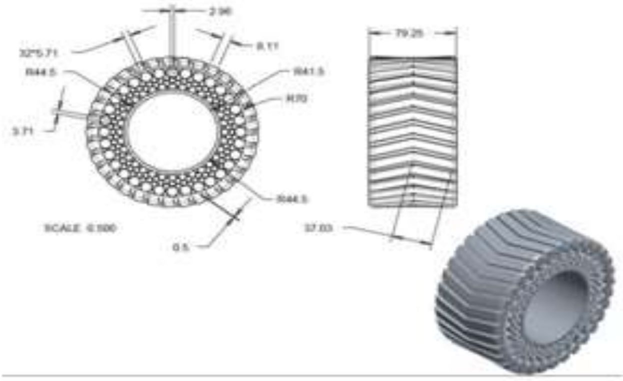


Fig 2.2: Detail view of outer rubber portion (tire)

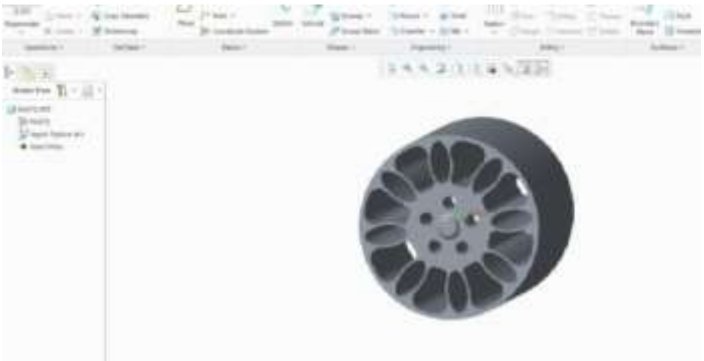


Fig 2.3: Metal rim

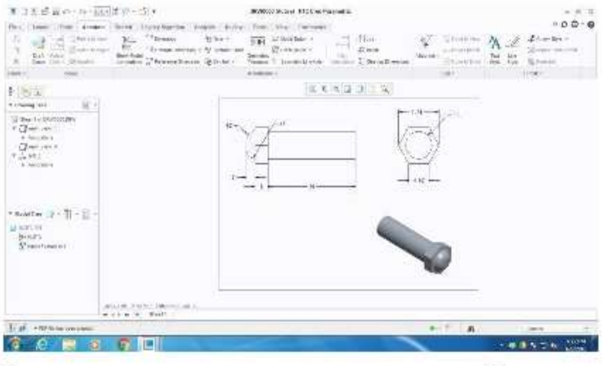
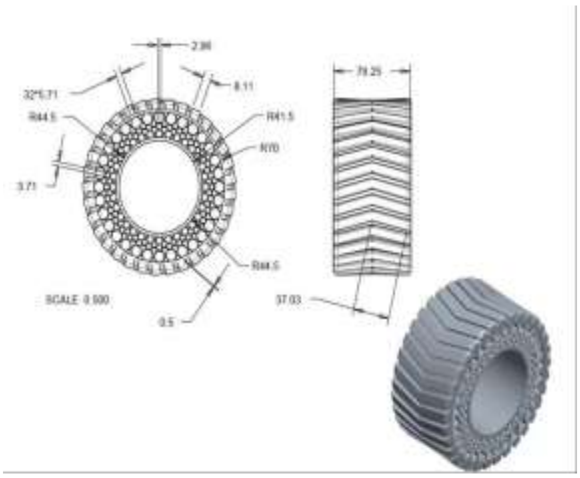
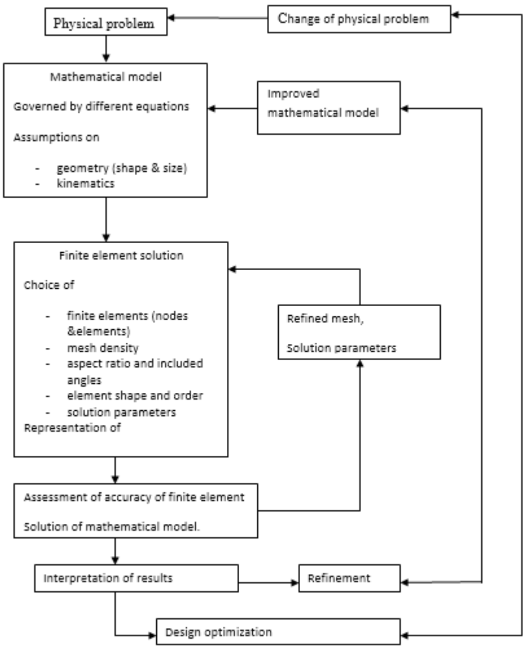


Fig 2.4: Detailed view of bolt

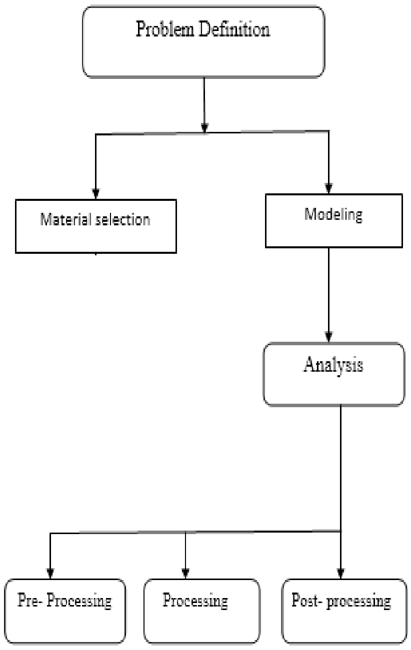


THE PROCESS OF FINITE ELEMENT METHOD



3.1 METHODOLOGY

The methodology adopted for the research work is represented by the following block diagram.



MATERIALS USED

Properties	Nylone4-6	polyethylene
Young's modulus (GPa)	4.8	2.7
Poisson's ratio	0.4	0.4
Density(kg/m^3)	1150	1400

4.1 ANALYSIS
Static analysis is used to determine the displacements stresses, stains and forces in structures or components due to loads that do not induce significant inertia and damping effects. Steady loading in response conditions is assumed. The kinds of loading that can be applied in a static analysis include externally applied forces and pressures, steady-state inertial forces such as gravity or rotational velocity imposed (non-zero) displacements, temperatures (for thermal strain). A static analysis can be either linear or nonlinear. In our present work, we consider linear static analysis.

4.2 PROCEDURE
4.2.1 Importing the Model
In this step the PRO/ E model is to be imported into ANSYS workbench as follows, In utility, menu file option and selecting import external geometry and open file and click on generate. To enter into simulation module click on project tab and click on new simulation

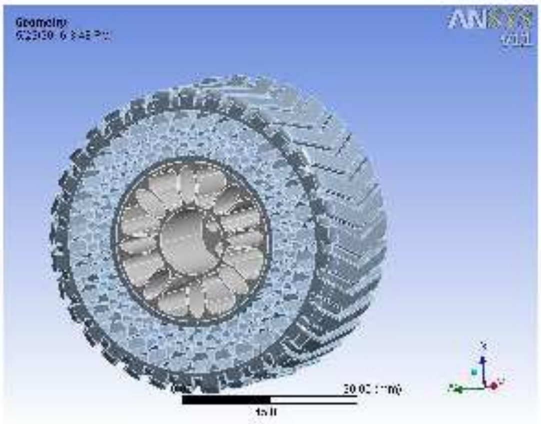


Fig 4.1 importing the model

4.2.2 Defining Material Properties
To define material properties for the analysis, following steps are used. The main menu is chosen the select model and click on corresponding bodies in the tree and then create new material enter the values again select simulation tab and select material.

4.2.3 Defining Element Type
To define type of element for the analysis, these steps are to be followed, Chose the main menu select type of contacts and then click on mesh-right click-insert method
Method - Tetrahedrons Algorithm m - Patch Conforming Element Mid-side Nodes – Kept

4.2.4 Meshing the model
To perform the meshing of the model these steps are to be followed, Chose the main menu click on mesh- right click-insert sizing and then select geometry to enter element size and click on edge behavior curvy proximity refinement

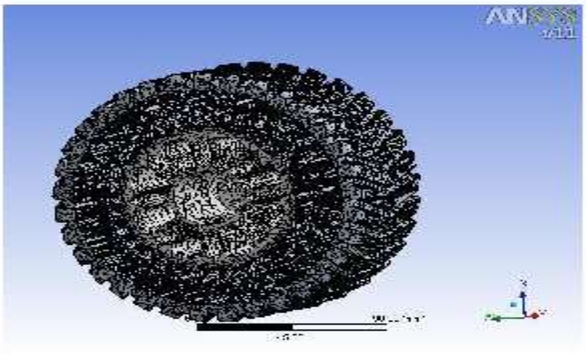


Fig 4.2 Meshing

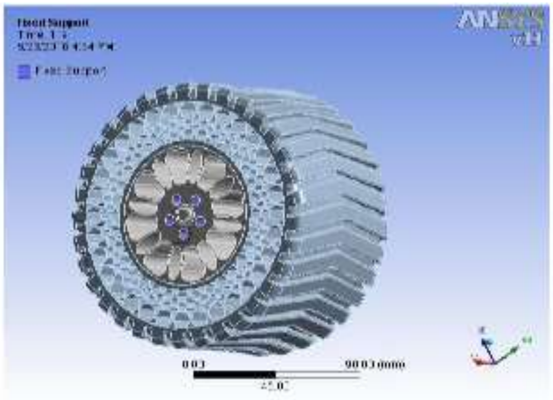


Fig 4.3: Fixed supports

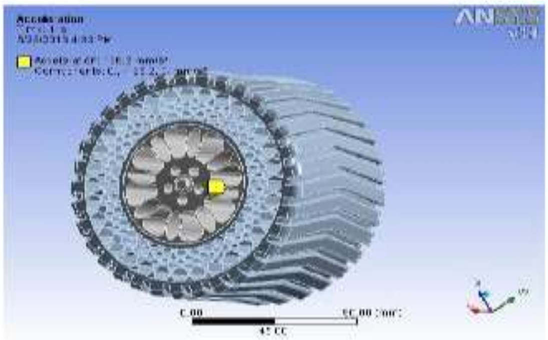


Fig 4.4: Acceleration application

4.3 Static Structural Analysis

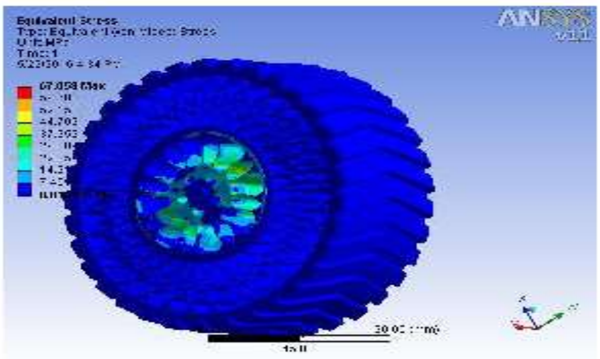


Fig 4.5: Equivalent stress

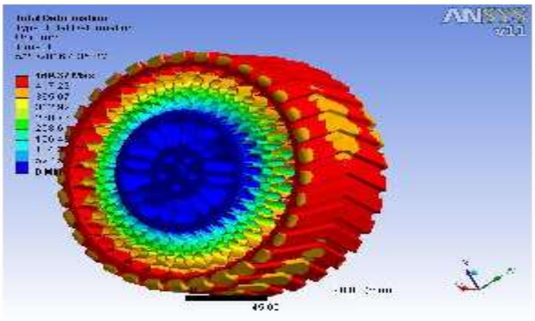


Fig 4.6: total deformation

4.4 Mode Analysis

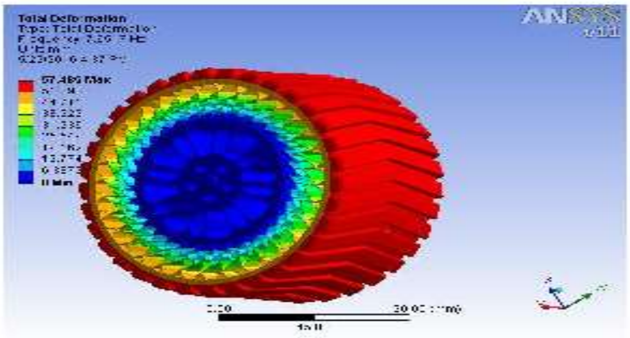


Fig 4.6: mode 1

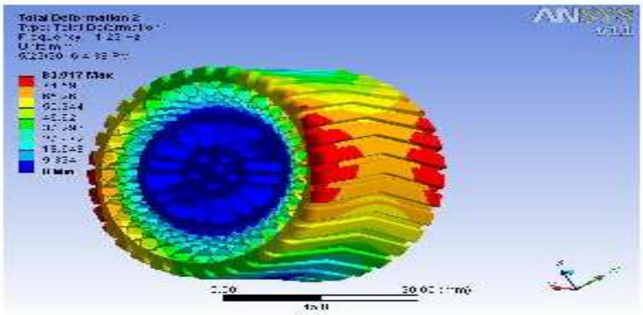


Fig 4.7: mode 2

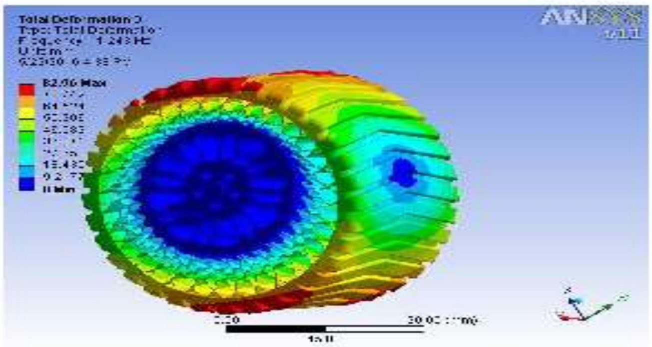


Fig 4.8: mode 3

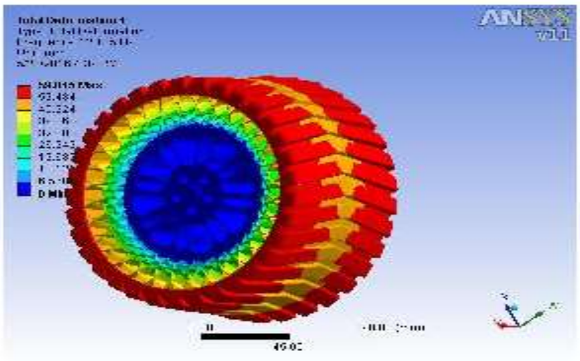


Fig 4.9: Mode 4

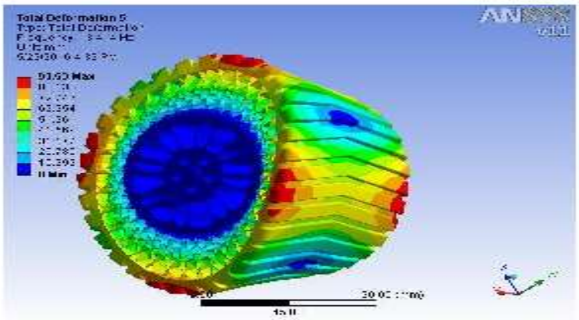


Fig 4.10: Mode 5

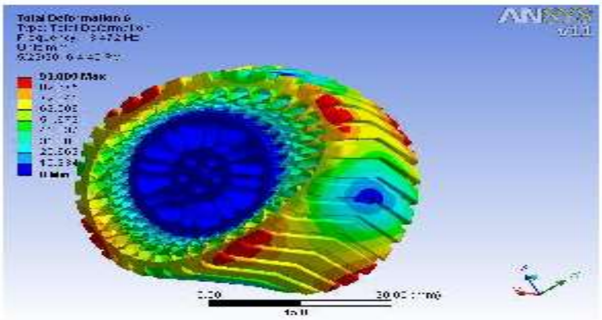


Fig 4.11: mode 6

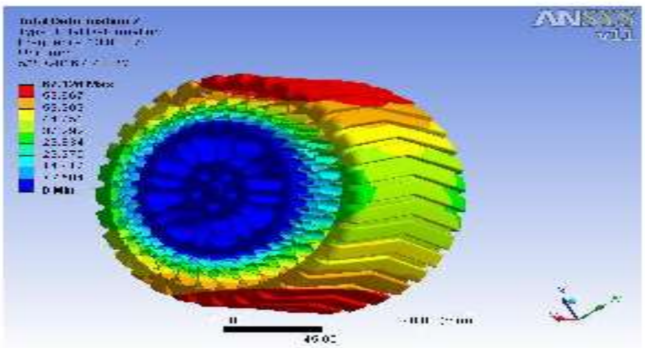


Fig 4.12: mode 7

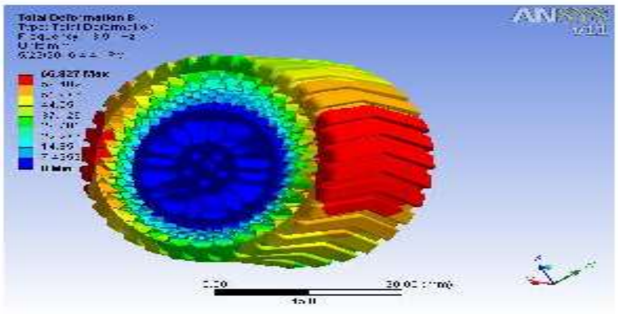


Fig 4.13: mode 8

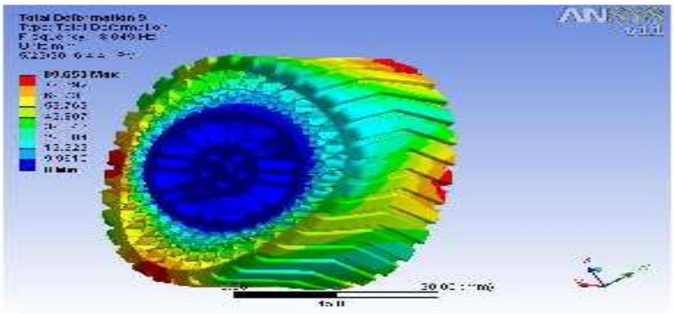


Fig 4.14: mode 9

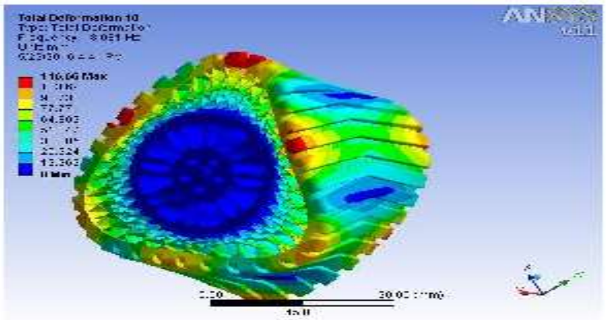


Fig 4.15: mode 10

4.5 Thermal Analysis

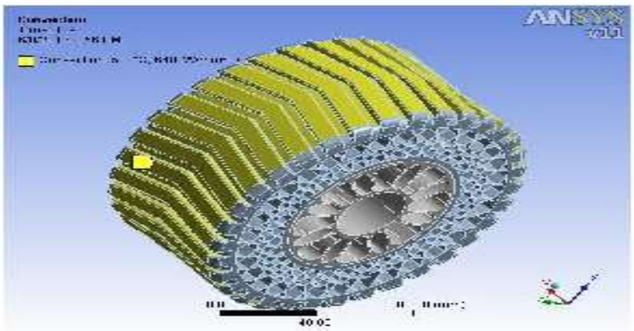


Fig 4.16: Heat Convection

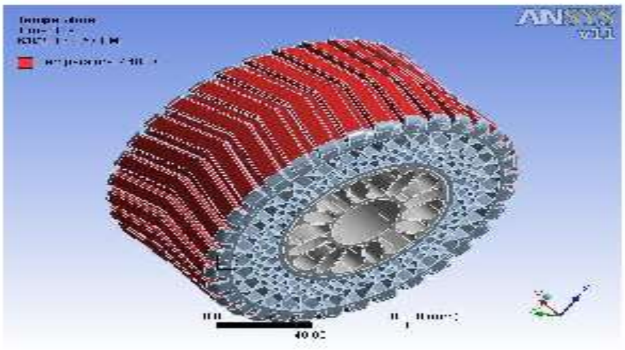


Fig 4.17: Temperature

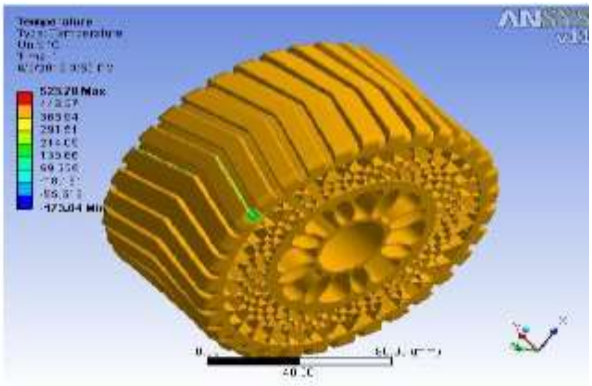


Fig 4.18 Output Temperature

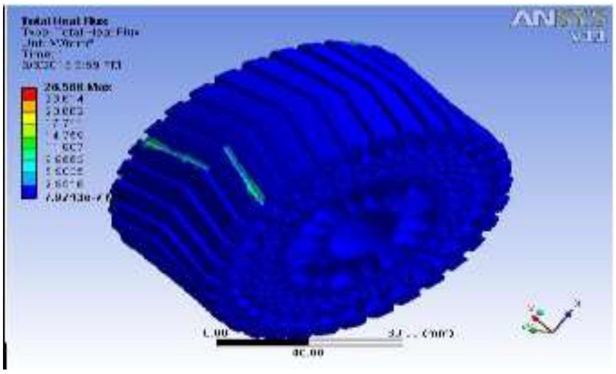


Fig 4.19: Total heat flux

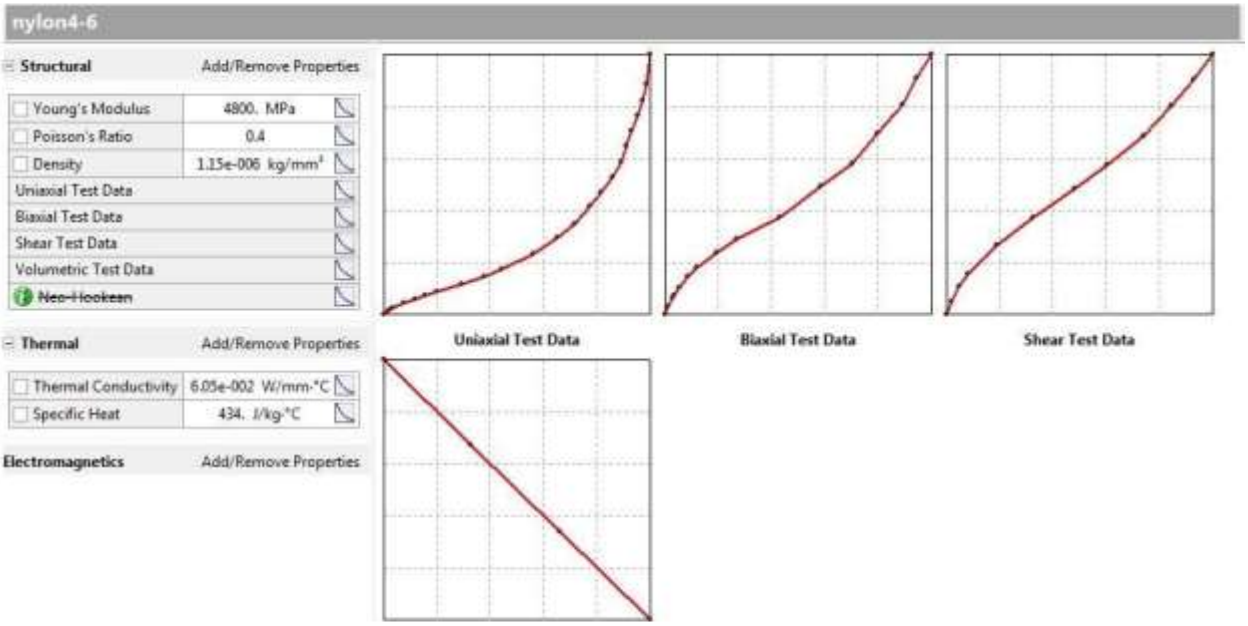


Fig 4.20: Material Properties of nyone4-6

4.6 structural Analysis for Nyone4-6

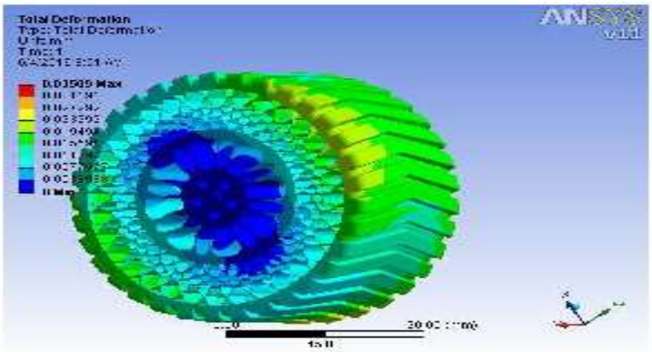


Fig 4.21 Total Deformation

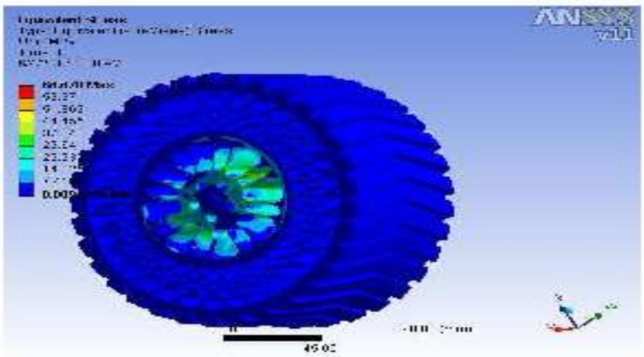


Fig 4.22: Equivalent stress

4.7 Mode Analysis

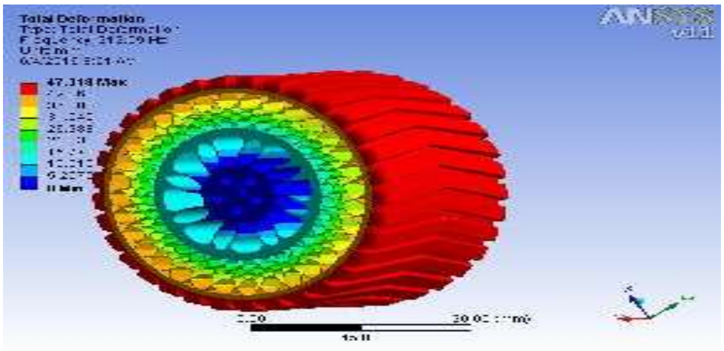


Fig 4.23: mode 1

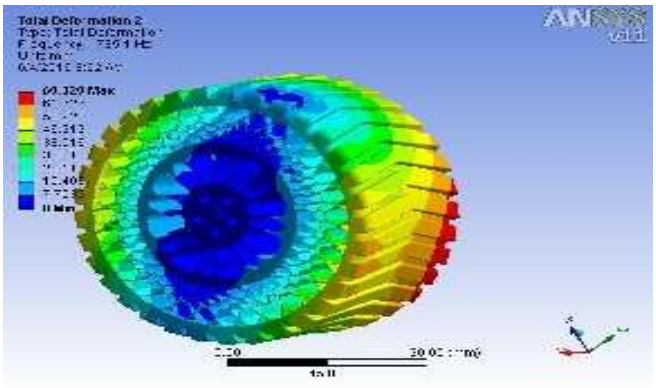


Fig 4.24: mode 2

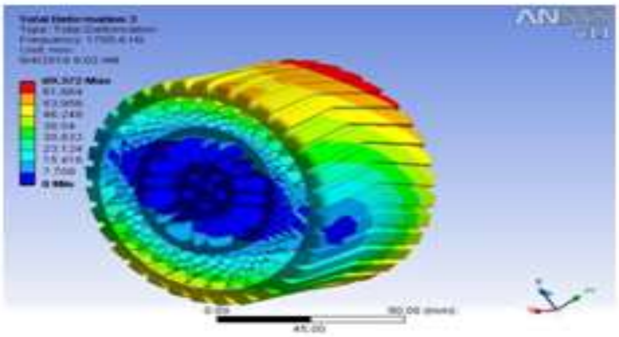


Fig 4.25: mode 3

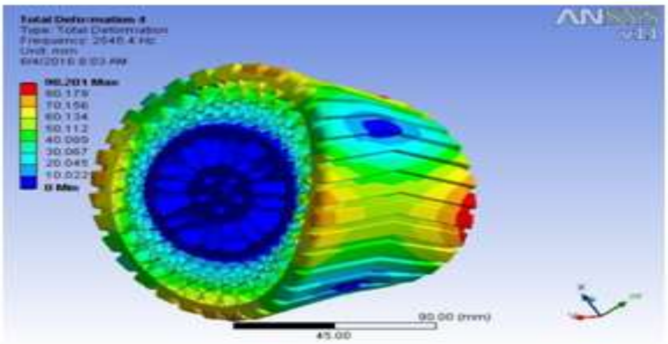


Fig 4.26: mode 4

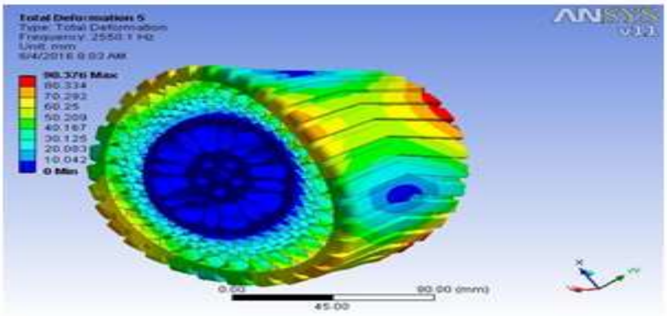


Fig 4.27: mode 5

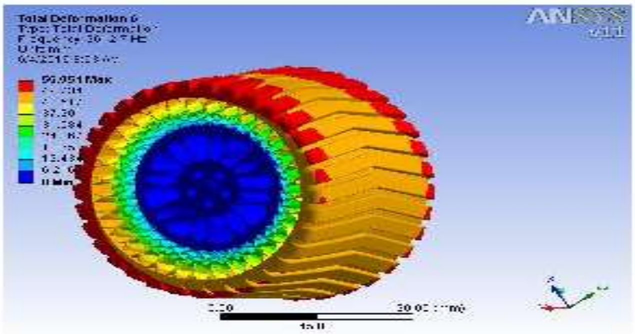


Fig 4.28: mode 6

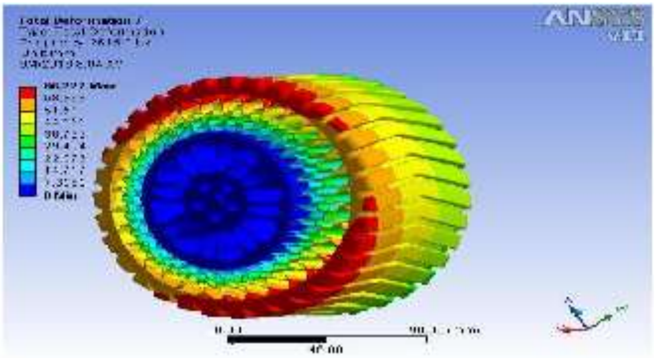


Fig 4.29: mode 7

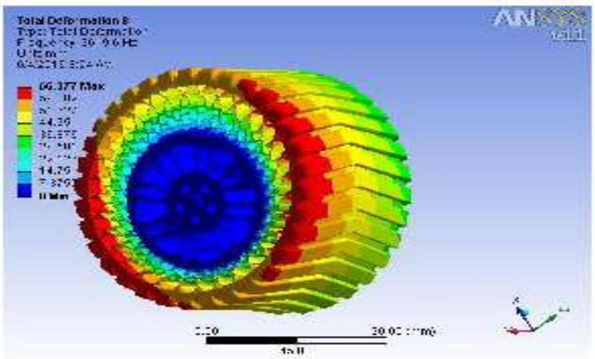


Fig 4.30: mode 8

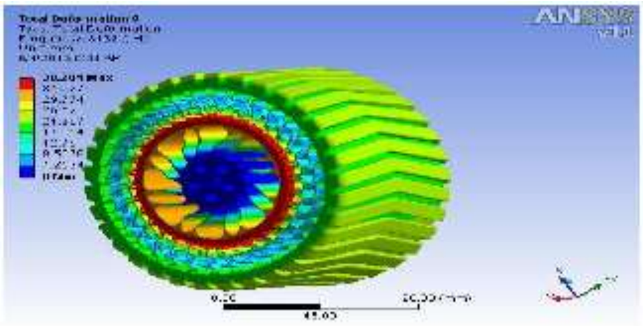


Fig 4.31: mode 9

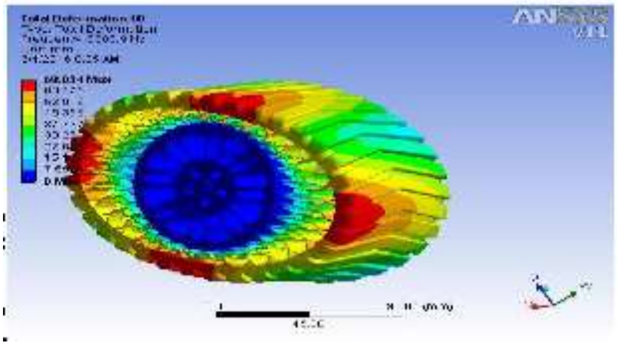


Fig 4.32: mode 10

4.8 Thermal Analysis

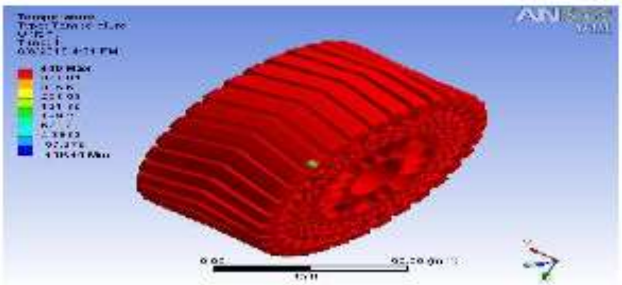


Fig 4.33: Out Put Temperature

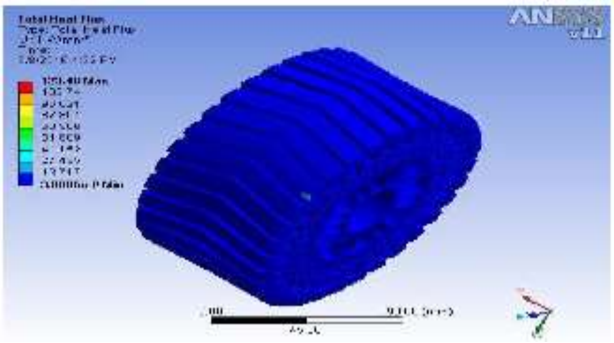


Fig 4.34: Total heat flux

5. RESULTS AND DISCUSSION

5.1 Deformation for Different Modes

Modes	Material	
	Neoprene Rubber	**Nylon 4 -6**
	Deformation (mm)	
Mode 1	57.485	47.318
Mode 2	83.917	69.329
Mode 3	82.96	69.372
Mode 4	59.045	90.201
Mode 5	95.53	90.376
Mode 6	93.009	55.951
Mode 7	67.126	66.227
Mode 8	66.827	66.377
Mode 9	89.653	38.281
Mode 10	116.66	68.034

5.2 Total Deformation & Equivalent Stress

Material	Total deformation (mm)		Stress (Mpa)	
	Min	**Max**	**Min**	**Max**
Neoprene Rubber	0	469.37	0.01635	67.058
Nylon 4-6	0	0.03509	0.009	66.678

5.3 Heat Flux and Temperature

Material	Heat Flux (w/mm^2)	Temperature (^0c)
Neoprene Rubber	26.566	573.79
Nylon 4-6	123.46	440

CONCLUSION

The results from analysis can be replaced the air tire as an Air-less tire. The tire provides good traction, cushion effect. The 4 side honey comb design satisfies the main functions of the tire. The air-less tire has two components that are an outer band and flexible inner band. In the air-less tire design manufacturing point of view, material saving is obtained by replacing outer band only after tread wear. The flexible inner band repeated use obtained green engineering and also reduce the environmental pollution. The driver mind-stress may reduce by using air-less tire in an automobile by avoiding irrelated problems in the tire. From the above table, we are concluded that the material Nylon 4-6 is suitable.

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