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Design and analysis of airless tire for two wheelers using additive manufacturing technology

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Abstract- Airless tire were presented with substitution of Pneumatic tire set up of air in an unequivocal structure. The development and material investigation of these airless tire done by contrasting it and pneumatic tire. A concise auxiliary examination on spokes of airless tire is done and is connected with moving protection and fuel proficiency. In airless tire the spokes are made by polyurethane material.

Keywords-spokes, airless tire, pneumatic tire, new design.

I. INTRODUCTION

Tire was one of the important engineering parts in automobiles.Two wheeler used for dealing with passengers. Tire consists of layers of the diverse rubber compounds of varying thickness to form a composite shape. Metallic rings also are used as reinforcing additives in tires, it was necessary in an effort to expect the mechanical behavior of the tire beneath applied load. Polyurethane material and Air tire includes tread, belt, carcass, air. This challenge is to design and development of air-much less tire of automobile. Secure and strain free power is to be furnished in cars by means of air is to be eliminated. Tube and tubeless tires are going through many troubles like puncture, bursting, and many others.

II. LITERATURE REVIEW

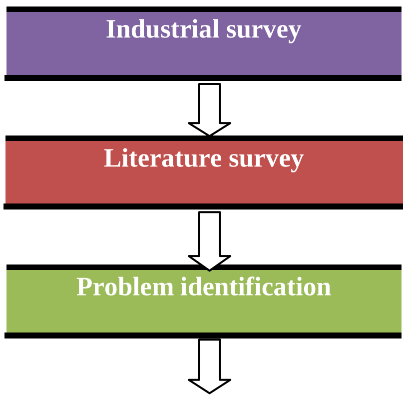
[1]C.Manibaalan et al, non- pneumatic and pneumatic tires are carry a significant load with deformation but the difference is that air less tire are with absence of contact pressure..

[2] Dr. R. Ramachandra et al, the main issue of design the non pneumatic tire is that with deformation of the tire in dynamic condition.

[3].S. Shashavali et al, Polyurethanes are produced by mixture of two or more liquid streams. The poly stream contains speeding agent, interfacial tension, blowing agents and so on. The mixture might also be called a 'resin' .

[4].G. Chandra Sekhar et al, to plan a non pneumatic tire is the issue of distortion by utilizing 3d displaying programming. The tire must be sufficiently solid to hold the auto and withstand a lot of load, and also have the capacity to distort somewhat when it interacts with the street. [5].Seetharama K S et al, Model the tires by using SOLID WORKS, import to ANSYS software. Road and tread were held contact boundary and the road was held fixed. Vertical loading on the wheel through the application of a uniformly distributed load on to the centre of rim which acts t rim tire contact region..

III. METHODOLOGY



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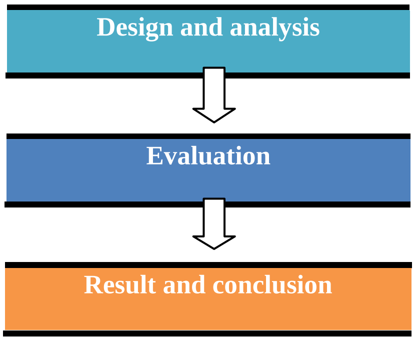

IV.DESIGN AND MODEL

The model was developed using Solid modeling software by using SOLID WORKS 2014. Solid works was the industry's de facto standard 3D mechanical design suit. It was the world's leading CAM /CAE software, gives a broad range of integrated solutions to cover all aspects of product design and manufacturing. Solid works provides the needs of small medium sized enterprises as well as large industrial corporations in all industries, consumer goods, fabrications and assembly. Electrical and electronics goods, automotive, aerospace, shipbuilding and plant design. It was user friendly solid and surface modelling can be done easily. The magnesium alloy wheel diameter is 12inch and the polyurethane flexible structure diameter is 16inch and the rubber tire diameter is 18inch. This design was full sketched in part area and it assembled in assemble area.

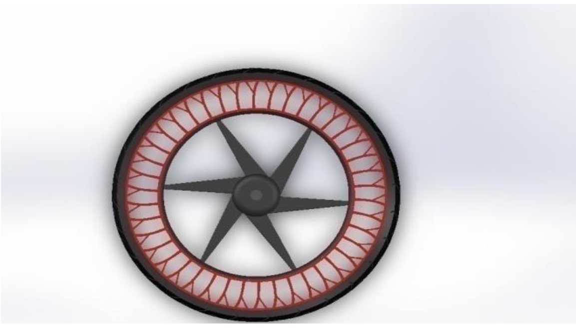

Fig.1 Airless Tyre Model Made In Solid Works

Fig. 2 Airless Tire Model Made In Solid Works

V. ANALYSIS AND MATERIAL DATA

The analysis was developed in ansys software. we have analyzed rotational static structural analysis and static structural analysis.

Table.1 Material Properties Of Polyurethane Material

S.NO	Material properties	Values
1	Density	1.265e-009 tonne mm^-3
2	Coefficient of Thermal Expansion	1.1e-005 C^-1
3	Specific Heat	4.47e+008 mJ tonne^-1 C^-1
4	Thermal Conductivity	5.2e-002 W mm^-1 C^-1
5	Resistivity	9.6e-005 ohm mm
6	Compressive Ultimate Strength	820 Mpa
7	Compressive Yield Strength	0 Mpa
8	Tensile Yield Strength	0 Mpa
9	Tensile Ultimate Strength	240 Mpa
10	Reference Temperature	22 c
11	Young's Modulus	1.1e+005 Mpa
12	Poisson's Ratio	0.28
13	Bulk Modulus	83333 Mpa
14	Shear Modulus	42969 Mpa
15	Relative Permeability	10000

Table.2 Material Properties Of Rubber Material

S.NO	Material properties	Values
1	Density	1.e-009 tonne mm^-3
2	Coefficient of Thermal Expansion	1.2e-005 C^-1
3	Specific Heat	4.34e+008 mJ tonne^-1 C^-1
4	Thermal Conductivity	6.05e-002 W mm^-1 C^-1
5	Resistivity	1.7e-004 ohm mm
6	Compressive Ultimate Strength	0 Mpa
7	Compressive Yield Strength	250 Mpa

8	Tensile Yield Strength	250 Mpa
9	Tensile Ultimate Strength	460 Mpa
10	Reference Temperature	22 c
11	Young's Modulus	2.e+005 Mpa
12	Poisson's Ratio	0.3
13	Bulk Modulus	1.6667e+005 Mpa
14	Shear Modulus	76923 Mpa
15	Relative Permeability	10000

Table.3 Material Properties Of Magnesium Alloy Material

S.NO	Material properties	values
1	Density	1.8e-009 Tonne mm^-3
2	Coefficient of Thermal Expansion	2.6e-005 C^-1
3	Specific Heat	1.024e+009 mJ tonne^-1 C^-1
4	Thermal Conductivity	0.156 W mm^-1 C^-1
5	Resistivity	7.7e-004 ohm mm
6	Compressive Ultimate Strength	0 Mpa
7	Compressive Yield Strength	193 Mpa
8	Tensile Yield Strength	193 Mpa
9	Tensile Ultimate Strength	255 Mpa
10	Reference Temperature	22 c
11	Young's Modulus	45000 Mpa
12	Poisson's Ratio	0.35
13	Bulk Modulus	50000 Mpa
14	Shear Modulus	16667 Mpa
15	Relative Permeability	10000

Rotational static structural analysis :

Static analysis is used to determine the displacements stresses, stains and forces in structures.

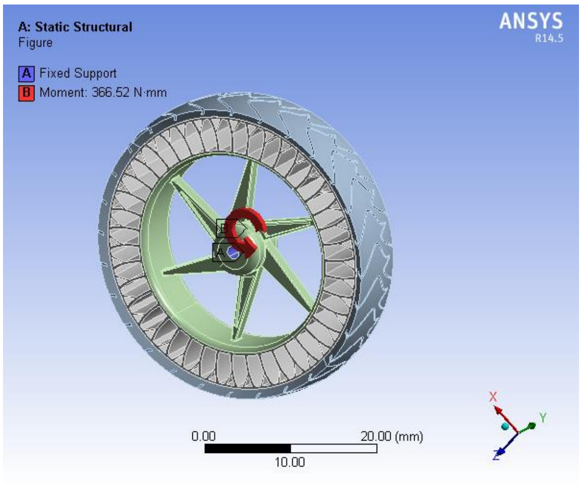

Fig.3 static structural model

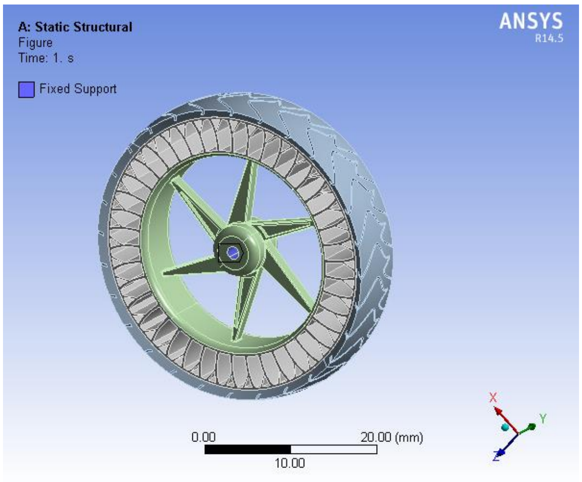

Fig.4 static structural fixed support

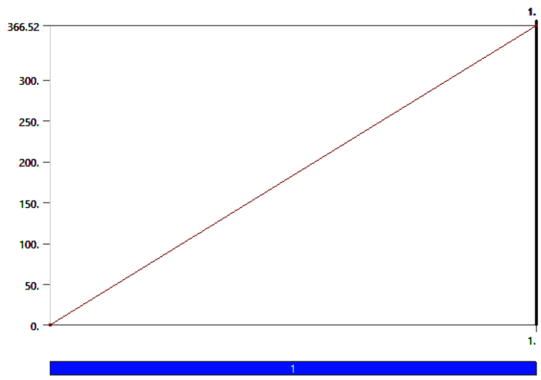

Fig.5 static structural moment graph

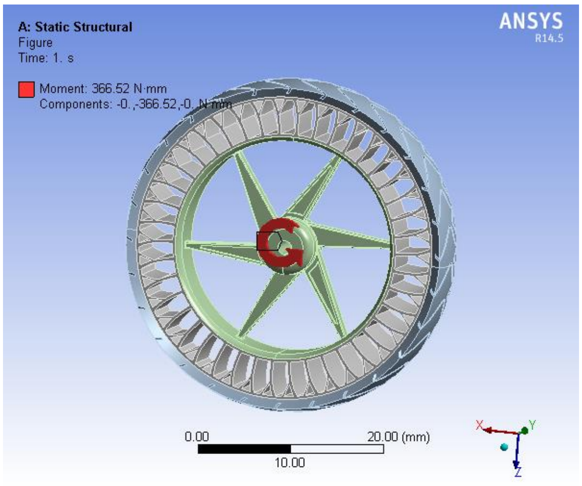

Fig.6 static structural moment

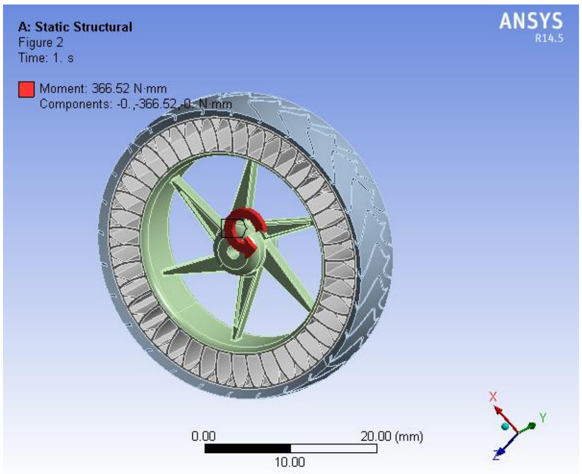

Fig.7 static structural moment.

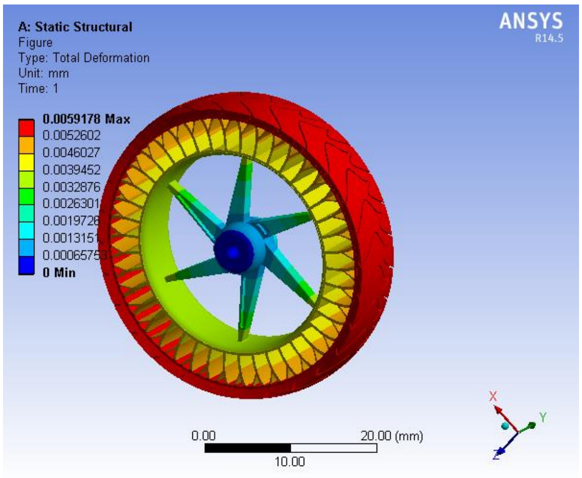

Fig.8 static structural solution at total deformation

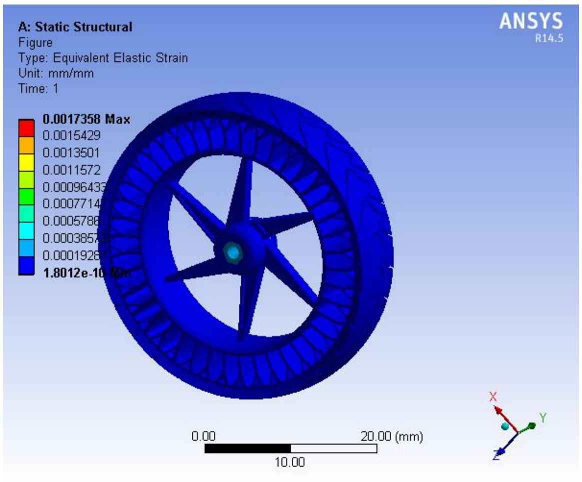

Fig.9 static structural solution at equivalent elastic strain.

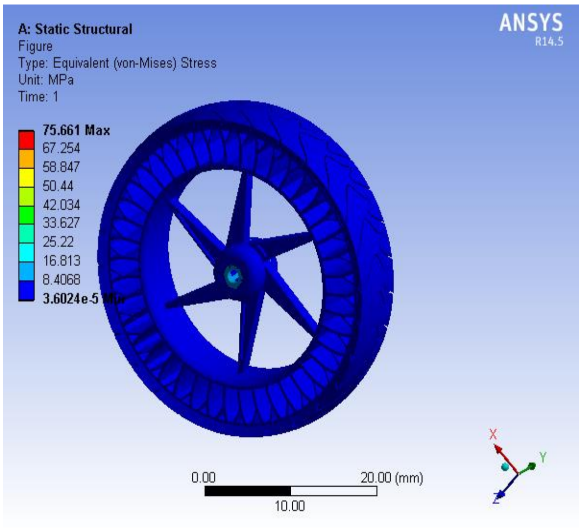

Fig.10 static structural solution at equivalent stress

Static structural analysis :

Static analysis is used to determine the displacements stresses, stains and forces in structures.

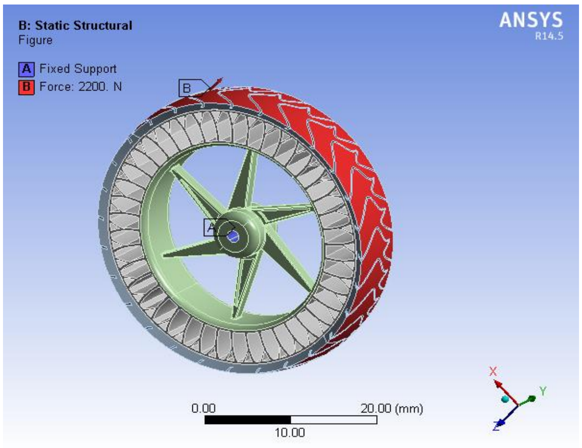

Fig.11 static structural model

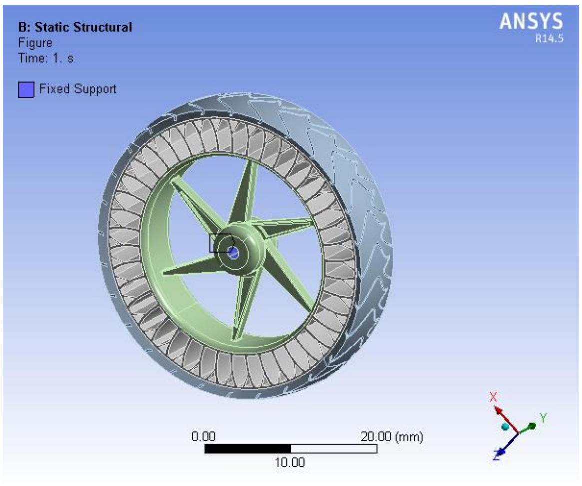

Fig.12 static structural fixed support

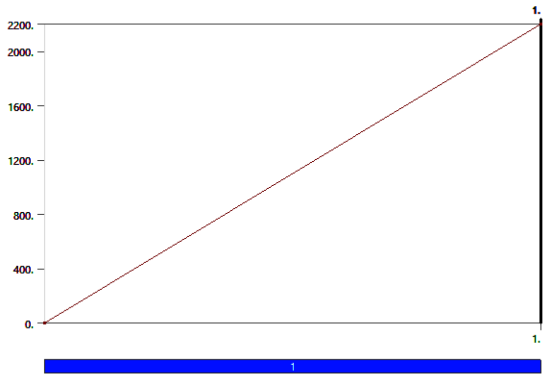

Fig.13 static structural graph

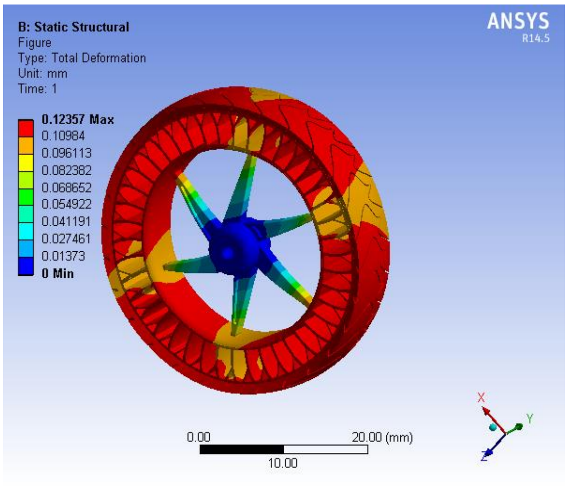

Fig.14 static structural solution at total deformation

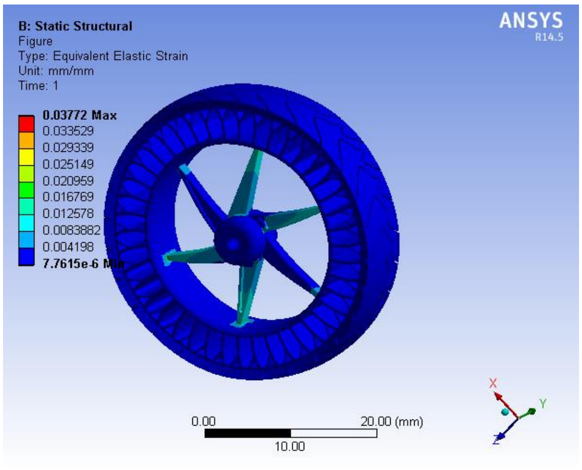

Fig.15 static structural solution at equivalent elastic strain

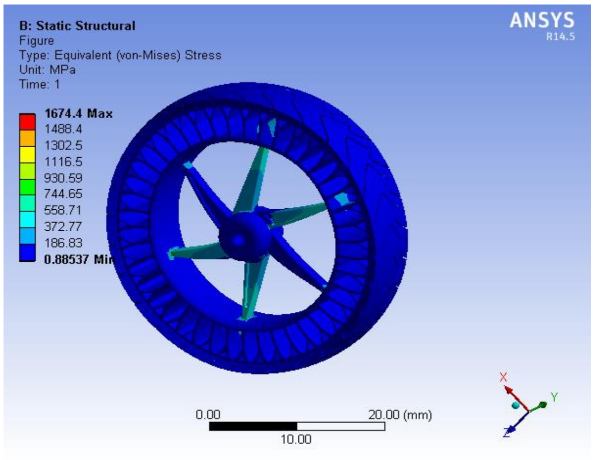

Fig.16 static structural solution at equivalent stress

VI. COMPARISION

AIR LESS WHEEL	TUBE LESS WHEEL
Rotational Static Structural Analysis **Maximum-75.661 MPa** **Minimum 3.6024e-005 MPa**	Rotational Static Structural Analysis **Maximum**-65.3 MPa **Minimum** 2.326e-005 Mpa
Static Structural Analysis **Maximum-1674.4 MPa** **Minimum-0.88537 MPa**	Static Structural Analysis **Maximum-9.0604e-002 MPa** **Minimum-2605.9 MPa**
Total deformation-**5.9178e-003 mm**	Total deformation-**6.4087e-002mm**

The comparison result of the airless tire have maximum yield strength than the tube less tire yield strength. The airless will with stand during dynamic and static position compare to tubeless tire.

VII. RESULTS

The design and analysis of airless tire have less deformation than tube less tire .the airless tire have maximum rotational and static structural yield strength than tubeless tire. So the designed and analyzed airless tire is safe to production and manufacturing.

Table.4 Rotational Static Structural Analysis

Minimum	**0. mm**	**1.8012e-010 mm/mm**	**3.6024e-005 MPa**
Maximum	5.9178e-003 mm	1.7358e-003 mm/mm	75.661 MPa
Minimum Occurs On	Solid		
Maximum Occurs On	Solid		

Table.5 Static Structural Analysis

Minimum	**0. mm**	**7.7615e-006 mm/mm**	**0.88537 MPa**
Maximum	0.12357 mm	3.772e-002 mm/mm	1674.4 MPa
Minimum Occurs On	Solid		
Maximum Occurs On	Solid		

VIII. CONCLUSION

Plan and advancement of air-less tire was takes out air in the tire. Air-less tire can give uniform footing and uniform wear while nonappearance of air. The Y-type structure configuration fulfills the fundamental elements of the tire. Air-less tire have three segments that are external band and adaptable center band and internal band. The adaptable center band rehashed utilize acquired green designing and furthermore diminish the ecological contamination. The driver mind-stress can be decrease by utilizing air-less tire in vehicle by maintaining a strategic distance from air related issues in the tire. In this tire elastic and polyurethane and magnesium combination materials are utilized. From static basic and rotational static investigation, I presumed that, the material polyurethane is ideal one, in light of the fact that the material polyurethane is got less twisting as strain 1.7358 mm and stress 75.661 MPa from rotational static basic examination and less disfigurement at high recurrence and high temperature with less warmth transition by contrasting with tube less tire. Henceforth configuration is protected.

XI . REFFERNCE

[1].C. Manibaalan., “Static Analysis Of Airless Tires” Volume 3, Issue 8, August 2013 1 ISSN 2250-3153.

[2].Dr. R. Ramachandra.,” Design and Analysis of Air less Tires” ISSN: 2454-132X Impact factor: 4.295 (Volume3, Issue5) November 2017.

[3].S. SHASHAVALI., “Design and Analysis of Four Wheeler Airless Tire” ISSN 2348–2370 Vol.08,Issue. 22, December-2016.

[4].G. Chandra Sekhar., “Design and Analysis of Four Wheeler Airless Tire” Volume 6 Issue No. 11, November 2016.

[5].K.S.Seetharama., “Analysis of Airless Tire for Static Forces” Volume 1 Issue 1, MAT Journals 2017.