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DESIGN AND ANALYSIS OF AIRLESS TYRE

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- **Abstract -** *The reason for present review is to study on manufacturing of airless tyres Dissimilar to pneumatic tyres, airless tyres or flat-proof tyres (also known as tweel) is designed to have poly-composite compound treaded around a hub of flexible spokes. The main advantage of this design is its robustness as airless tyres are impossible to deflate or to blowout at highway speeds like conventional tyres so the driver does not have to be restless about having a spare tire. The main objective of this tyre is to eliminate the tube. In pneumatic tyre the tube holds the air inside it, which is responsible for inflation and bursting of tyre. Airless tyres generally have high rolling resistance and provide less suspension than pneumatic tyres. Though airless tyres are not economical compared to pneumatic tyres, but they are more convenient, durable and they provide a safer space in the driving medium.*

Key Words: Polyurethane spokes, Nylon, Arc of a circle, Ansys.

1. INTRODUCTION

Airless tyres or **Non-pneumatic tyres** (NPT) , are tyres that are not supported by air pressure. They are more convenient, durable and they provide a safer space in the driving medium.

1.1 PNEUMATIC

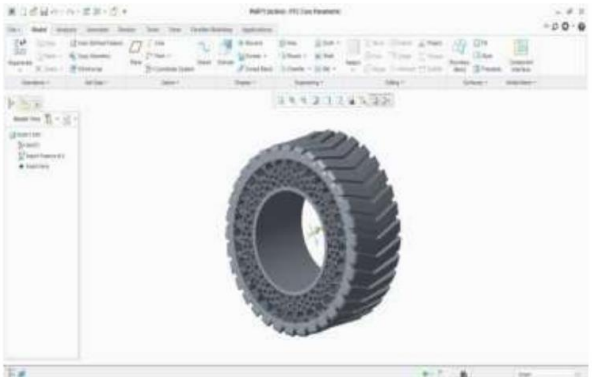
A pneumatic, or air-filled, tyre is made of an air tight inner core filled with pressurized air. The pressure of the air inside the tyre is greater than atmospheric air pressure, so the tyre remains inflated even with the weight of a vehicle resting on it. It gives a certain degree a cushioning effect as the tyre hits bumps in the road.

Fig -1: Pneumatic Tyre

1.2 NON-PNEUMATIC

Airless tyres or non-pneumatic tyres are rubber structure which support the vehicle load during its all mobility. The properties of tyre such as stiffness, lateral stiffness, load bearing capacity are considered in the design.

2. MODELLING



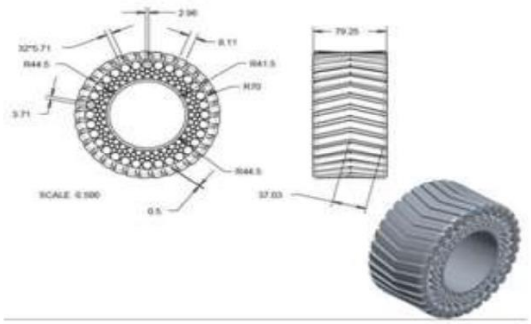


Fig 2.2: Detail view of outer rubber portion (tire)

3. OBJECTIVE AND RESEARCH METHODOLOGY

3.1 OBJECTIVES

- Eliminates air leaks or tyre blow outs.
- No maintenance required.
- Facilitate recycling.
- Remains mobile even with some of the spokes are damaged or missing.
- Durability & Long Life.
- Can take gunfire or explosion.
- Less environmental impact.

3.2 METHODOLOGY

Cable reinforced band of conventional tyre rubber is moulded around shear band. Energy absorbing polyurethane spokes are used for absorbing the shocks during mobility of vehicle. The flexible thread and shear bands deforms temporarily as a spokes bend and retain its initial dimensions.

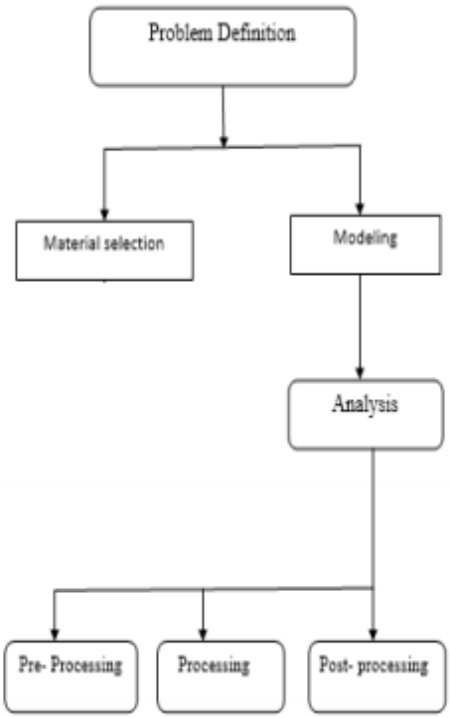


Fig -2: Methodology

4. ANALYSIS USING ANSYS

Ansys Mechanical is a dynamic tool that has a complete range of analysis tools. Ansys Mechanical enables you to solve complex structural engineering problems and make better, faster design decisions.

4.1 Modeling of Tyre

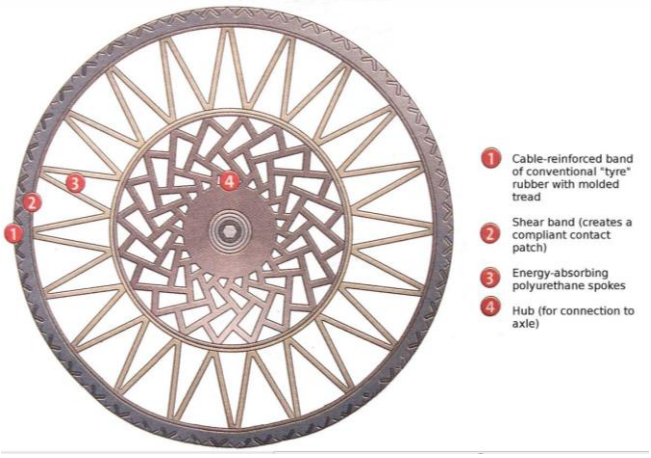


Fig -3: Tyre modelling

5. ANALYSIS AND DESIGN OF AIRLESS TYRE

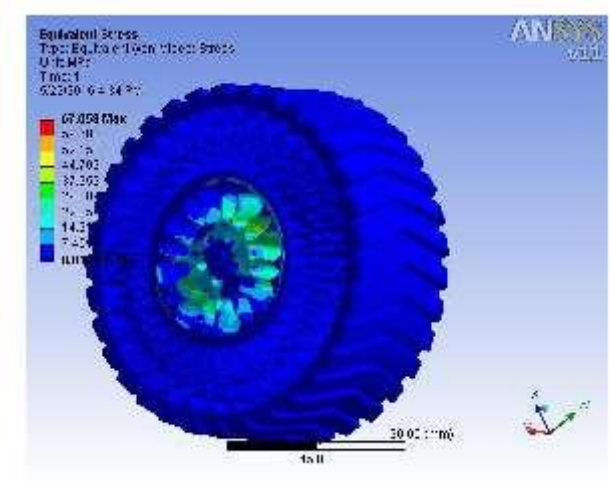


Fig-4: Equivalent Stress

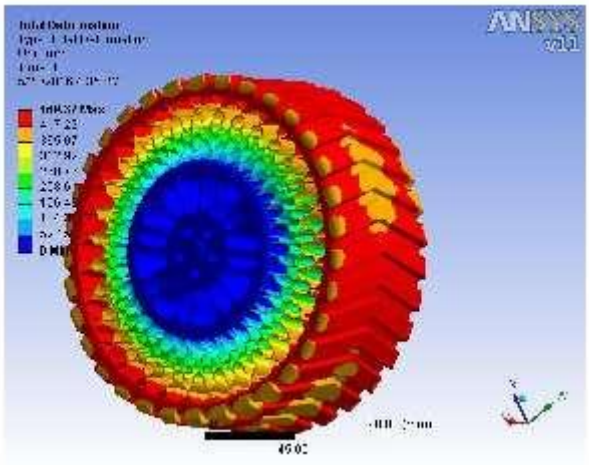


Fig-5: Total Deformation

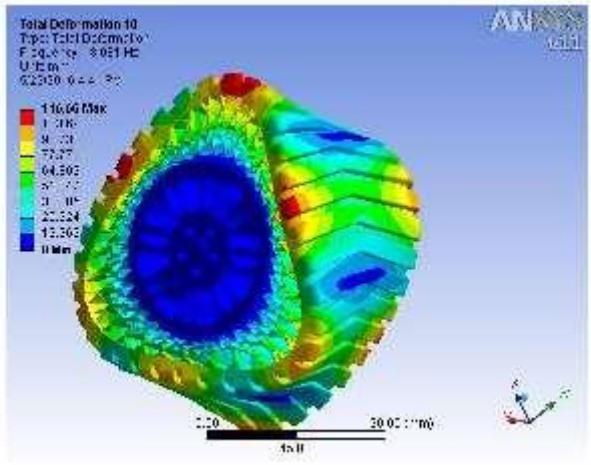


Fig-6: Mode Analysis

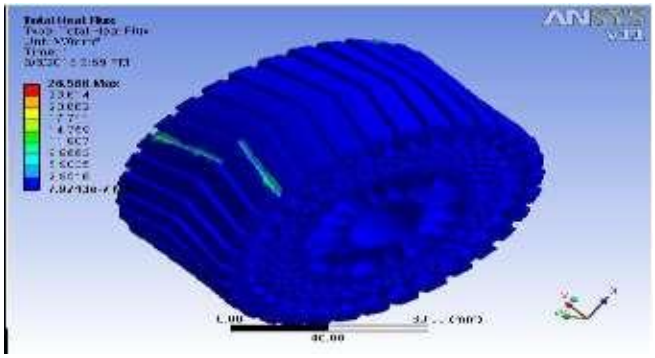


Fig-7: Thermal Analysis (Total Heat Flux)

6. RESULTS AND CONCLUSION

6.1 Deformation for Different Mode

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

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

6.2 CONCLUSION

After considering all the above results we come to a conclusion that airless tyres can be used for overcoming the drawbacks faced by the pneumatic tyre as it is more

efficient and durable. The honeycomb structure and the spokes satisfies and provided better traction, mobility and convenience to the driver. From the above results, we are concluded that the material Nylon 4-6 is suitable for the design.

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BIOGRAPHIES

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