Improvement in weight distribution, comfort and durability of Electric two-wheeler.

Yogesh H. soni
Mechanical engineering
Thakur college of engineering and technology
Mumbai, India

Abstract: Stability in two wheelers can be achieved by proper weight distribution; in turn it contributes in increasing comfort and maneuverability. The disadvantages of traditional tyres such as flatting, timely check-up for air pressure, high down time if flattened and much more can be overcame by use of non-pneumatic tyres. This paper presents how proper weight distribution can be achieved by placement of battery in a certain position in an electric scooter and how comfort in electric scooter and durability of tyres can be improved. Theoretical proof for improvement in stability due to improved weight distribution has been given and information about technology is given in detail. This paper aims to provide the information about the latest technological advancements in automotive field and how these newly emerged technologies can be employed in electric scooters in order to achieve better stability, comfort and long lasting tyre life.

INTRODUCTION:

This paper mainly focuses on two major problems in scooters.1. Weight distribution 2. Maintenance and poor durability of tyres. 1. Due to increase in demand for highly efficient vehicles, the automotive manufacturers have moved to the concept of light weight vehicle construction. Due to this type of construction although the fuel economy of vehicles has increased but these light weight vehicle are facing problems of stability due to poor weight distribution and low strength [1]. Also scooters have a smaller wheel which adds to instability [2]. This problem can be solved by using high strength chassis and placing the battery under leg space of scooter. 2. Traditional rubber tyres have problems like comparatively less life, low wear resistance, high down time if punchered, poor damping capacity(if encounters a sudden bump or pothole), timely checking for air pressures, etc., also, synthetic rubber tyres are difficult to recycle. In order to overcome these disadvantages, Non-Pneumatic (NPT) can be used.

Keywords: Electric two wheeler, Weight distribution, Stability, Non-Pneumatic tyres.

METHODOLOGY:

1. WEIGHT DISTRTIBUTION

The entire load on scooter (weight of rider, passenger, motor, battery, transmission and luggage) is concentrated on rear half of the scooter. Which when loaded fully, it may result into lifting of front end.

The battery is one of the heavy component of electric scooter so it can be placed in the front half of the scooter i.e., under the leg space in horizontal orientation as shown in “figure 1.” By employing this method of placement of battery at least 10-15% of the applied load on the rear half is reduced, which will contribute for improving the balance of scooter.

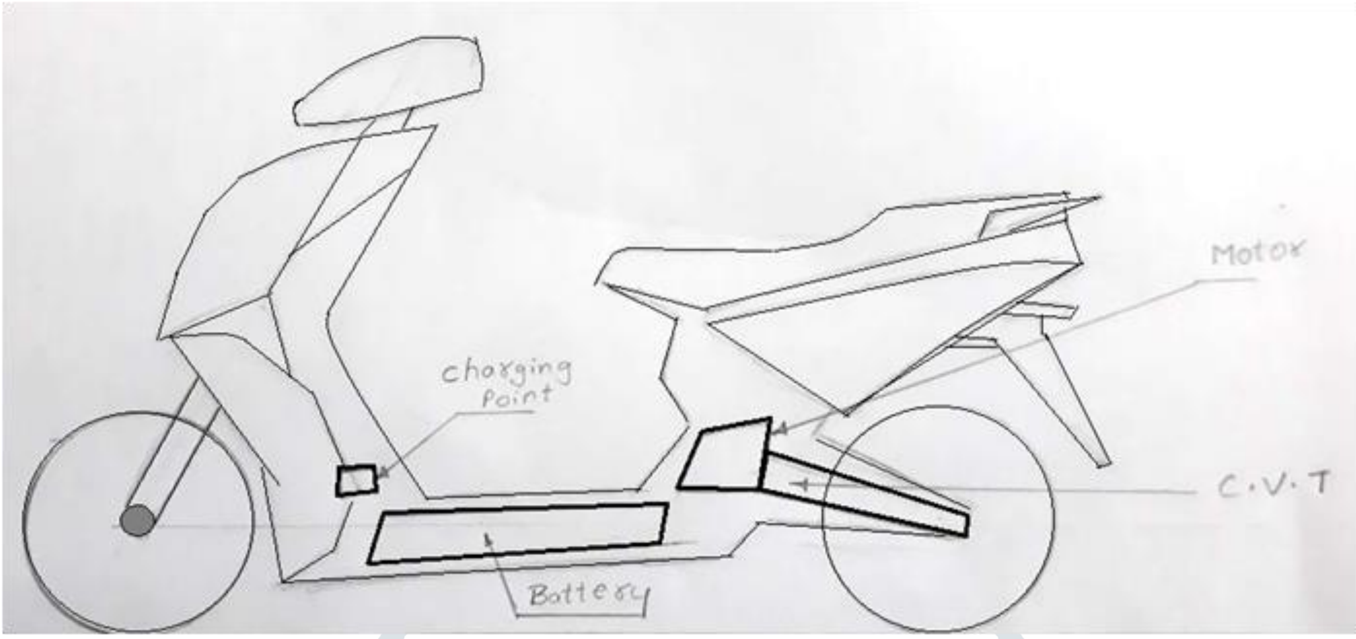


Fig.1. Layout of electric scooter

2. NON-PNEUMATIC TYRES:

Structure of tyre:

Mostly the pneumatic tyres are the integrated unit of wheel and tyre. As shown in figure 2. It consists of hub and outer periphery of tyre connected together with either spokes, criss cross structures, honey comb structures made up of poly urethane material.

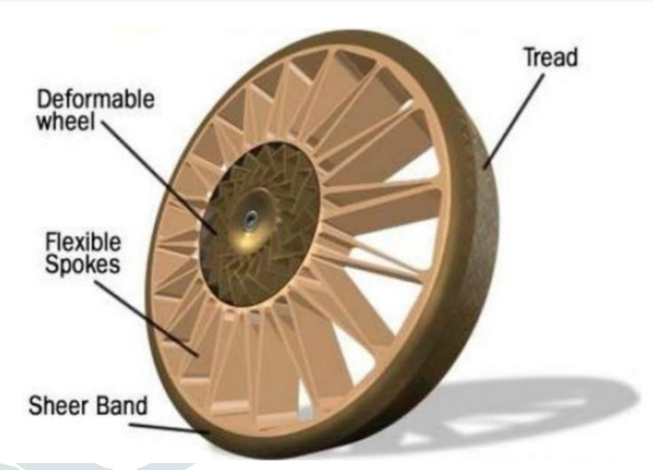


Fig.2

Material: Basically Poly composite materials such as Polyurethane are used.

DEFORMATION/STRESS ANALYSIS:

Fig.3. shows the deforation of the wheel when it hits sudden bump. Stress analysis of different structures of non-pneumatic tyres is been carried out using ANYSIS workbench. And CREO is used for 3D modelling.

Properties of material: A better cushioning, considerable cutting and tearing resistance, satisfactory performance at high speed operations, good grip on road surfaces, high load capacities, good wear and abrasion resistance.

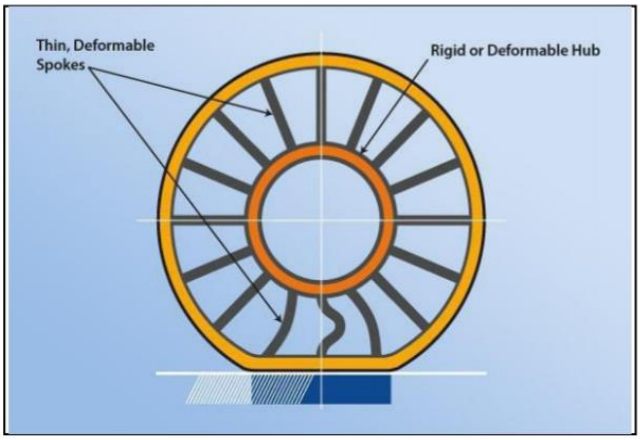
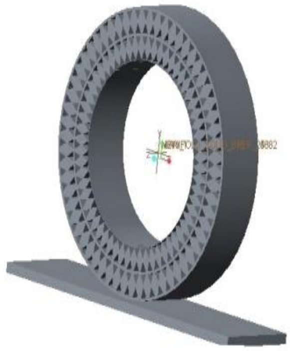


Fig.3

Structures considered for stress analysis:

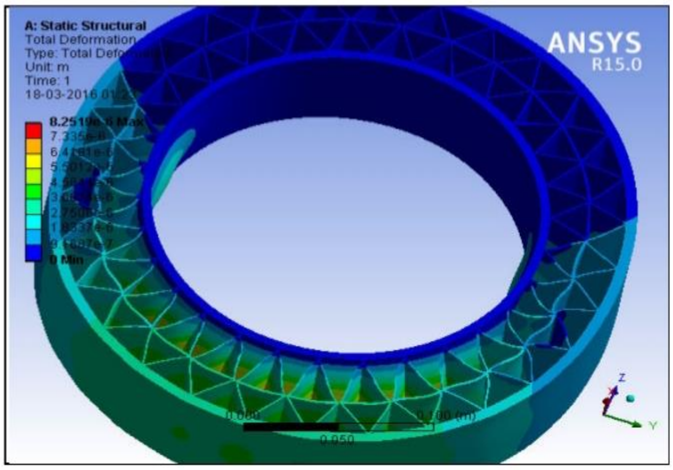
Triangular Structure

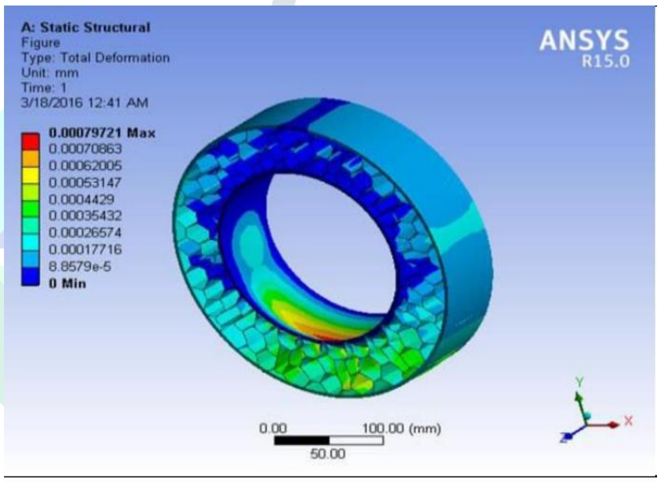


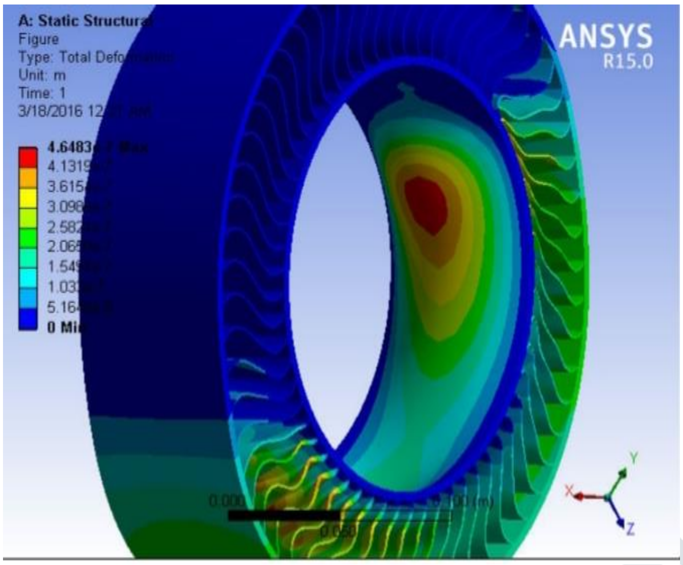
Diamond Structure

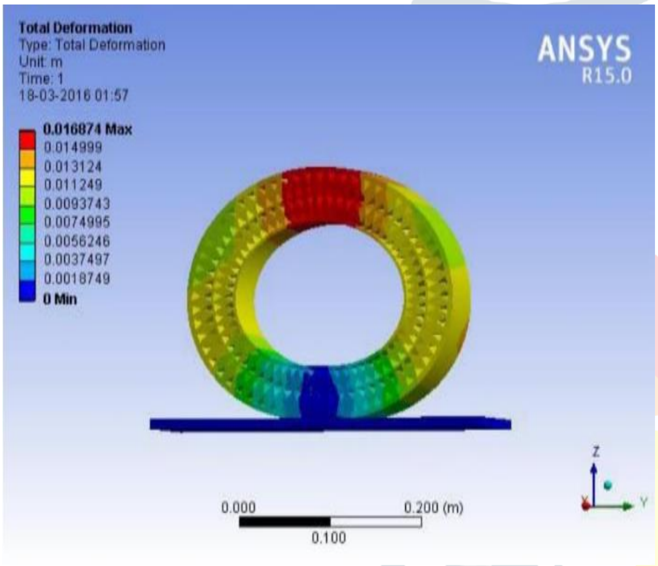
Honeycomb Structure spoke type structure

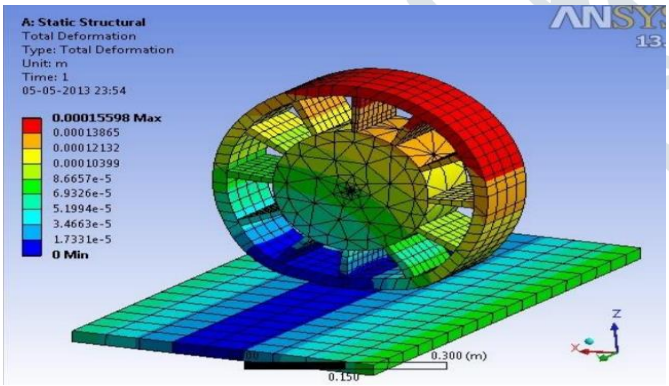
Deformation result: tetrahedral meshing is used for analysis.

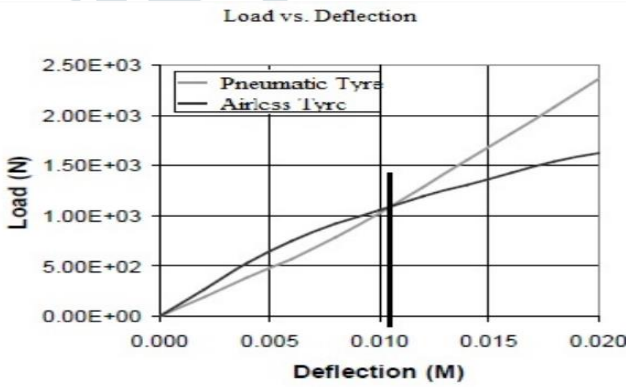












Deformation on static loading

Graph of results for deflection and load

Comparision of stress/ deformation results of various structures:

S. No	Structure	Force Applied(N)	Total Deformation (Existing Material) mm	Total Deformation (Existing Material) mm
1	Honeycomb	1200	0.00079721	1.0608e-007
2	Spokes	1200	4.6483e-7	2.8606e-007
3	Triangular	1200	8.2519e-6	1.3521e-007
4	Diamond	1200	0.016874	1.0498e-007

CONCLUSION:

Thus the stress analysis for various struture of non pneumatic tyres has been carried out and results have been obtained which gives the theoretical proof for strength and durability of airless tyres.

These results shows eligibility of the non pneumatic tyres for the mass production.

The stability of electric scooter can be improved by placement of battery in leg space.

ADVANTAGE:

- Increased stability of scooter.
- Better weight distribution can be achieved.
- Tyres never go flat.
- Life of tyre is increased considerably(upto 5 years of life).
- High durability.

DISADVANTAGES:

- Increased design cost of scooter and its components.
- Airless tyres has comparitively more rolling resistance as of traditional tyres.
- Airless tyres are 20-30% expensive than the conventional rubber tyres.
- Airless tyres cannot be repaired if damaged.

FUTURE SCOPE:

Better materials in terms of strength and light weight can be developed and employed for body and chessis construction. High capacity batteries with longer life having minimum environmental effect can be developed. Better materials in terms of strenght, flexibility, toughness, cost effctive and properties similar to conventional pneumatic tyres can be developed so that it is feasible to produce non pneumaitc tyres on large scale and can be made commercially availabe for consumers.

REFERENCES:

[1] In august 2013 C. Manibaalan, Balamurugan. S,keshore, Dr. Joshi. C. Haran published research paper in International journal of scientific and research publications. Under title "STATIC ANALYSIS OF AIRLESS TYRES"

[2] In Feb 2016 Sadoksaasi, Mohamed Ebrahemi, Musab Al Mozim and Yousef El Hadary published research paper in international journal of mechanical systems engineering under the title of "NEW DESIGN OF FLAT-PROOF NON PNEUMATIC TYRE".

[3] In March 2017 Nibin Jacob Mathew, Dillip Kumar Sahoo, E. Mithunchakarvarthy published research paper in international journal of mechanical systems engineering under the title of "DESIGN AND STATIC ANALYSIS OF AIRLESS TYRE TO REDUCE DEFORMATION".

Researches has been made in order to develop the airless/non-pneumatic tyres by various tyre manufacturing firms, automakers and by NASA as well.

The following paragraph gives a brief history and background of the research area of this paper.
Non-pneumatic tyres were actually invented in 1938 by J.V martin an American scientist. He invented an safety tyre with hoops of hickory encased in rubber and fitted with crisscross spokes of ribbed rubber. This tyre can drive over 4 inches blocks when tested in springless car.

NASA: In beginning of 1970 NASA developed an non-pneumatic tyre and used in its Apollo Lunar Roving Vehicle. These tyres were made with spun aluminium hub and woven steel strands coated with zinc. The contact area were partially coated with titanium chevrons. These were specially designed for moon surface.

Michelin: In 2005 started developing an integrated tyre and wheel combination, it was named as "TWEEL" It was the combination of both wheel and tyre) Michlien claims that its TWEEL has the high load carrying capacity,shock absorbing and hanling characteristics that compare favourably to conventionl tyres.
Big tyre PVT LTD: In 2011 an Australian based company started developing non-pneumatic tyres,non solid wheels. Which is designed to handle high workloads, such those found in underground mines. The wheel utilizes multiple arrays concentric leaf springs to distribute force evenly across the wheel.

Resilient Technologies and university of Wisconsin: In 2012,this company developed non-pneumatic tyre which is basically honeycomb wrapped with a thick black tread. This was the first company who started making commercially available, mass produced tyres.

The energy return wheel: Developed by Michler,Andrew in 2012. It was the outer edge of the tyre connected to inner rim by a system of springs. The springs can have their tension changed to vary the handling characteristics.

Bridgestone: In 2013 Bridgestone developed Air-free concept which was similar to TWEEL and can hold 150 kg of load per tyre.

Hankook: In 2015,Hankook developed the iFlexairless tyre. It was basically an integrated unit of both rim and tyres
Crocodile tyres: In 2017 Crocodile tyres developed robust airless tyres which were used in mining areas.