DESIGN DEVELOPMENT ANALYSIS & TESTING OF AUTOMATIC TYRE SELF INFLATION WITH HYBRID -MECHANICAL VALVE SYSTEM

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ABSTRACT

Studies performed earlier indicate that reduction in tyre pressure by just a small value (below28 PSI)can result in the reduction of fuel mileage, reduction in tire life, compromised safety, and deteriorated vehicle performance. In attempt to design and develop an automatic, self-inflating tire system that ensures that tyres are properly inflated at all times. Earlier design proposes and successfully implements the use of a portable compressor that will supply air to all four tyres via hoses and a rotary joint fixed between the wheel spindle and wheel hub at each wheel. The rotary joints effectively allow air to be channelled to the tyres without the tangling of hoses. With the recent oil price hikes and growing concern of environmental issues, this system addresses a potential improvement in gas mileage; tyre wear reduction; and an increase in handling and tyre performance in diverse conditions. This system is commercially available in the market by the name AERIS ---made by STEMCO .These systems have a prerequisite of an inbuilt compressor , tyre pressure monitoring system and sea of complex components to fulfil the operation of automatic tyre inflation

Keyword: - *Self Inflation, Hybrid mechanical valve, efficiency, Increase life.*

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1. INTRODUCTION

The automatic tyre self inflation with hybrid -mechanical valve system can not only make the driver more safety, but also save fuel and protect the tire., the United States had developed laws to enforce the TPMS installation in the car. In this project, the basic structure and the implement method, automatic filling of air are introduced. This is an excellent unique hybrid mechanical system designed to monitor air pressure inside the tires on various types of vehicles. This system report real time tire pressure information to the driver via a display. Appropriate good tire inflation pressure improves fuel efficiency, reduces breaking distance, improves handling, and increases tire life, while under inflation creates overheating and can lead to accidents. The main causes of under inflation are natural leakage, temperature changes and road hazards. The accurately measured temperature and pressure values were obtained by using SMART transmitter pressure sensor. The unique excellent agreement between the pressure and temperature results measured by the sensor and the direct measurement data is presented. The practical results in the certain ranges of pressure and temperature demonstrated that the micro sensor is able to measure temperature (20ºC-100ºC) and pressure (0kPsi- 150Psi) at the same time

2. Literature Review

In Central Tyre Air Inflation System by Sagar Adakmol Tushar Shende Dikshit Poriya Sanjot Fotedar Prof. S.P.Shinde and The aim of this study is to design and fabricate a system in which there is proper inflation in the tyre at all times which produce fuel savings of 1-4% and increase tyre life by up to 10%. A trial was done in this case paper involving two cement tankers in NSW Australia operated over a period of 12 weeks in 2013.[3] For first 6 weeks central inflation system was turned ON in both tankers and for another 6 weeks central inflation system was turned OFF in the both and graphs are prepared showing trucks with central inflated system is good in conditions like average vehicle idle time, average vehicle time spent using power take off, average vehicle GHG emissions, average vehicle fuel consumption across the trial period. [1]

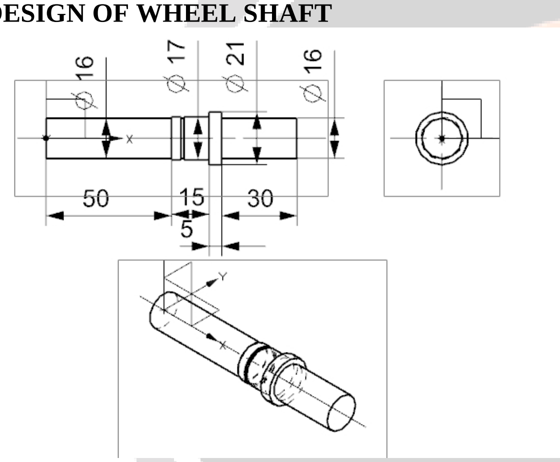
3. Objectives

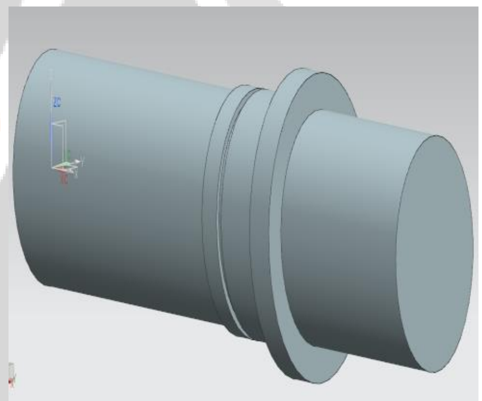
The objective of present work is:

1. Design development of Hybrid (Made by application to different filling systems) mechanical valve .
2. Design development of tyre pressure based valve stem actuation linkage where in strokes of valve per revolution of tyre can be automatically governed with help of simply automated kinematic linkage
3. Design development and analysis of quarter car (single wheel) test rig with condition of traction change , speed change and road condition variance ...to determine the damping parameter (displacement , velocity , acceleration and damping coefficient)provide by the air pressure in tyre.

4. Design

4.1 DESIGN OF WHEEL SHAFT

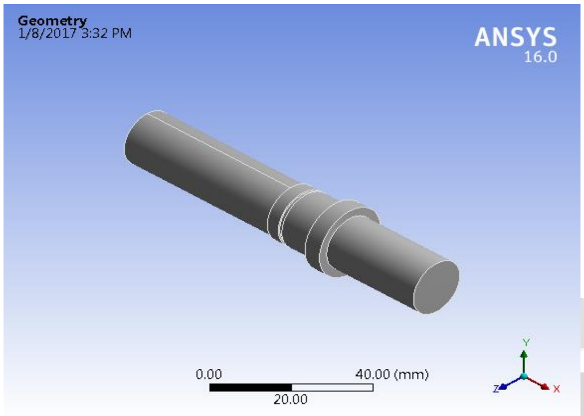




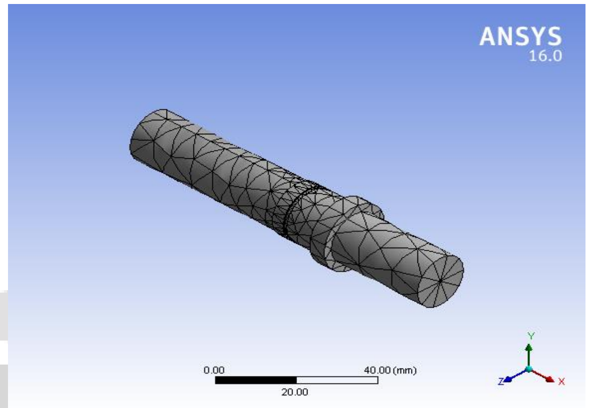
DESIGNATION	ULTIMATE TENSILE STRENGTH N/mm^2	YIELD STRENGTH N/mm^2
EN 24	800	680

FEA and Experimental Analysis

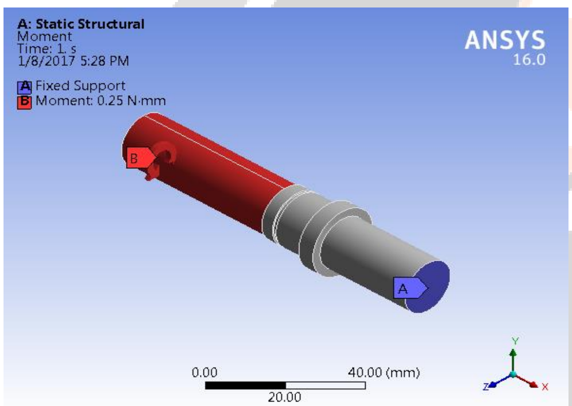
FEA Analysis



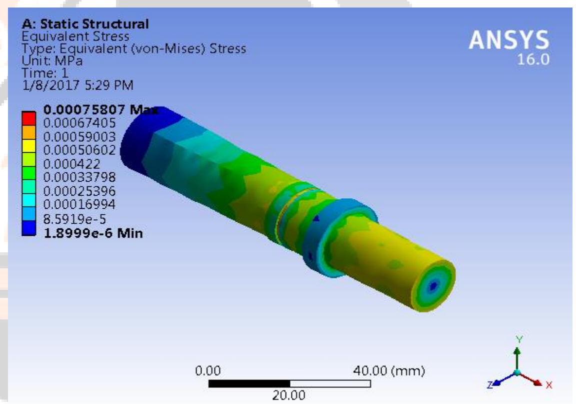
Geometry of shaft



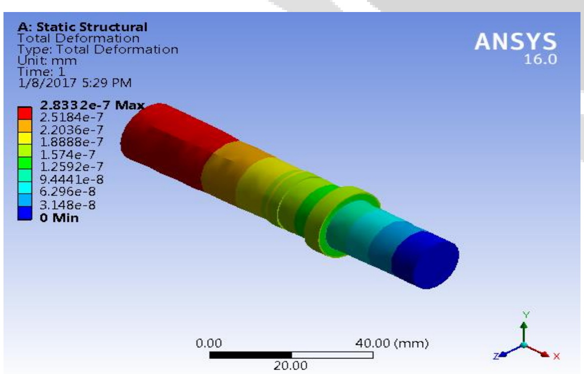
Meshing of Shaft



Static Structural Moment

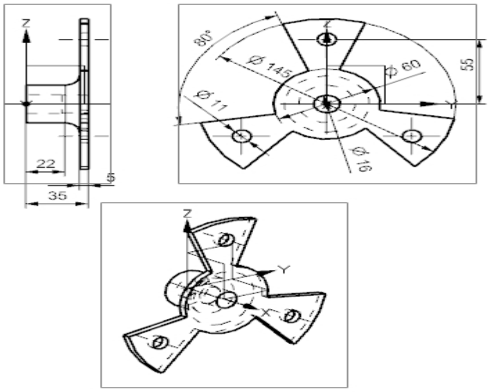


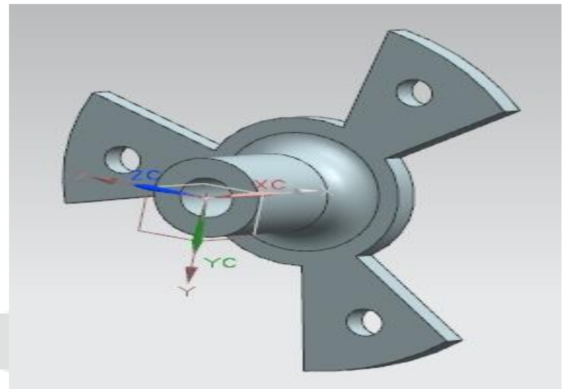
Von Mises Stress



Total Deformation

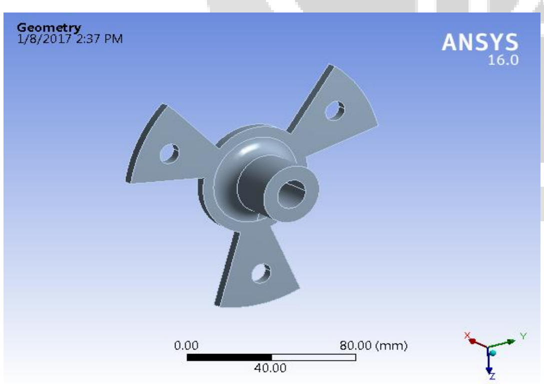
4.2 Design Of Left Hand Coupler Disk For Roller Of Belt Conveyor



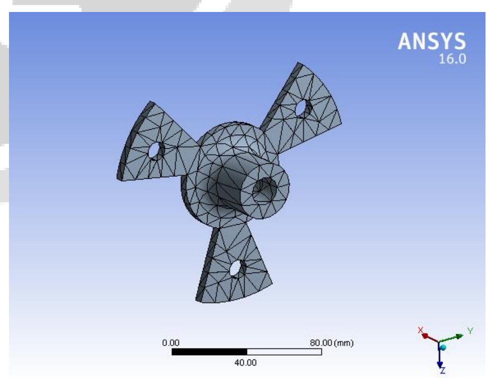


Left Hand Coupler Disk For Roller Of Belt Conveyor
Solid Model

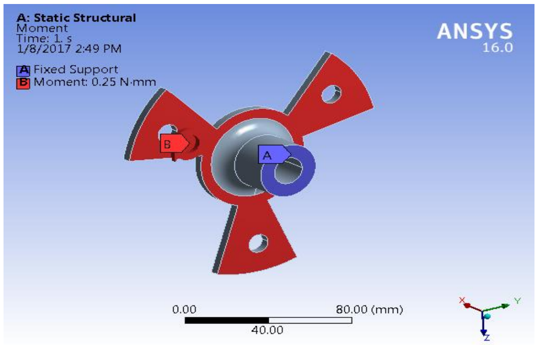
Designation	Ultimate Tensile strength N/mm^2	Yield strength N/mm^2
EN 24	800	680



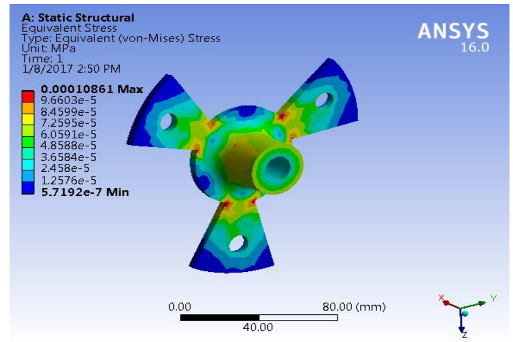
Geometry



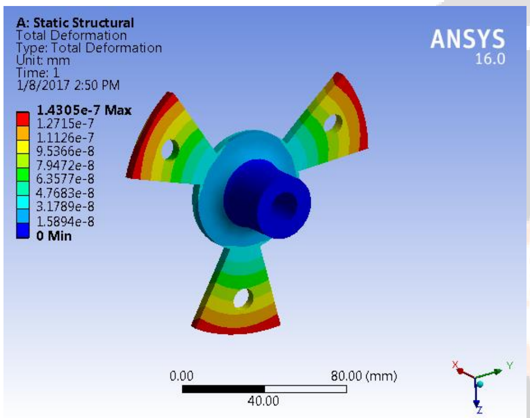
Meshing Of Coupler Disc



Static Structural Moment

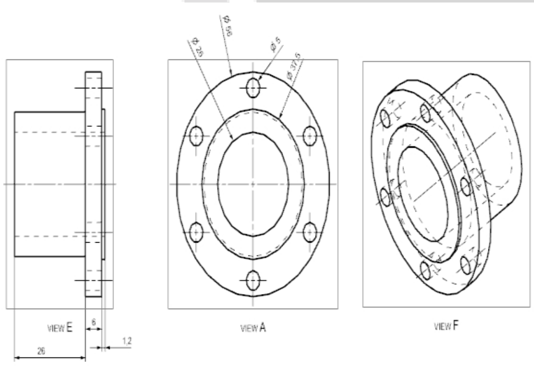


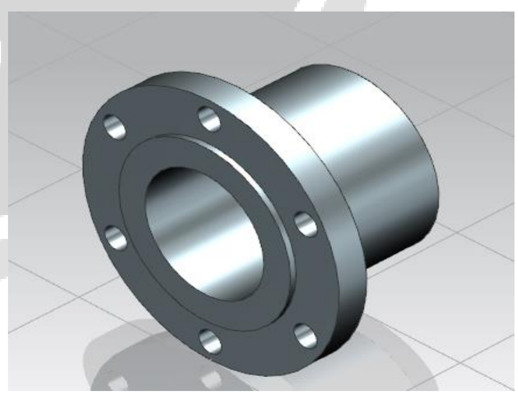
Von Mises Stress



Static Total Deformation

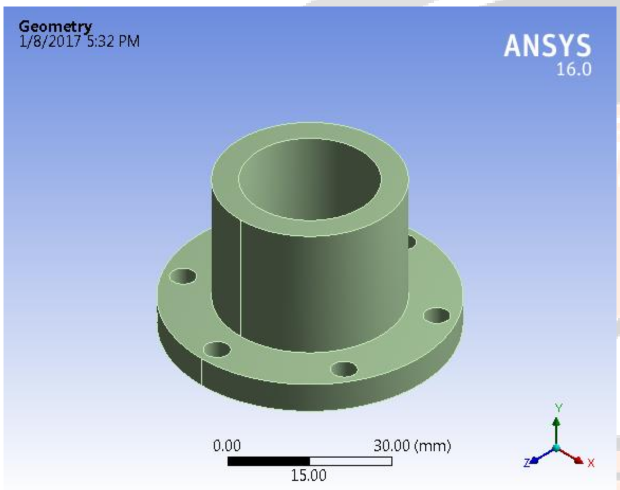
4.3 DESIGN OF WHEEL HUB:



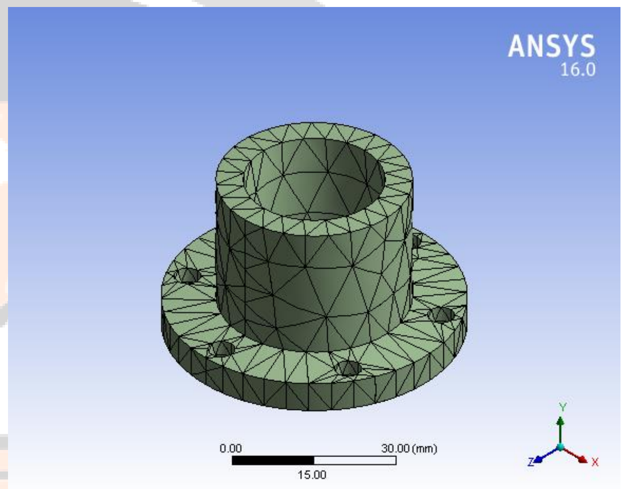


Solid Model

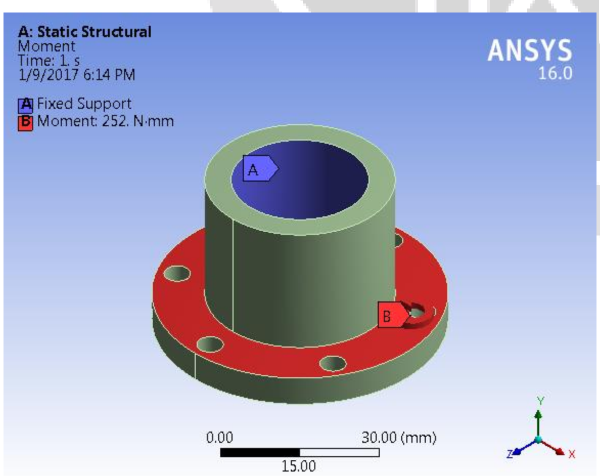
DESIGNATION	ULTIMATE TENSILE STRENGTH N/mm^2	YEILD STRENGTH N/mm^2
EN8	520	360



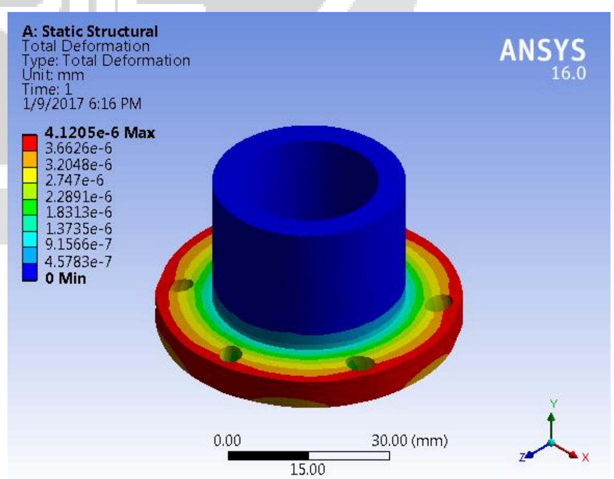
Geometry



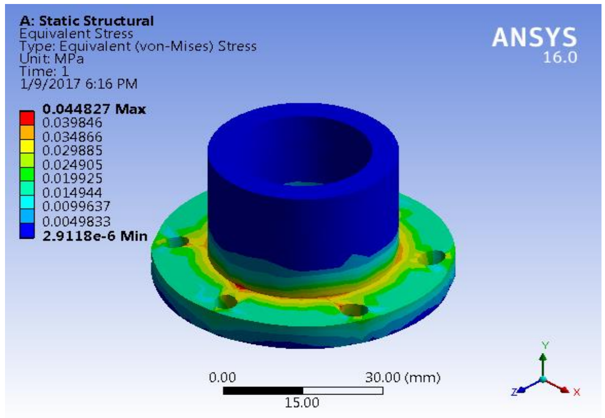
Meshing Of Wheel Hub



Static Structural Moment

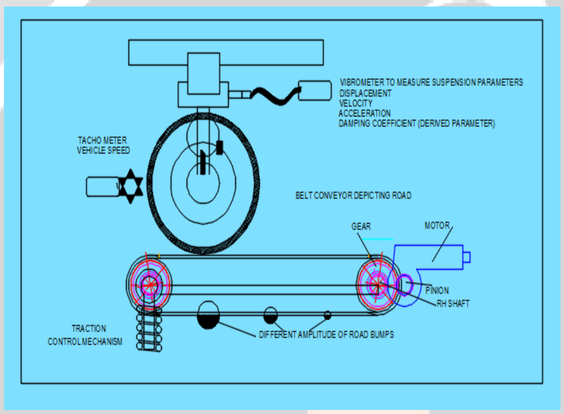


Total Deformation



Von Misses Stress

5 Experimental Setup



Experimental Setup

Process variable:

1. Vehicle speed
2. Traction
3. Amplitude of bumps

Measured parameters :

1. Tyre pressure (electronic tyre pressure gage)
2. Vibration (damping parameters owing to tyre pressure)

A)Displacement

B) velocity

C) acceleration

3. Tractive load

Total volume of tyre @32 psi = 16674.858 cc

Assuming that pressure drops to 28 psi --to activate the system

Percentage change in volume = percentage change in pressure

Percentage change in pressure = (initial pressure- drop pressure / initial pressure)*100

% pressure drop = 12.5 %

Target volume drop = 12.5 x 16674.859 *12.5 /100 = 2084 cc ----
So to recover tyre pressure from 28 psi to 32 psi volume to be refilled is 2084 cc.

Assuming vehicle speed to be 20 to 25 kmph (reference ---towing speed)

Distance covered by the vehicle in one minute = 333.33 m

Considering vehicle tyre diameter to be 22 inch

Distance covered in one rotation =1.6m

Total rotations per minute of tyre = number strokes for single valve system
= 333.3 /1.6 = 208 strokes

No of strokes available for refill = 208

Pump piston dia = 12mm

Pump stroke = 15 mm

Assuming that 80 % stroke is effective so volume of air pumped per stroke = 1.35 cc
So , volume pumped per stroke = 1.35 cc

Volume pumped by single unit system to replenish the dropped pressure
= 208 * 1.35 =280.8 cc

So total time required for a single unit to replenish dropped pressure

= total volume to be replenished / volume replenished per minute

= 2084 /280.8 = 7.42 minute

6 CONCLUSION.

So maximum time required for a single unit valve system to restore pressure from 28 psi to 32 psi considering only 805 efficiency of system = 7.5 min

6. REFERENCES

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