MODELLING AND ANALYSIS OF HUB FOR ALL - TERRAIN VEHICLE

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Abstract: Wheel hub is most important component in terrain vehicle which is used to support the wheel & braking system and transmit motion from the propeller shaft to wheels. The wheel hub in the vehicle is always exposed to self weight of the vehicle, shear loads and twisting loads. Due to the above listed loads the hub will be stressed so that the stress and strain analysis is required.This paper focus on to design and analyze the terrain wheel hub. The design had been carried out by the CATIA and FEA analysis been carried out by the ANSYS. In this paper the design of the hub had been modified and stress are determined by performing stress analysis. The computed results are compared to the existing model.

Key Words : Wheel Hub, EN24 Material, CATIA, ANSYS

I. INTRODUCTION

The purpose of the wheel hub is to serve as the glue between the tire and the axle. Tires are attached with studs to the hub assembly. The hub assembly then fits on the axle, which connects the tire component to the rest of the car. Because the wheel hub is the bridge between the tire and the entire vehicle, if one of its parts breaks down, it creates a ripple effect. That could include problems such as impaired steering or a broken axle.

Fig.1.Practical wheel hub

II. Methodology

II.I Properties of materials

Table1. Comparison of En24 material with Al-7075

S.No.	Material Type	En24	Al -7075
1	Yield Strength (N/mm^2)	680	505
2	Tensile Strength (N/mm^2)	870	570
3	Mass Density (Kg/m^3)	7850	2810

II.II. Specifications of Modified Wheel Hub & Model Calculations

- Diameter of hub = 180mm
- Corner Fillet radius = R15mm
- Pitch circle diameter= 140mm
- Bolt diameter= 12mm

- Shaft hole diameter = 25mm
- Number of bolts = 4 bolts

Model calculations

Braking Torque:

1. The force applied on the pedal is assumed to be 294.3 N (30kgf)
2. Pedal Ratio =6:1
3. F_{max}=Force*Pedal Ratio = 294.3*6=1765.8N

(Max=Forces applied onto the master cylinder)

$$P = \frac{F_{max}}{\frac{\pi}{4} * d^2}$$

(P=Hydrostatic Pressure, d=Diameter of Master Cylinder's Piston)

$$F_{max} = P * \frac{\pi}{4} * d^2 \text{ (By Pascals Law)}$$

(F_{max}=force acting on each piston of the cylinder, D=diameter of the piston in the caliper)

4. $F_{max} = f_{max} * \left(\frac{D}{d}\right)^2$

$= (1912.95 * \left(\frac{0.029}{0.190}\right)^2$

= 4074.98 N

5. Torque acting on the disc:

T=$F_{max} * \mu * R_e$ * Number of Pistons per caliper

=4074.8 $* 0.30 * 0.30 * 097 *$

=474.33 N-m

Where, µ=coefficient of friction between brake pad and disc (0.3)

II.III Meshing

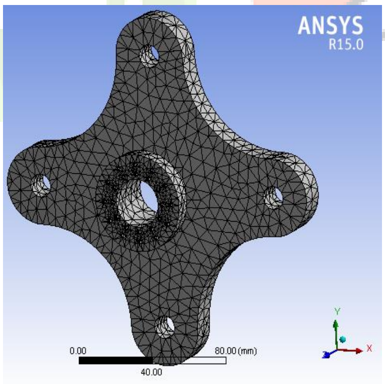

Fig.2. Meshing of proposed model

II.IV. Boundary conditions

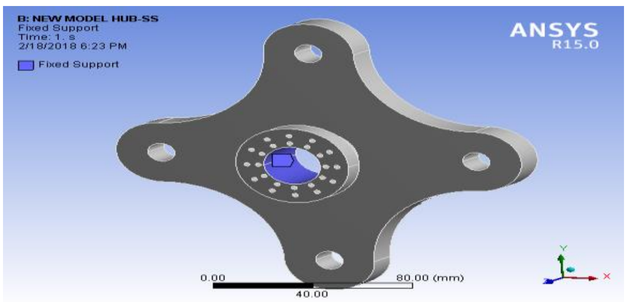

Fig.3. Fixed support applied on centre of the hub

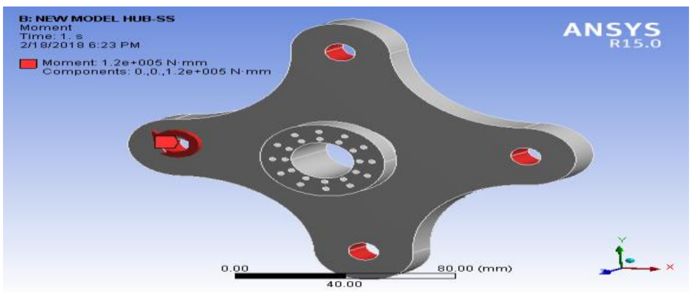

Fig.4. Moment applied on the outer circumference hole

II.V. Designed wheel hub

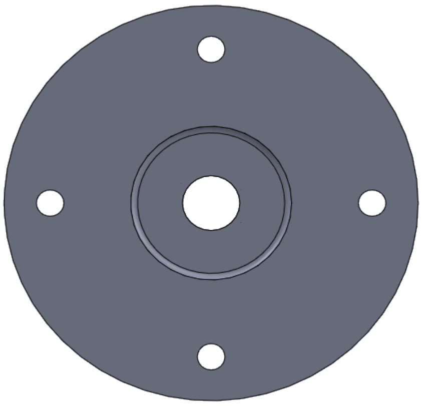

Fig.5.The proposed existing model

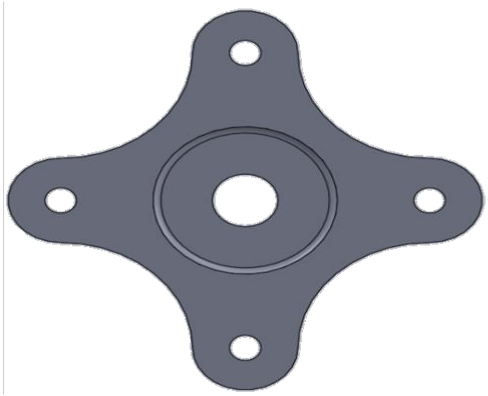

Fig.6. The proposed modified model

III. RESULTS & DISCUSSION

Static Structural Analysis of Existing Hub for EN24

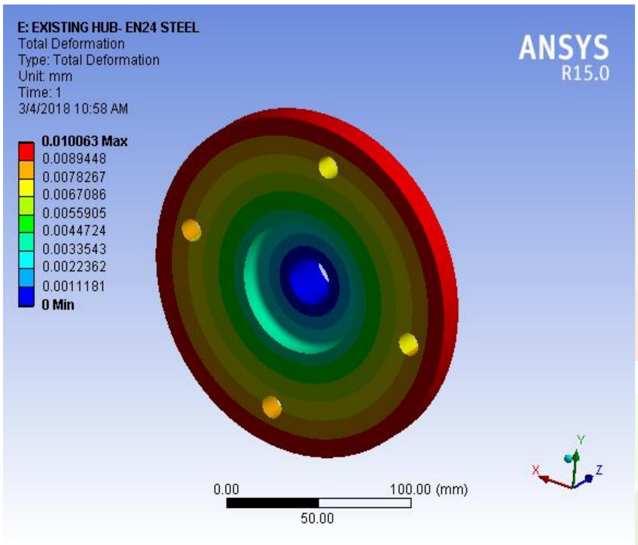

Fig.7 Total Deformation

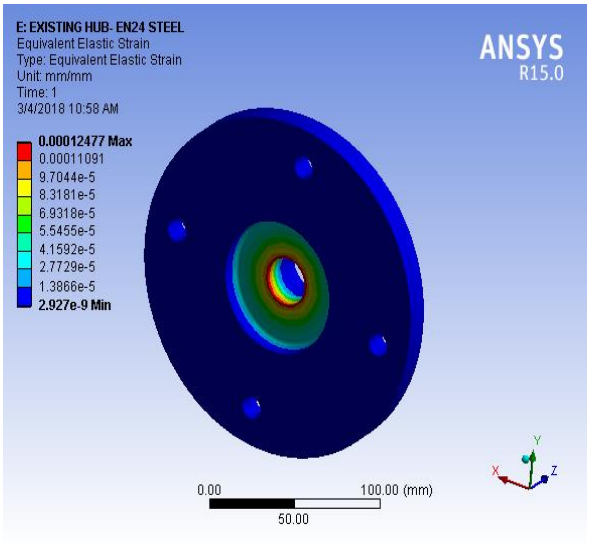

Fig.8 Equivalent Elastic Strain

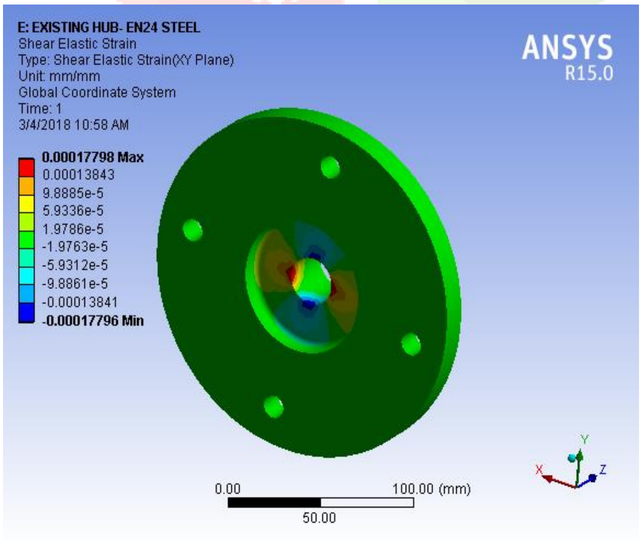

Fig.9 Shear Elastic Strain

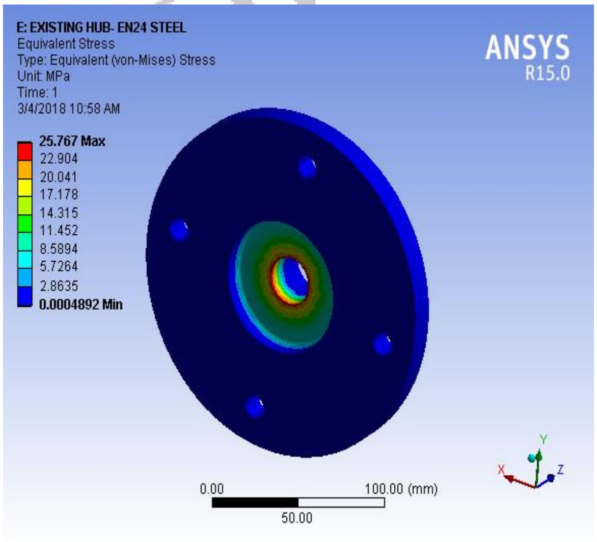

Fig.10 Equivalent (Von-Mises) Stress

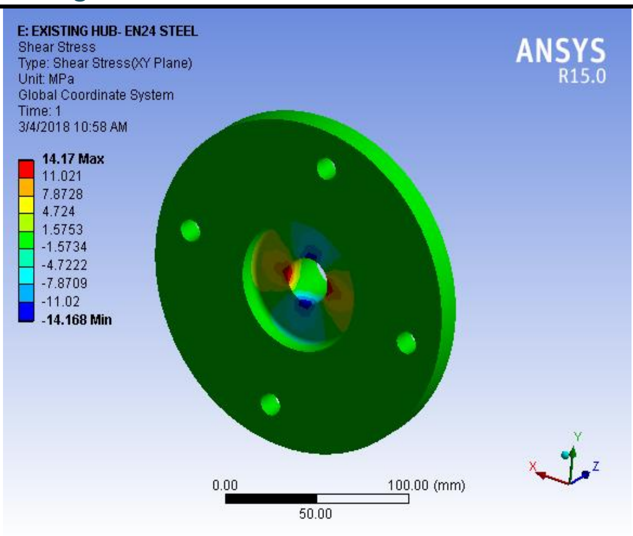

Fig.11 Shear Stress

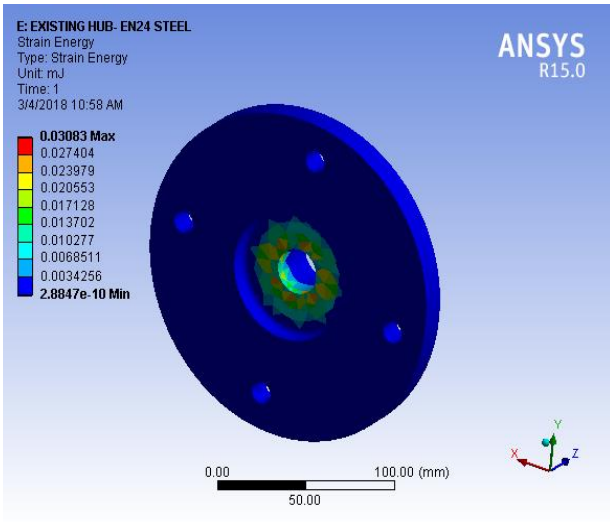

Fig.12 Strain Energy

Static Structural Analysis of Modified Hub EN24

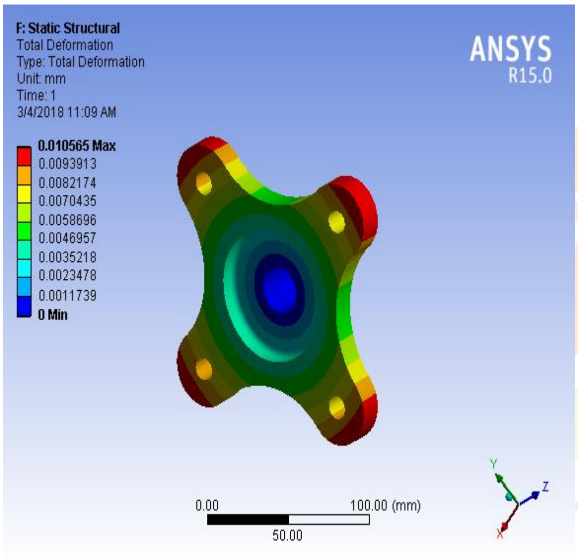

Fig.13 Total Deformation

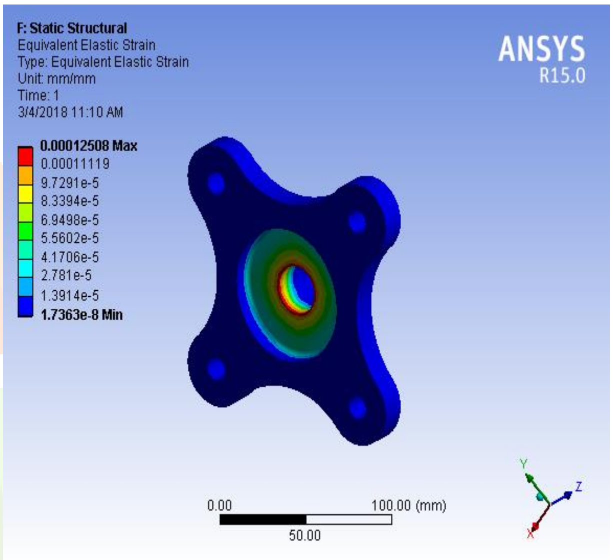

Fig.14 Equivalent Elastic Strain

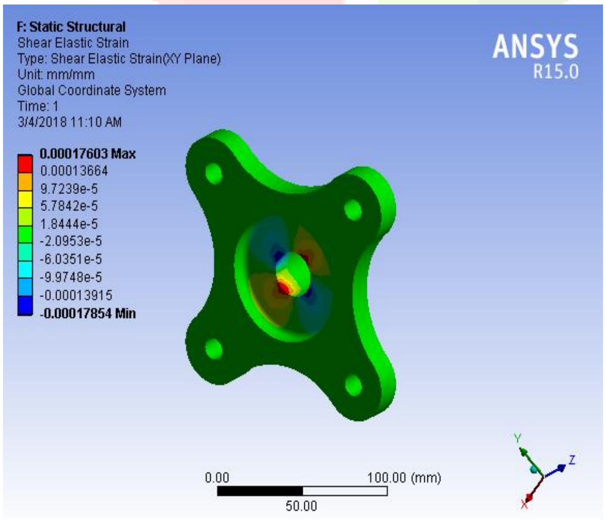

Fig.15 Shear Elastic Strain

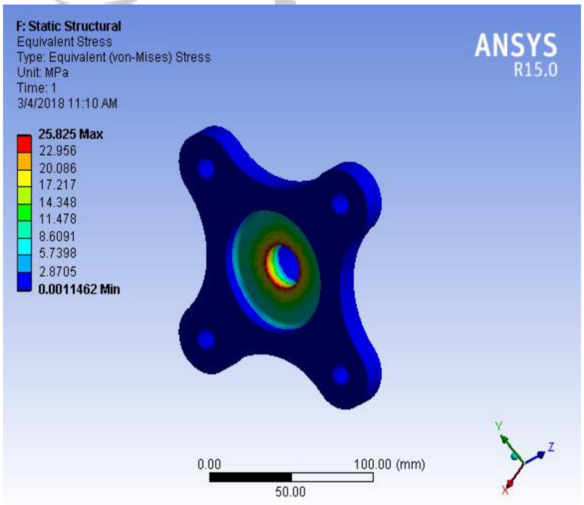

Fig.16 Equivalent (Von-Mises) Stress

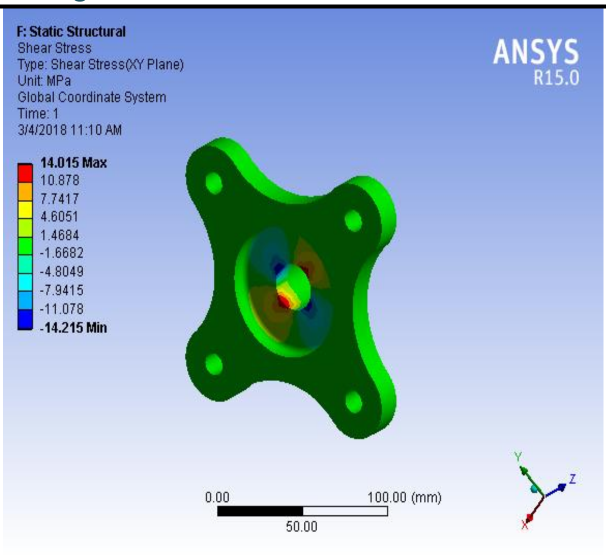

Fig.17 Shear stress (Modified Hub-EN24)

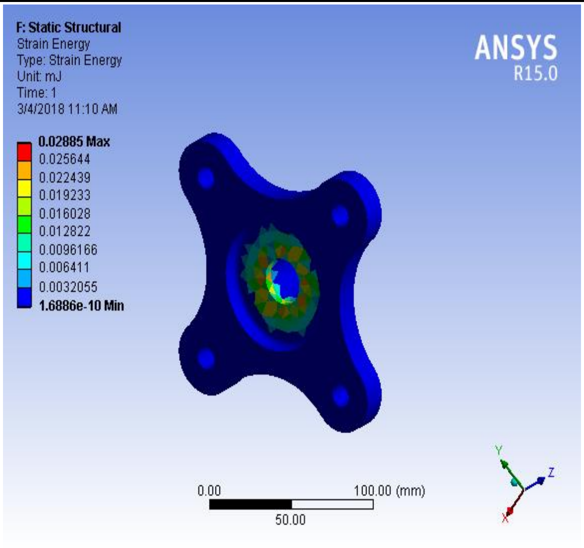

Fig.18 Strain Energy (Modified Hub-EN24)

Discussion

Table 2 Comparison of Existing Model and Modified Model with EN24

S.No	Properties	Units	Existing model	Modified model
1	Total Deformation	mm	0.010063	0.010565
2	Equivalent Elastic Strain	mm/mm	0.00012477	0.00012508
3	Equivalent Von Misses Stress	MPa	25.767	25.825
4	Strain energy	Joule	0.03083	0.02885

IV.Conclusion

The existing model of wheel hub Von miss stress value was 25.767 Mpa and modified model of wheel hub Von miss stress value 25.825. When comparing the existing model and modified model with EN24 the obtained results are very close, so that the weight of the modified model was reduced.

V.References

[1] Josh Carrol, Lloyd Outten, Joseph Perry, Taylor Watkins, "Formula SAE Team Final Report", Old Dominion University, April 2013.

[2] 'ANALYSIS OF WHEEL' by Jesus Fco, Rincon Garcia from Bachelor's thesis May 2014 Degree Programme.

[3] John C. Dixon; Suspension analysis and computation geometry; ISBN: 978-0-470-51021-6; October 2009.

[4] Thomas D. Gillespie; Fundamental of Vehicle Dynamics; ISBN: 978-1-56091-199-9; February 1992.

[5] IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), e-ISSN: 2278-1684, p-ISSN: 2320-334X PP 49-53.

[6] Thomas D.Gillespie, Fundamentals of Vehicle Dynamics, Research Professor Emeritus, University of Michigan Transportation Research Institute (UMTRI).

[7] R.K.Rajput, (2007). Strength of Materials, 4th Edition. S.Chand Publications.

[8] Nitin S.Gokhale, (2008).Practical Finite Element Analysis, Finite to Infinite.

[9] ShubhamYembarwar, BhushanKamble, PrashantPande, AmanWankhade, "Design and Finite element analysis of roll cage of an All-terrain vehicle", International Journal of Science and Research Volume 2, Issue 3.

[10] Khelan Chaudhari, Amogh Joshi, RanjitKunte, Kushal Nair, "Design and Development of Roll Cage for an All-Terrain Vehicle" International Journal on Theoretical and Applied Research in Mechanical Engineering (IJTARME), Vol. 2, Issue– 4, 2013.

[11] "Standards for All Terrain Vehicles and Ban of Three-Wheeled All-Terrain Vehicles; Proposed Rule". Consumer Product Safety Commission (Federal Register). 2006-08-10.

[12] BruceBoardman, 1990, Fatigue resistance of steels, ASM Handbook, Volume:1 Properties and Selection: Irons ,Steels,and High Performance Alloys ASM Handbook Committee, p 677.

[13] Preeti Vishwakarma, Mukesh Kanungoo, February 2014, Finite element analysis of Chevrolet front hub with the help of inventor, IJITE, Vol-02, Issue-02, p 11, 12.