Static Analysis Of Tractor Trolley Axle

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Abstract: **This paper deals with static analysis of tractor trolley axle. In India tractor trolley (or) trailers are very popular and cheaper mode for transport of goods and in rural as well as urban areas. Especially various small scale industries are adopting the crude methodologies for designing and manufacturing machine components. One such industry producing tractor trolleys for agricultural use has been identified for this study. Most of the tractor trolley axle used today is rectangular cross section type which in turn leads to increase in the weight of tractor trolley and axle. The solid modeling of axle is developed by CATIA-V5. Analysis is done using ANSYS work bench. In paper an attempt has made by replacing rectangular cross section with circular section. Further static analysis is done to determine von-misses stress, equivalent elastic strain, maximum shear stress, total deformation. Finally the results of rectangular section axle with circular section axle are compared which result in reducing the 20% weight of the circular axle.**

Keywords: ANSYS Workbench, CATIAV5, Static Analysis.

I. INTRODUCTION

In the present market scenario, cost reduction technique is playing a signified role to meet the competition in the market. Weight reduction and simplicity in design are application of industrial engineering etc., are used as source of technique. Various components or products used in rural areas are mostly manufactured in small scale industries such as farming machinery, thrashers, tractor trolleys etc .It has been observed that these rural products are not properly designed. Tractor trolleys are manufactured in small to moderate scale industries. Though tractor trolleys are manufactured of various capacities by various industries, still there is a large variation in manufacturing methods, component design etc [1].

The trolley axle is a central shaft for rotating wheels. The wheels are fixed to the axle, with bearings or bushings provided at the mounting points where the axle is supported. The axle maintains the position of the wheels relative to each other and to the vehicle body.[5]

II. STATIC LOAD ANALYSIS

The total capacity of the trolley is 80KN but self weight of trolley and axle assembly is 25KN.So we consider the gross weight come over axle is 105KN.As the leaf spring is used as the isolator and whole weight of the trolley is mounted over there. Due to leaf spring the total weight of the trolley is transferred over the axle at two point C and E as shown in load distribution diagram(fig1).Table1. Shows the specification of 4-wheeler tractor trolley.Fig.1 shows the load diagram tractor trolley axle.

Table 1: Specification of 10-tonne 4-wheeler trolley

1.	Overall length of Trolley	4880mm
2.	Overall width of trolley	2290mm
3.	Overall height of trolley	1780mm
4.	pay load	80KN
5.	Unloaded weight	25KN
6.	Gross load weight	105KN
7.	Axle	120mm dia of length2060mm

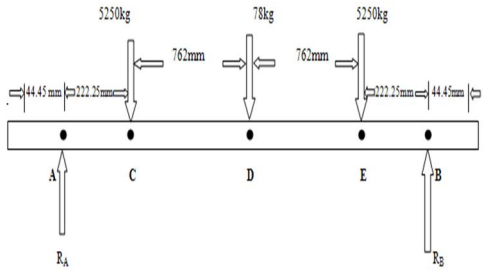

Fig1.Load diagram of tractor trolley axle

III. MODELING

In the present study market available tractor trolley axle is selected and its dimension is noted. The possible loads acting and the place of loads are noted. According to the dimensions tractor trolley axle is modeled using CATIAV5 software and their specification are shown in table1. It is then imported to design modeler software ANSYS.

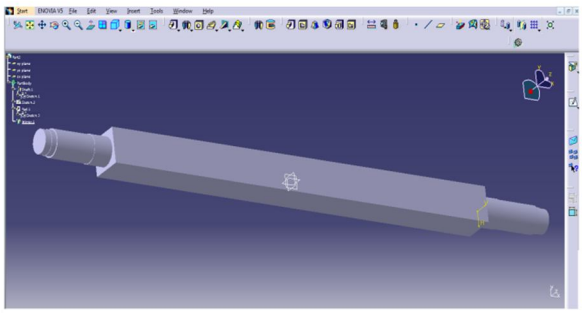

Fig: 2 Model of rectangular trolley axle

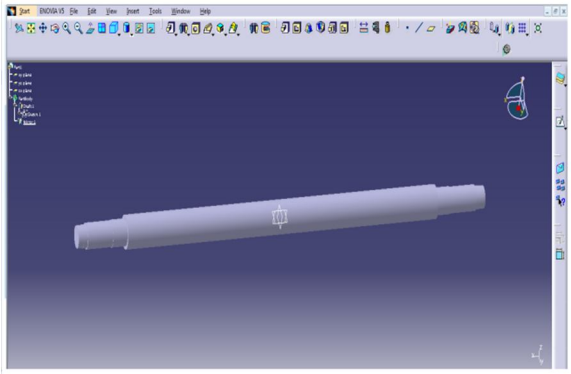

Fig: 3 Model of circular trolley axle

Material properties:

Material used for tractor trolley axle is SAE1020 and their properties as shown in the table2.

Table 2: Properties of SAE1020

Material	SAE1020
Young's modulus	2.05e+005 MPa
Poisson's Ratio	0.3
Density	7.87e-006kg/mm3
Tensile yield strength	350 MPa
Tensile ultimate strength	420 MPa

IV.STRUCTURAL STATIC ANALYSIS

Solid geometry of axle is created and is imported to analysis software ANSYS and get stress, strain, total deformation by using the steps given below and also figure shows the color effect which shows effect of load on the axle.

STEPS

- **Model**
  - Geometry
    - Part 1
  - Mesh
  - **Static structural**
    - Analysis settings
    - Loads
    - Supports
  - Solution
    - Stress
    - Strain
    - Total deformation
  - Results

Fig 4&5 shows imported model of rectangular and circular section trolley axle.

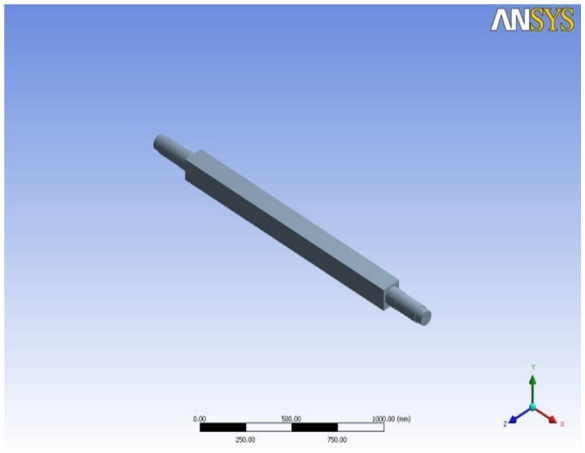

Fig: 4 Imported model of rectangular axle

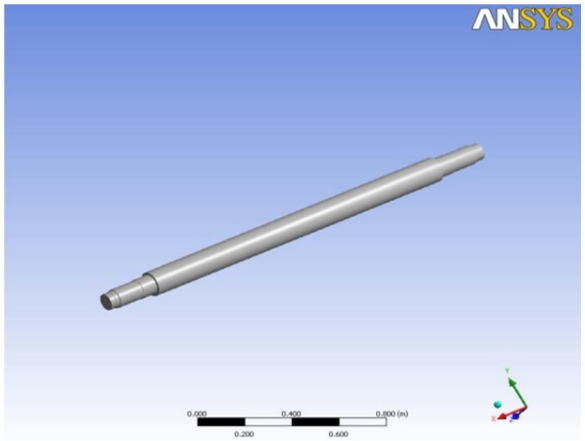

Fig: 5 imported model of circular axle

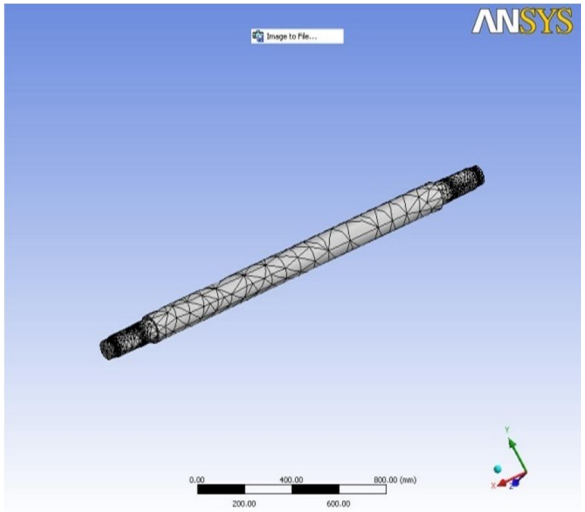

Fig: 6 Meshed model of circular axle

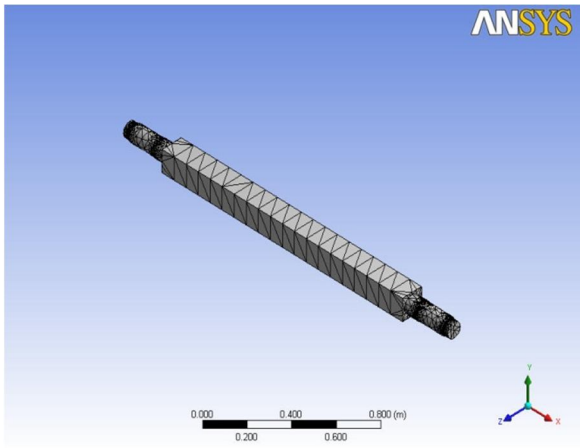

Fig: 7 Meshed model of rectangular axle

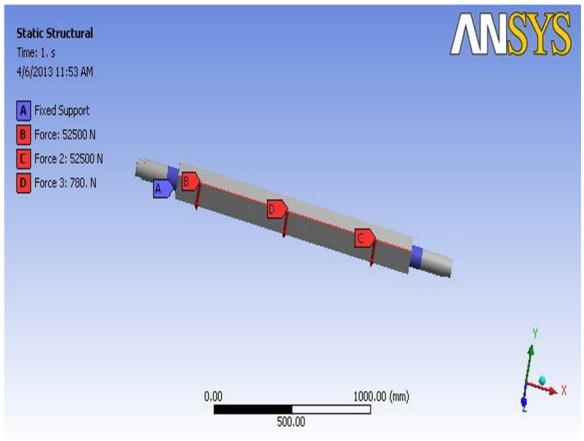

Fig: 8 Load diagram of rectangular axle

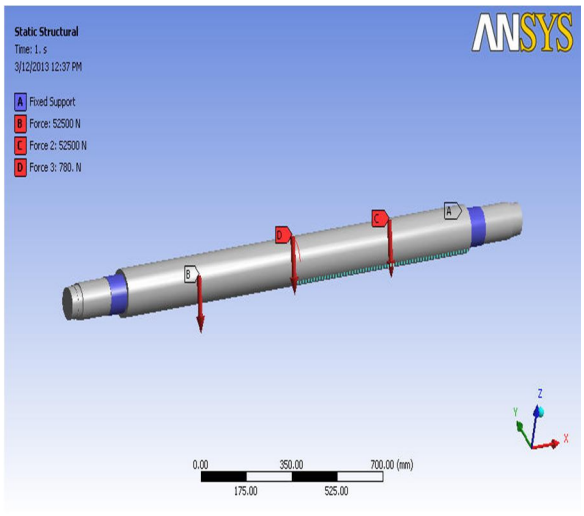

Fig: 9 Load diagram of circular axle

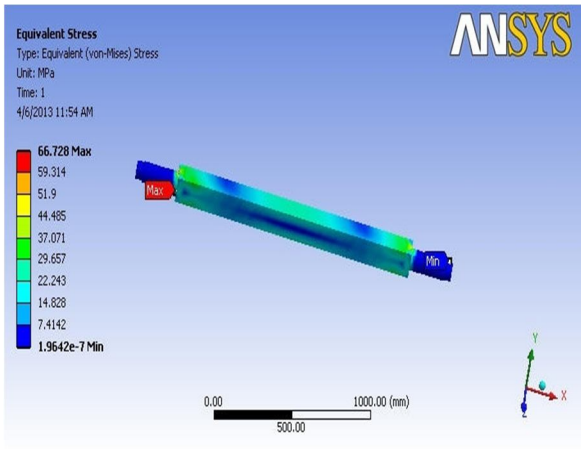

Fig: 10 stress diagram of rectangular axle

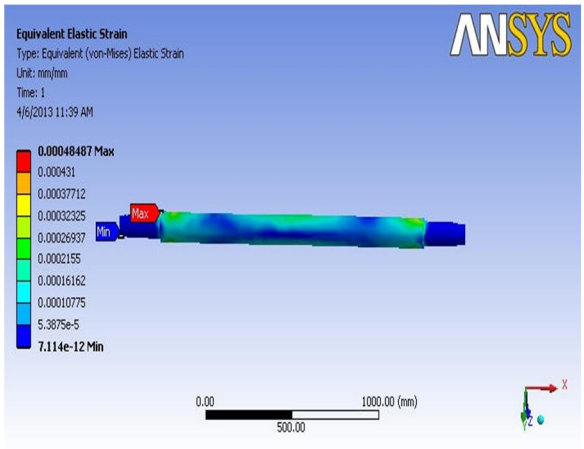

Fig: 13 Strain diagram of circular axle

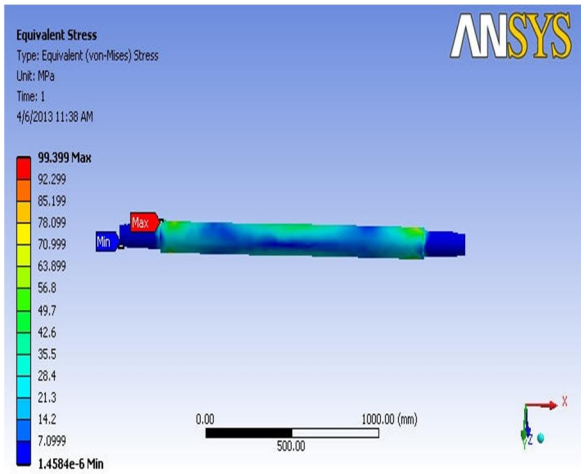

Fig: 11 stress diagram of circular axle

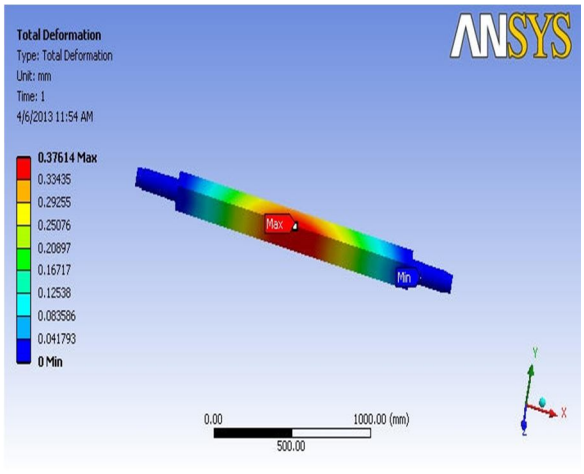

Fig: 14 Total deformation of rectangular axle

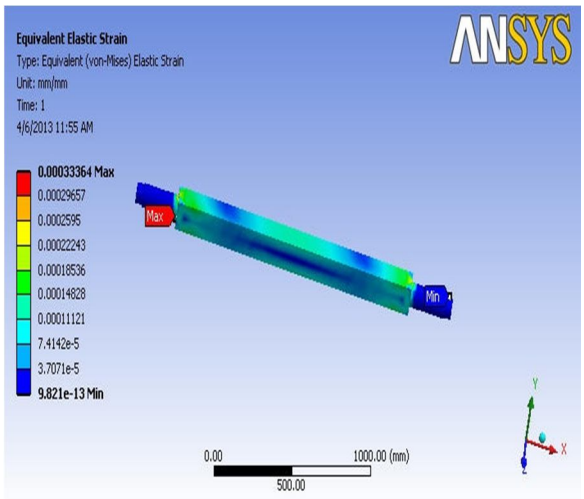

Fig: 12 Strain diagram of rectangular axle

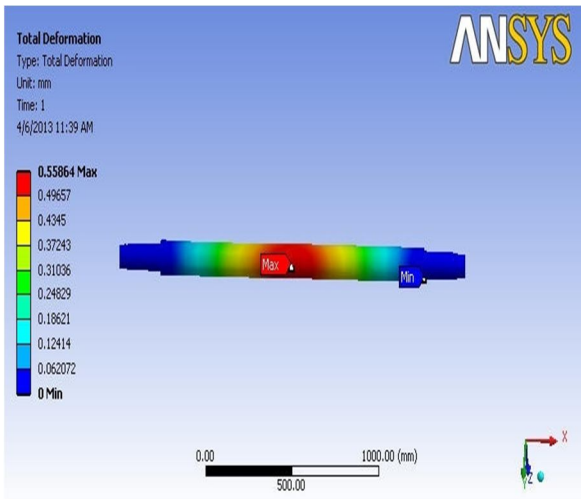

Fig: 15 Total deformation of circular axle

V.CONCLUSION

TABLE3: Comparison between rectangular and circular axle

S.NO	RECTANGULAR AXLE	CIRCULAR AXLE
1.	Equivalent stress=66.728MPa	Equivalent stress=99.399MPa
2.	Equivalent Elastic strain=$3.255e^{-4}$	Equivalent Elastic strain=$4.848e^{-4}$
3.	Maximum shear stress=36.499MPa	Maximum shear stress=53.564MPa
4.	Total deformation=0.37614mm	Total deformation=0.558 mm
5.	Mass=200.25kg	Mass=160.13kg

Weight Reduction Analysis:

= Mass of rectangular axle-Mass of circular axle÷Mass of rectangular axle

= 200.25-160.13/200.25=0.20035×100=20%

From the above results 20% 0f the weight of the tractor trolley axle is reduced due to rectangular cross section is replaced by circular cross section. Finally, the stress induced in the tractor trolley axle is less than the allowable stress (i.e.,430 Mpa).so the design is safe under given loading condition.

REFERENCES

[1]. H. V. Katore, S. B. Jaju, "Redesigning of Tractor- Trolley Axle using ANSYS,"International Journal of Engineering Science and Technology (IJEST), vol.3, pp. 4702-4710, June2011.
[2]. MajidKhanali, Ali Jafari, HosseinMobliand Ali Rajabipour "Analysis and design optimization of a frontal combine harvester axle using finite element and experimental methods "Journal of food, Agriculture, &Enviournmental,WFL Publisher, Vol 8(2) pp. 359-364, 2010.
[3]. Happy Bansal , Sunil Kumar, "Weight Reduction and Analysis of Trolley Axle UsingAnsys", International Journal of Engineering and Management Research, Vol.-2, Issue-6, Pages: 32-36, December 2012.
[4]. Sanjay Aloni, Sandip Khedkar,"Comparative Evaluation of Tractor Trolley Axle by Using Finite Element Analysis Approach "International Journal of Engineering Science and Technology (IJEST). Vol4. No.4 pp- 1351-1360, April 2012
[5]. http://en.wikipedia.org.
[6]. R.S. Khurmi" Strength of material".
[7]. R.S. Khurmi and Gupta" Theory of Machine".