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DYNAMIC ANALYSIS OF SUGARCANE TROLLEY AXLE BY USING ANSYS

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Abstract:

In this paper a Dynamic analysis is conducted on sugar cane trolley axle. The solid modeling of axle and analysis is done using ANSYS work bench. Axel is analyzed and studied to solve the problems frequent bending problem of sugarcane trolley of sugar mill . The failure analysis is performed on the axle of trolley used in agricultural area. These results provide a technical basis to prevent future damage to the location axle. The design is optimized based on the manufacturing cost of the axle. Hollow axle optimized for the ultimate value so that the strength should be maintained with the reduction in cost and weight and weight is reduce 40 to 60 %.

Keywords: ANSYS, axle design, optimization, stress analysis

1. Introduction

Tractor trolley or Trailers are widely used for transporting agriculture product, building construction material, industrial equipments & many other types of goods. Many varieties are available in trailer and use of particular trailer depends upon the application. The main requirements of trailer manufacturing are high performance with longer working life and robust construction. Tractor trolleys used for transportation are manufactured in small to moderate scale industries. Though tractor trolleys are manufactured of various capacities by various industries, there is a variation in manufacturing methods.

The axle of a tractor trolley is one of the major and very important component and needs to be designed carefully, science this part also experiences the worst load condition such as static and dynamic loads due to irregularities of road, mostly during its travel on off road. Therefore it must be resistant to tolerate additional stress and loads.Farm tractor is an off road vehicle, used as a portable machine to do various useful works such as farming, haulage, heavy earthmoving & transportation. An off-road vehicle is considered to be any type of vehicle which is capable of driving on and off paved or

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gravel surface. Off road condition includes uneven agricultural field surfaces and bumpy village roads on which the tractor has to operate. These ground irregularities leads to unexpected loads coming on the tractor components.

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. In India tractor trolley is verypopular and cheaper mode for transport of goods andin rural as well as urban areas. Especially various smallscale industries are adopting the crude methodologies for designing and manufacturing machine components.

3. PROBLEM DEFINITION:

Sugar mill have frequent axel bending problem of trolley .The net weight capacity of axle is 8800 kg and having average speed 20 to 40 km/hr. wheel mounted on axle having diameter 1000 mm and material mild steel is used to manufacturing the axle therefor we consider axle r.p.m for 40 km/hr is N=11.11x60/3.14x1 we get axle r.p.m is 212.29 r.p.m. and square axle having weight 90 kg respectively. Axle posses cyclic loading that may cause bending. This trolley uses round axle having diameter 80 mm it subjected to bending at one end of axle.

Fig1. bending problem of round axel trolley

Fig2. bending problem of square axel trolley

4. OBJECTIVES OF THE WORK

1. To find stress and strain of square axle and round axle of trolley
2. To overcome the axle bending problem
3. Dimension / Material Optimization of the axle.

5. OPTIMIZATION TECHNIQUE:

In optimization technique more stress concentrated material will be change by adding or subtracting the material for the purpose of increasing strength of axle and reducing stress concentrated area of axle to avoid the bending without increasing cost of axle.

6. MODELING

The solid modeling of existing axle an is done using CATIA V5 .

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7.Load Diagram For Tractor Trolley Axle

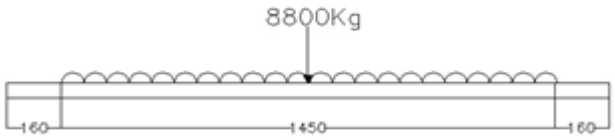

FIG 3: LOAD DIAGRAM

8. Material properties:

Material	Low Grade M.S.	High Grade M.S.
Young's modulus (Gpa)	120	200
Poisson's Ratio	0.28	0.3
Density(kg/m3)	7800	7800
Tensile yield strength (Pa)	2.4*10^8	2.5*10^8

9. DYNAMIC ANALYSIS

Solid geometry of axle is created and is imported to analysis software ANSYS and get stress, strain, total deformation .

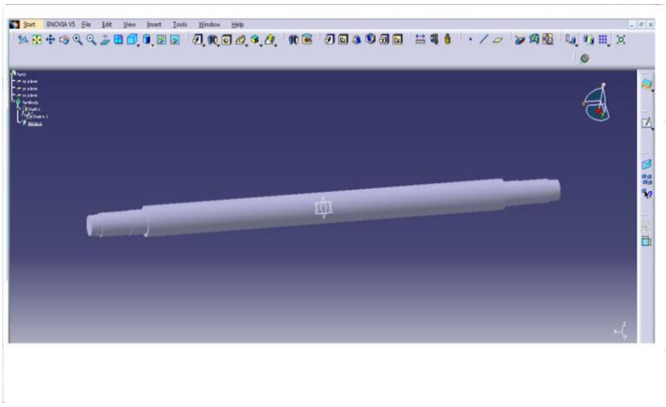

Fig4.CAD Model of axle using CATIA V5

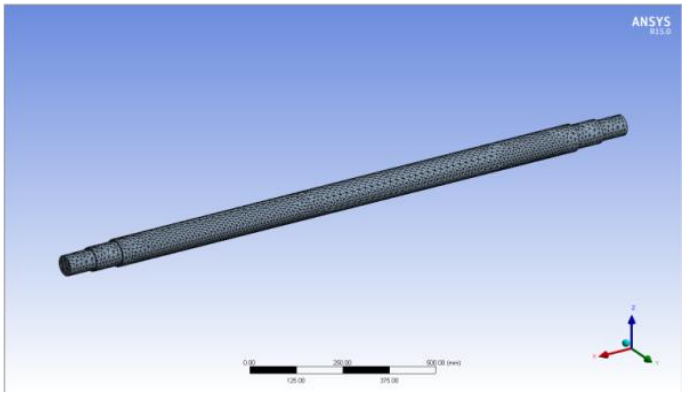

Fig5. Mesh generated of axle in ANSYS

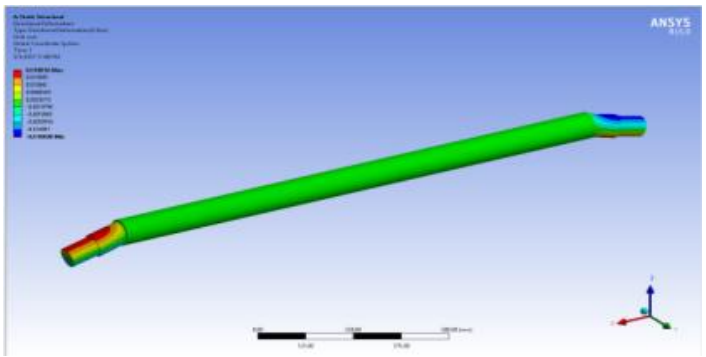

Fig6a : Von-misses stress

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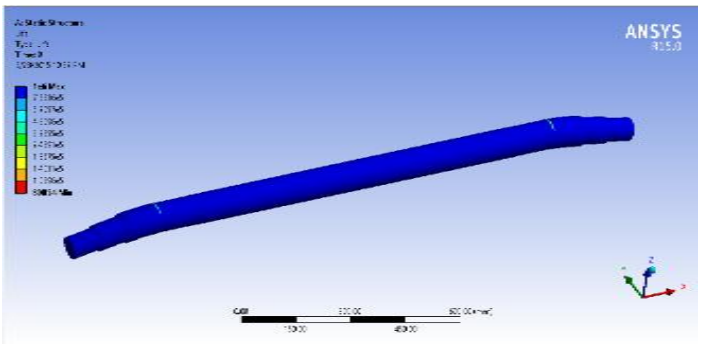

Fig6b : Life

Fig6 .Analysis result for Existing axel Low Grade M.S.

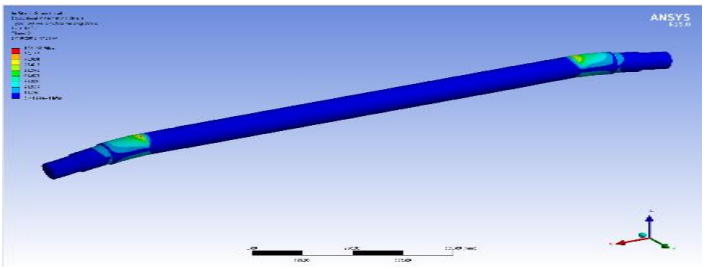

Fig 7a: Von-misses stress

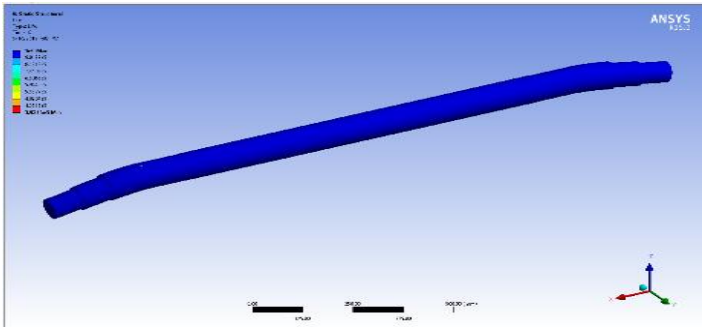

Fig7b : Life

Fig7 .Analysis result for Existing axel for High Grade M.S.

RESULTS AND DISCUSSION

Case I

Old design with Dia. 80 mm	Material	Life(cycle/Hr)	Stress (N/mm^2)
Existing Axel	Low Grade M.S.	$7.553e^5$	146

Table 1. Analysis Results for existing axel

Case II

New design with Dia. 85 mm	Material	Life(cycle/Hr)	Stress (N/mm^2)
Modified /Proposed Axel	High Grade M.S.	$9.02112e^5$	101

Table 2 . Analysis Results for modified axel

The comparison of the initial and modified designs on the various parameters are given below

1)Considering initial design for a axel , simulation results showinglife of axel is $7.553e^5$ and modified designs deformation of axel is $9.02112e^5$. For material solution High grade M.S have lower deformation and stress for same dimension of existing design axel .

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2) In dimensional solution , dimension of existing axel changed from 80 mm to 85 mm for high grade M.S. material shows lower deformation result than existing axel .

3) Stress and deformation induced in the modified axle are less than the existing axel .

CONCLUSION

This study was conducted on a existing axle shaft used in tractor trolley. From the above results life of modified axel is increases as compare to the existing axle. Stress induced in the tractor trolley in modified axle is less than the allowable stress .so the design is safe under given loading condition..

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