DESIGN AND ANALYSIS OF TRACTOR FRONT AXLE BY REVERSE ENGINEERING APPROACH

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***ABSTRACT*:- The present off-highway vehicle market demands low cost and light weight component to meet the need of cost effective vehicle with fuel efficient. This in turn gives the rise to more effective use of materials for vehicle parts which can reduce the overall weight with enhanced utility of vehicle for various applications. In tractor industry, many casting components always suffer dynamic load with less frequency and very high amplitude which may cause the potential danger. Due to brittle behavior of the material, such component can break suddenly without any apparent caution. During the service life, dynamic forces caused by the road surface roughness produce dynamic stresses and these force lead to fatigue failure of axle shaft and its housing, which is the main load carrying part of the assembly.**

The weight is reduced by changing the front axle design slightly without sacrificing its strength. By minimizing the weight of the component the fuel consumption rate is reduced by 5-10%.the design was done using CATIA and meshed in HYPERMESH software module. The meshed model was solved in ANSYS software.

***Keywords*: Front Axle; Stress Concentration; Finite Element Analysis; Life Cycle.**

I.INTRODUCTION

Reverse engineering, also called back engineering, is the processes of extracting knowledge or design information from anything man-made and reproducing it or reproducing anything based on the extracted information. The front axle is designed to transmit the weight of the automobile from the springs to the front wheels, turning right or left as required.

To prevent interference due to front engine location, and for providing greater stability and safety at high speeds by lowering the center of gravity of the road vehicles, the entire center portion of the axle is dropped. Front axles can be live axles and dead axles. A live front axle contains the differential mechanism through which the engine power flows towards the front wheels. For steering the front wheels, constant velocity joints are contained in the axle half shafts. Without affecting the power flow through the half shafts, these joints help in turning the stub axles around the king-pin.

II. COMPONENTS

For design purpose the front axle beam of Mahindra 575 DI BHOOMIPUTRA truck was chosen. All standard axles have an I cross section in the middle (spring seat to spring seat) and circular or elliptical cross sections at its ends. An axle is usually a forged component for which a higher strength to weight ratio is desirable. The mounting surface is called spring seats and usually have five holes. The four holes on the outer edge of the mounting surface are for the U-bolts which hold the spring and axle together. The center hole provides an anchor point for the central bolt of the spring. A lubrication fitting and a drilled passage provide a method of forcing grease onto the bearing surfaces of the thinner and outer wheel bearings. The outer end of the spindle is threaded. The king pin acts like a pin of a door hinge as it connects the steering knuckles to the ends of the axle I- beam. When the vehicle goes into a motion, the axle receives a twisting stress of driving and braking. When the vehicle is not in a motion, the only job that axle has to do is hold the wheel in proper alignment and support part of the weight.

Photo 2 (A) Mahindra Tractor

Photo 2 (B) Bottom View of Front Axle

2.1 Vehicle Specifications

ENGINE	
No of cylinder	4
Capacity , CC	2730
Engine Rated RPM	1900
Fuel Tank Capacity, LIT	47.5 lit

Table 2.1 (A) Engine Specifications

TRANSMISSION	
Transmission Type	Partial Constant Mesh Transmission
No Of Gears	8 Forward + 2 Reverse
Brake Type	Oil Brake
Main Clutch Type & Size	Dual
Steering Type	Power Steering

Table 2.1 (B) Transmission Specification

HYDRAULIC SYSTEM	
Lift Capacity at Hitch , KG	1600 kg

Table 2.1 (C) Hydraulic System Specification

DIMENSION	
Wheel Base MM	1945
Tyre Size, Front + Rear	6.00*16 + 13.6*28/14.9(optional)

Table 2.1 (D) Dimension Specification

III. DESIGN OF FRONT AXLE

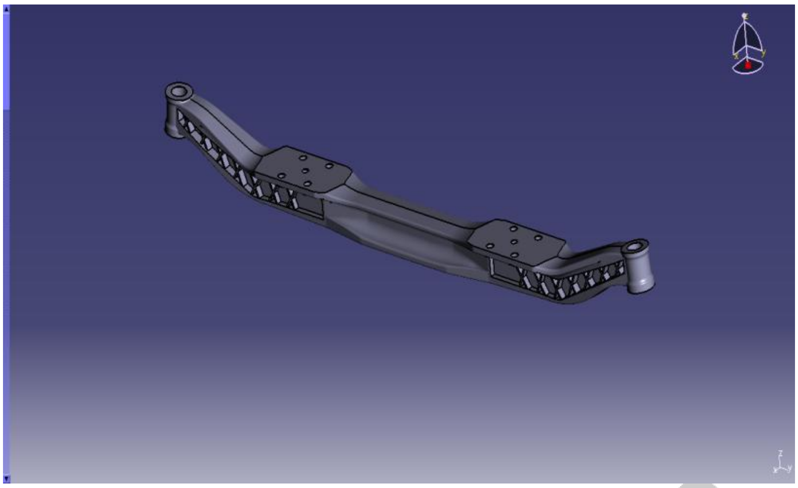
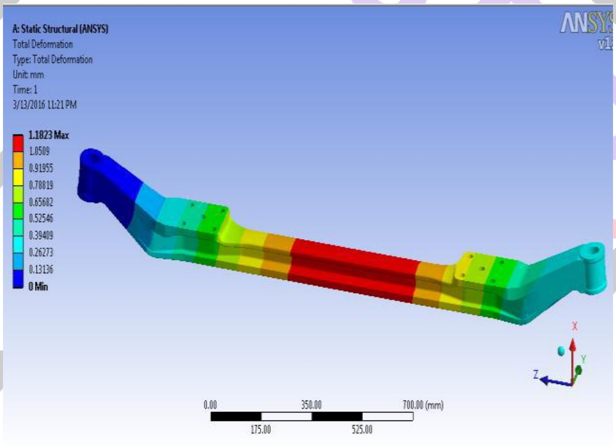


Fig 3 Front axle design

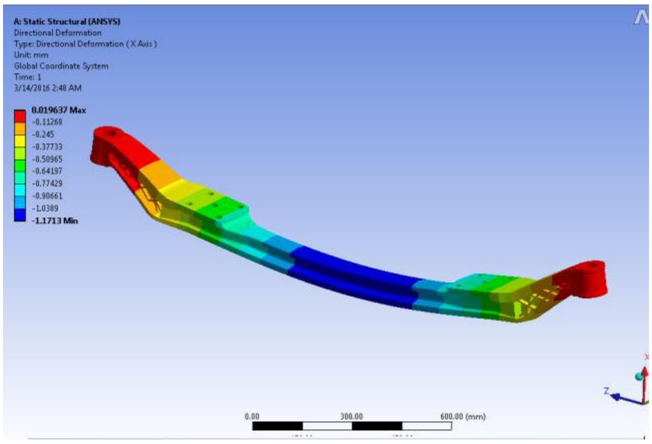
IV. FINITE ELEMENT ANALYSIS

After finishing the optimized design using CATIA the model was solved in ANSYS 14.5 software. The displacement and stress has been plot in ANSYS 14.5 software module.

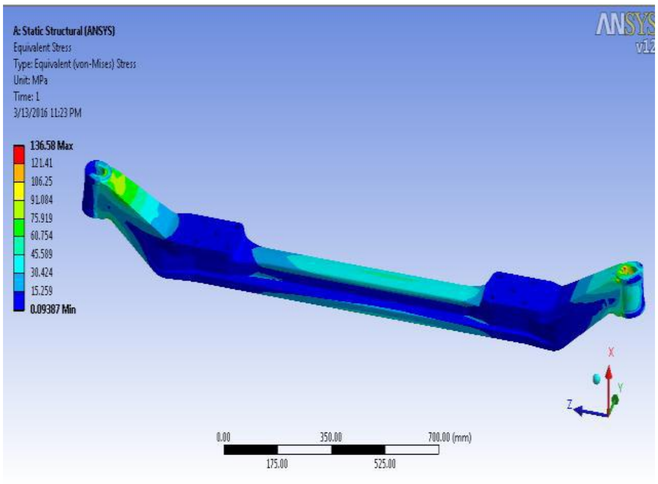
1. Deflection in Existing model:



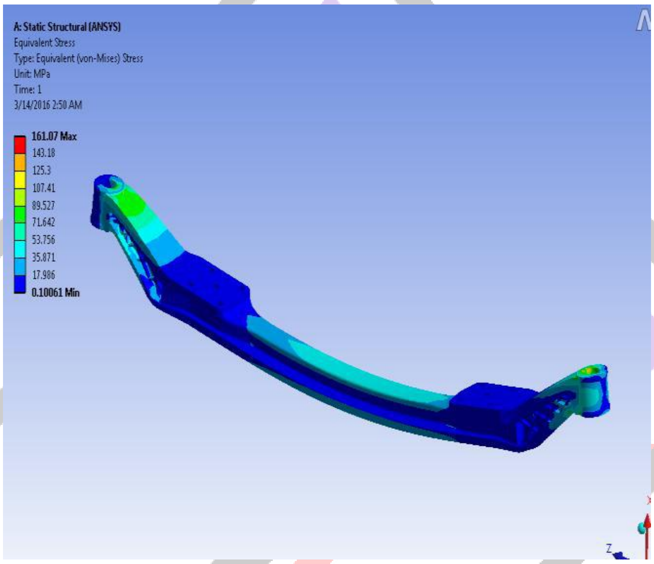
2. Deflection in optimized model:



3. Von- mises stress for existing model:



4. Von- mises stress for optimized model:



V. CONCLUSION

	Existing Model	Optimized Model
Mass	105.34 kg	96.345 kg
Deflection	1.2454 mm	0.034211 mm
Von- mises stress	143.53 Mpa	184.23 Mpa

From the above table shows that the deflection and stress distribution in optimized model is greater than the existing model hence the weight of the axle has been reduced. Finally we were able to deliver a safe and validate design to suit the requirement of the project.

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