"STUDY OF TRACTOR TROLLEY AXLE BASED ON CAD MODEL"

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ABSTRACT: *One of the most crucial and very important component of a tractor trolley is the axle which needs to be designed carefully, in the agricultural or rural areas this part of tractor trolley which is axle also undergo worst load condition mostly because irregularities which occurs due to static and dynamic loads, mainly in its off road transport. Therefore it should be resistant to tolerate additional stress and loads. In tractor trolley case the axle simply act as a support for some rotating body such as it act as support for rotating tires. The existing trolley is designed for heavy axle in the industry without considering actual loading conditions which results in increasing the value of factor of safety and the overall cost of the axle. In this study, existing trolley axle is redesigned considering the load conditions. A CAD model is prepared using design software like CATIA V5 as a tool. The analysis is performed on the axle of trolley used in agricultural area. The future damage can be prevented to the locational axle by using provided technical basis results.*

***Keywords*:** Tractor trolley, Axle, CAD model, Analysis

1. INTRODUCTION

The works such as material handling and construction works has become basic necessities. The material supply to such works is provided through trucks, dumper, trailers, trolleys, etc. These materials should be properly loaded, managed, stacked, transported and unloaded. Tractor trolleys are widely & mainly used for transporting agriculture products, raw materials, building construction materials, industrial equipment and many other types of goods. So various trolleys are used depends upon the application. The agricultural trolley has two types which are semi-trailer having single axle which are available in capacity of 3 ton to 6 ton and balanced trailer having double axel which are used for capacity of 6 ton above.

An axle of tractor trolley is a central shaft for a rotating wheel. With the help of bearings or bushings which are provided at the mounting points where the axle is supported, the wheels are fixed to it. The axles help in maintaining the position of the wheels relative to each other and also maintain wheels position to the vehicle body. Generally axle shafts experiences various different stresses like are stresses due to self-weight or weights of components or possible misalignment between journal bearings. Primary function of an axle is to support the weight of tractor trolley and transmit it through the wheels. The experimental evaluation of trolley axle is executed with the help of latest era of CAD. CAD model of the trolley axle is modelled separately using commercially available modelling tool. And assembled them together for the work. The axle is fixed to the wheels, constant to its surroundings and a bearing sits within the hub with which a wheel revolves around the axle. A trolley axle is referred as beam axle.

2. LITERATURE REVIEW

Sunil Ravindra Patil et al. (2016) [1], In this paper, for designing of tractor trolley two approaches are used one of the approach is the finite element analysis and other is analytical approach which are used for consideration of stress concentration and safe working condition of tractor trolley, weight and cost reduction of existing trolley axle. Both the factors are related to each other. Performance of design related work in CATIA V5 R24 and the analysis work in the ANSYS 15.0 Software is done. Static analysis i.e. analytical method compares the ANSYS results. From the comparison reports suggestion of the best possible solution for the Tractor Trolley is done.

Manish S. Lande et al. (2013) [2], Evaluates that the current back hub shaft utilized in tractor trolley shows that the current hub has more noteworthy factor of wellbeing so un-wontedly, an axle is utilized for trolley in existing condition which increment the heaviness of hub just as cost of hub. However, the recently planned hub with various cross segment and distinctive material show that we can maximally diminish the 33.92% load as contrast with the current axle. Likewise diminishes the expense of trolley hub as the heaviness of the hub lessens. We analyses the expense of axle, just as stresses created in new planned hub are in inside limits the base expense acquired for I cross area hub of SAE 1040 material, the twisting for that hub is 0.984 mm and stresses created in that hub is 259.525 (N/mm2) which are within limit. To make a safer working condition of trolley axle finite element analysis approach is used as well as for stress concentration, in reduction of weight and cost of existing trolley axle.

Happy Bansal et al. (2012) [3], Small scale industries are adopting the crude methodologies for designing and manufacturing machine components. In this paper a static analysis method is used for tractor trolley axle analysis. The CATIA-V5 software is used for developing design of solid modelling of axle. By considering the fully loaded trolley model the static load on axle is calculated. Rectangular cross section type of axle are mostly used today for its use in tractor trolley which gives not only increase in the weight of the axle but also of tractor trolley. In this paper reduction of the weight and cost is done by replacing rectangular cross section axle with circular cross section axle.

P. Manasa et al. (2013) [4], This paper deals with static analysis of tractor trolley axle. For analysis of axle in ANSYS software solid geometry of axle is created and is imported into ANSYS software and values for stress, strain, total deformation are obtained by using the steps given. The solid modelling of axle is developed by CATIA-V5. Analysis is done using ANSYS. Replacement attempt has made of rectangular cross section with circular cross section in this paper. Further von-misses stress, equivalent elastic strain, maximum shear stress, total deformation are determine by using static analysis. Finally after comparing results of rectangular section axle with circular section axle, result have shown the weight reduction of 20% for the circular axle.

Harish V. Katore et al. (2011) [5], The existing trolley is designed for heavy axle in the industry without considering actual loading conditions which results in increasing the value of factor of safety and the overall cost of the axle. In this study, existing trolley axle is newly designed considering conditions such as static and dynamic loads. With newly designed axle the weight and cost of axle was reduced with the help of finite element analysis and maintained the mechanical strength with easy manufacturability and cost reduction. In this paper optimization is carried out for the hollow axle for ultimate value while maintaining the strength and the reduction in weight and cost, with reduction in weight of about 40 to 60 %. The axle design is optimized based on the manufacturing cost. Further the failure analysis is performed on the axle. These results helps to prevent future damage to the location axle.

3. OBJECTIVE

Objective of this analysis is to check the deformations for various material or shapes & suggest the best one, to find stress of an axle, to overcome the axle problem, to check strength of axle by analysis, to optimize the shape by modifying the design. It has been surveyed that the high burdens are probably going to be happened in the axle shaft subsequently it is chosen as the significant part to analyze. It is found that most of axles having common problems like deformation, weight, cost, strength problems, etc. Almost all tractor trollies due to these problems of axle will ultimately fails before the life designed by manufacturer. In this project work analysis is done for checking stresses, strengths, deformations, etc. by using various materials or shapes.

4. METHODOLOGY

- Create the CAD model in CATIA V5 software in which we can use various commands like sketch, dimensioning, constraints, pad etc.
- Then the CATIA model is import in an ANSYS software.
- Then the geometry will be generated in ANSYS. Then mesh will be generate on the model and after that load points will be defined and load values will be given, the results will generate automatically for stress and deformation in solution phase.

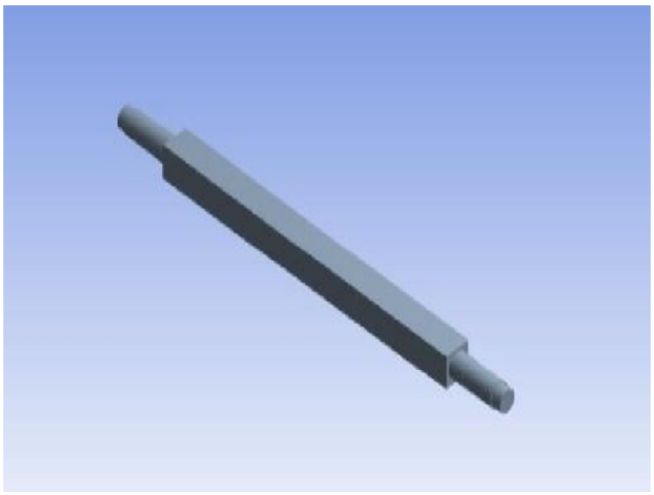

Figure 1: Model of trolley axle using CATIA V5

5. CALCULATION

Analytical calculations for Tractor Trolley Axle are as follows:

Total Deformation:

δmax = (Fa / 24EI)x(3L2-4a2)

Where,
δmax = Total Deformation
F = Total Load
a = Distance
E = Young's Modulus
L = Total Length
I = Moment of Inertia

Normal Stress:

σ = F / A

Where,
σ = Normal Stress
A = Area
F = Total Force

Shear Stress:

τsh = Fs / As

Where,
τsh = Shear Stress
A = Area
F = Total Force

6. SCOPE OF FUTURE WORK

1) Comparative study of several different materials for axle has better scope.
2) Buckling Analysis may play important role in designing of axle.

7. CONCLUSION

From the literature review it is seen that different analysis and experimentation is done by varying axle material and shape. Also these literature reviews shows circular cross section axle has less stress, less deformation, reduction in weight, also reduces the cost of trolley axle as the weight of the axle reduces. So we are doing CAD modeling and analysis by varying material or shape to reduce the deformations, as well as stresses developed in trolley axle.

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