Literature Overview on Front Axle Beam of Heavy Commercial Vehicle

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Abstract- *Front axle beam of heavy commercial truck is the important component of vehicle and needs good design under the various loading conditions of the complete vehicle. 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. Weight reduction and simplicity in design are application of industrial engineering etc., the sources of the technique which are used. In the global competition, it is very important for the manufacturer to bring new product designs to market at a faster rate and at reduced cost. The front axle is designed to transmit the weight of the Automobile front the spring to the front wheels, turning right and left as required. So proper design of front axle beam is extremely crucial.*

Keywords- Front axle, I-beam section, Automobile axle, Heavy commercial truck

I. INTRODUCTION

There are many industrial sectors using this truck for their transportations such as the logistics, agricultures, factories and other industries. The front axle of a truck is one of the major and very important components and needs to be designed carefully; 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. The front axles are generally dead axles in heavy commercial vehicle. The axle beam is used is of I-section. Front axle beam has I-cros section at middle and circular cros section at end. Reversed Elliot type of front axle used in truck. Front axle will experience a 3G load condition when the vehicle goes on the bump Front axle are subjected to both bending & shear stress. Also experience a horizontal and vertical bending moment. In static condition, the axle may be considered as beam supported vertically upwards at the ends. Under dynamic condition, vertical bending moment is increased due to road roughness Axle experiences different loads in different direction, primarily vertical beaming or bending load due to curb weight and payload, torsion. Due to drive torque, cornering load and braking load. In real life scenario all these loads vary with time. Due to their higher loading capacity; solid axles are typically used in the heavy commercial vehicles.

II. LITERATURE REVIEW

[1] M. Porus Purushothaman, V. Jayachandran

There are many industrial sectors using this truck for their transportations such as the logistics, agricultures, factories and other industries. The axle is fixed to the wheels, fixed to its surroundings and a bearing sits inside the hub with which a wheel revolves around the axle. A front axle is also called as beam axle which is typically suspended by leaf springs. The front axle of a truck is one of the major and very important components and needs to be designed carefully; 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. Stress analysis of front axle of truck combine under static loading conditions resulted from the applied modifications was performed by using finite element method. The commercial finite element package ANSYS version 9.0 was used for the solution of the problem. the front axle entity model into reasonable mechanical model, and choice three static analysis conditions, namely the front axle static full load, Impact load, Emergency braking make loading analysis. The front axle is made of AISI 1020 and their properties. The various cross section used in study are a] CIRCULAR C/S ,b] SQUARE C/S and c] I SECTION C/S .analysis done on this three crossection. Then we get result I crossection is best which has maximum stress and deformation, weight will be reduced. Here we get conclusion weight and cost of axle been reduced.

[2] Hemant L. Aghav1, M.V. Walame

Present off-highway vehicle market demands low cost, light weight & long life components.The main three reasons of failure of mechanical components are Corrosion, wear and fatigue. Main reason for failure of front axle beam is the fatigue damage due to continuous fluctuating loads which acts from irregular road surface. Bending occurs in axle, when vehicle takes turn and torsion due to braking load. Component of front axle beam. Material use here are AISI 1045 and also show vehicle major dimensions.Front axle beam assembly was modeled in the NX CAD software. Meshing and Stress analysis is performed by ANSYS workbench and fatigue analysis is performed by NCODE design life ANSYS tool under different loading cases. Axle experiences completely different loads in different direction, primarily bending load or vertical beaming due to curb weight and payload, torsion due to drive torque and braking load Apply vertical and breaking load condition. Fatigue life of axle obtained by FEA method is more than 2 x 105 cycles, which is considered as safe for vertical loading case. Similarly, Fatigue life of axle obtained is more than 4 x 103 cycles, which is considered as safe for vertical and braking loading case. The max stress region is below spring pad of axle for vertical loading and in the goose neck of axle for vertical and braking loading case.

[3] Aparajita P. Ray1, Dr. R. R. Arakerimat

The front axle of a truck is one of the major and very important component and needs to be designed carefully, 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. The main purpose of project is to make a safer working condition of trolley axle as well as for stress concentration, weight and cost reduction. One important constraint are permissible stress and strain levels. The optimization process involves following activities: Selection of variables that describe the design alternatives , Selection of objective functions to be minimized or maximized. Establishment of restrictions, expressed in terms of design variables, which must be satisfied by any acceptable design. The front axle is made of AISI 1020 and their properties. The various cross section used in study are a]CIRCULAR C/S,b] SQUARE C/S and c] I SECTION C/S .analysis done on this three crossection. Then we get result I crossection is best which has maximum stress and deformation, weight will be reduced. Here we get conclusion weight and cost of axle been reduced.

[4] Ketan Vijay Dhande1, Prashant Ulh

During last few decades due to global economic scenario optimum vehicle design is major concern. To accomplish the need to design a moderate car, the structural engineer will need to use imaginative concepts. The demands on the automobile designer increased and changed rapidly, first to meet new safety requirements and later to reduce weight in order to satisfy fuel economy requirements. Experience could not be extended to new vehicle sizes, and performance data was not available on the new criteria. Mathematical modelling was therefore a logical avenue to explore. In present research work design of the front axle for Ashok Leyland 1612 Comet heavy commercial vehicle were done. The approach in this project has been divided into two steps. In the first step front axle was design by analytical method. For this, the vehicle specifications, its gross weight and payload capacity in order to find the stresses and deflection in the beam has been used. In the second step front axle were modelled in NX-CAD and meshed in HYPERMESH software module. The meshed model was solved in ANSYS software. The FE results were compared with analytical design Performing physical test for vertical beaming fatigue load is costly and time consuming. So there is a necessity to build FE models which can virtually simulate these loads and predict the behaviour. Even though the FEA produce fairly accurate results, solution accuracy heavily depends on accuracy of input conditions and overall modelling method used to represent the actual physics of problem. Therefore validation of FEA model is of utmost importance. it is clear that the maximum deflection in axle is for SAE 1020 materials but at the same time the maximum stress distribution is low for SAE 1020 than Ductile Cast Iron. So, that SAE 1020 is better material for manufacturing of axle than Ductile Cast Iron.

[5] S. Eswaran , B.Dinakaran , L.Jeevankumar , 2 K.P.Karthick , S.Karthick

Weight reduction plays an important role in automobile components. When the weight of the vehicle is reduced then the fuel consumption of the particular vehicle will be decreased. Usually the normal load about 35-40% of the weight of the vehicle is acting on the front axle. While applying the break about 60% of the vehicle weight is acted on the front axle. Due to this higher loading capacity solid axles are most commonly used in heavy duty commercial vehicles. In this research work design of the front axle for Tata LPT2518 6X4 heavy commercial vehicle were done. The approach in this project has been divided into two types. In the first step front axle was design by analytical method. For this, the vehicle specifications, its gross weight and payload capacity in order to find the stresses and deflection in the beam has been used. In the second step front axle were

modelled in CATIA and meshed in HYPERMESH software module. The meshed model was solved in ANSYS software. The FE results were compared with analytical design. All types of standard front axle have an I-cross section in the middle and circular or elliptical cross section at the ends. The I-section will gives high strength with lower weight. This type of construction used in front axle that is light weight and yet has great strength. 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 requirements of the project. deflection and stress distribution in optimized model is greater than the existing model hence the weight of the axle has been reduced.

[6] Pravin R.Ahire, Prof.K. H. Munde

The paper deals with design and analysis of front axle. The same analysis with help of FE results were compared with analytical design. For which paper has been divided in to two steps. In the first step front axle was design by analytical method. For this vehicle specification – its gross weight, payload capacity, braking torque used for subject to matter to find the principle stresses & deflection in the beam has been used. In the second step front axle were modelled in CAD software & analysis in ANSYS software.

[7] M. Ruban, S. Sivaganesa

The reverse Elliot front axles have hinged spindle yoke on spindle itself instead of on the axle. The forked portion is integral with the steering knuckle. This type is commonly used as this facilitates the mounting of brake backing plate on the forged legs of the steering knuckle.

III. OVERVIEW

Front axle carries the weight of the front part of the automobile as well as facilitates steering and absorbs shocks due to road surface variations. The front axle must be rigid and robust in construction. It is usually steel drop forging having 0.4 % carbon steel or 1 to 3% nickel steel. The front axles are generally dead axles, but are live axles in small cars of compact designs and also in case of four-wheel drive. A live front axle contains the differential mechanism through which the engine power flows towards the front wheels.

The front axles are generally dead axles, which does not transmit power. The front wheel hubs rotate on antifriction bearings of tapered-roller type on the steering spindles, which are an integral part of steering knuckles. To permit the wheels to be turned by the steering gear, the steering spindle and steering knuckle assemblies are hinged on the end of axle. The pin that forms the pivot of this hinge is known as king pin or steering knuckle pin. Generally dead front axles are three types.

In the Elliot type front axles, the yoke for king spindle is located on the ends of I-beam. The axle ends are forked to hold the steering knuckle extension between them. The reverse Elliot front axles have hinged spindle yoke on spindle itself instead of on the axle. The forked portion is integral with the steering knuckle. This type is commonly used as this facilitates the mounting of brake backing plate on the forged legs of the steering knuckle. In the Lemoine type front axle, instead of a yoke type hinge, an L-shaped spindle is used which is attached to the end of the axle by means of a pivot. It is normally used in tractors. To act as an axle beam upon the ends of which the road wheels can revolve and through which the weight of the body and load can be transmitted via the spring and the road wheels to the ground.

The dead front axle has sufficiently rigidly and strength to transmit the weight of the vehicle from springs to the front wheels. The ends of the axle beam are shaped suitably to assemble the stub axle. These types of axles are made of I-sections in center portions while the ends are made either circular or elliptical. In this construction it takes bending loads due to the load of the vehicle and also torque due to braking of the wheels. The main purpose of project is to make a safer working of front axle beams as well as, weight and cost reduction.

IV. PROBLEM IDENTIFICATION

Front axle beam takes about 30-40 % of total vehicle weight. The main three reasons of failure of mechanical components are Corrosion, wear and fatigue. Main reason for failure of front axle beam is the fatigue damage due to continuous fluctuating loads which acts from irregular road surface. Therefore, the research on the fatigue life of different vehicle parts has important value.

Bending occurs in axle, when vehicle takes turn and torsion due to braking load. While applying the break about 60% of the vehicle weight is acted on the front axle. Axle experiences various loads like bending load, payload and torsion. These loads are varying with respect to time. Due to this higher loading capacity Solid axles are most commonly used in heavy duty commercial vehicles. Performing the physical test for bending load is costly and time consuming. So there is a need to build Finite element models which can virtually simulate these loads and predict the behavior. The finite element analysis produces accurate results; this accurate result purely depends upon the accuracy of input conditions. Fatigue failure often occurs from cracks initiated below spring pad and at notches of front axle beam. Axle experiences different loads in different direction, primarily vertical beaming or bending load due to curb weight and payload, torsion due to drive torque, cornering load and braking load.

VI. CONCLUSION

Research paper reviewed so far explores the failure cause of front axle beam. Mostly I-section is used and there will be wide scope in analyzing the other crossection beam like I-crosssection, circular crossection, square crossection. By analyzing the front axle beam of heavy commercial vehicle we will assess the strength and capability of the product to survive against failure.

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