



DESIGN OF A LIGHTWEIGHT CHASSIS FOR E-RIKSHAW- A REVIEW

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Abstract

Three wheeler Auto-rickshaws are considered to be small vehicles but extensively used in many countries for small distance purpose especially within same city. These three wheelers are majorly used as taxi in urban areas in India due to inexpensive services. Mainly 2 and 4-stroke engine with no pollution control is used in rickshaw causes pollution. In order to prevent this issue E-Rickshaw (Electric Rickshaw) is used in many parts of country. This paper is to suggest a lightweight chassis design of vehicle like E-rickshaws.

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Introduction

To redesign the auto-rickshaw the best possible way to modify its engine with some renewable energy sources which is also pollution free such as solar batteries can be used to run the engines. One of the most significant and prominent structure of any automotive vehicle is chassis. It is a structure or frame on which the body of vehicle and other components such as engine is mounted it also concludes the frame, suspension, wheels and brakes and it is made of hollow tube structure. The chassis frame should also provide support to load of the body and can easily carry the load of passengers. Chassis frame should withstand the forces and stresses caused by sudden movement and road condition. The chassis frame is majorly manufactured using carbon steel materials or aluminium alloys due to their structural properties and light weight characteristics.

There are mainly three types of chassis frames-

- Conventional frame



- Integral frames
- Semi-integral frame.

These frames are used as per the design and requirement of the automotive system. Each types of frame have their own specifications and characteristics due to this these frames are able to support different structures of automotive vehicles.

Literature Review

In April 2016 **Amrendra Kumar Singh [1]** has presented his study on truck chassis which is the structural backbone of any vehicle. The main function of the truck chassis is to carry the goods and payload placed upon it. The chassis frame has to bear the stresses developed and deformation occurs in it and that should be within a limit. This paper presents the study of the stress developed in chassis as well as deformation of chassis frame.

The stress and deformation has been calculated for the chassis frame and the analysis has been done for the validation on the chassis frame. The model of the chassis has been developed in CREO (Pro-E) 2.0 and static structural analysis has been done in ANSYS WORKBENCH 15.0.

In 2015 the research work presented by **Mr Birajdar M. D. [2]** describes the analysis of ladder chassis frame for Ashok Leyland truck Model No. IL super 3118. Practically load distribution on the chassis is not uniform across its total area, so according to the intensity of load it is possible to vary the area of ladder chassis. Analysing the effect of reduction in cross section area with constrains of bending stress, shear stress and deflection, reduction in area will save amount of material required for ladder chassis. Four different cases are considered and in each case height is reduced for some specific span of chassis where intensity of load is less. Reduction of area for some specific span will distribute nearly uniform stresses across its whole area. The research work is carried out on side member of ladder chassis particularly.

In January 2015 **Gaurav Vasantrao Bhunte [3]** has presented a paper to review the investigations that have been made on the different analysis techniques of automobile frames. That analysis may be static analysis or dynamic analysis. A number of analytical and



experimental techniques are available for the analysis of the automobile frames. Determination of the different analysis around different conditions in an automobile frames has been reported in literature.

An attempt has been made in the article to present an overview of various techniques developed for the analysis of automobile frames and results of that analysis due to which further study on the chassis will become easy.

As per the study conducted by **Prakash Katdare [4]** the chassis frame forms the backbone of a vehicle; its principle function is to safely carry the maximum load for all designed operating conditions. Automotive chassis is the main carriage system of a vehicle. The chassis serves as a skeleton upon which parts like gearbox and engine are mounted. The two-wheeler chassis consists of a frame, suspension, wheels and brakes. The chassis is what truly sets the overall style of the two wheels.

Commonly used material for two-wheeler chassis is steel which is heavy in weight or more accurately in density. There are various alternate materials like aluminium alloys, titanium, carbon fibre, magnesium, etc. which are lesser in weight and provide high strength and thus can be used for chassis. This paper deals with design of two wheeler chassis frame and its weight optimization. Various loading conditions like static and dynamic loadings were carried out on the chassis and the design is optimized by reducing the weight of the chassis by using alternate material while maintaining the strength.

N. Lenin Rakesh [5] has conducted a research on the present scenario in automotive industry is an sum in demand of trucks not only on the cost and heaviness aspects but too on improved total vehicle features and overall work performance. The chassis plays an important role in the design of any truck. Truck chassis forms the structural backbone of a commercial vehicle. The main function of the truck chassis is to support the components and payload placed upon it. When the truck travels along the road, the chassis is subjected to vibration induced by road roughness and excitation by vibrating components mounted on it.

The responses of the truck chassis which include the stress distribution and displacement under various loading condition are also observed. The mode shape results determine the suitable mounting locations of components like engine and suspension system. Some modifications are also suggested to reduce the vibration and to improve the strength of the



truck chassis. The chassis design in general is a complex methodology and to reach at a solution which yields a good performance is a tedious task. Since the chassis has a complex geometry and loading patterns, there is no well-defined analytical procedure to analyse the chassis. So the numerical route of analysis is adopted, in which Finite Element Technique is most widely used route.

In 2013 **Nagarjuna Reddy Y. [6]** has presented this paper on implementation of Finite Element Analysis on a chassis space frame has been highlighted in this study. The topic has constrained the study of the chassis space frame. Complex assemblies are to be avoided, for sports car. The model of the chassis space frame is built using CATIA V5 and then imported to ANSYS CLASSIC 11.0 to find its finite element module. To perform a torsion and Bending Test is applied on the computational prototype chassis to determine its torsional stiffness. To incorporate a design improvement study and note the effects on the global torsional stiffness of the chassis. The stress, strength and degrees of freedom of the chassis will be investigated. The body shape is fixed and therefore the overall external shape of the chassis must not be altered. The engine bay must remain as open as possible to allow a variety of engines to be fitted.

Mohamad Sazuan Bin Sarifudin [7] concerns on the assessment on making an analysis of the car chassis will fit all aspects and concepts according to the rules of Eco Marathon Challenge. The objective of this project is to design and analyse of car chassis. To avoid any possibilities of failure of the structure enough supporting members are provided to make the region stronger in term of deformation. Finite element analysis enables to predict the region that tends to fail due to loading. Besides that, need to utilize the feature of CAE software named as FEMPRO to get the distribution of stress and strain on the chassis, both component as well as the material costing. The main objective is to study the effect of load that applied in term of driver weight, the car body and the equipment.

Pravin A. Renuke [8] investigated in this study of the vibrational characteristics of the car chassis including the natural frequencies and mode shapes. Car chassis forms the structural backbone of a passenger vehicle. When the car travels along the road, the car chassis is excited by dynamic forces caused by the road roughness, engine, transmission and more. Modal analysis using Finite Element Method (FEM) can be used to determine natural frequencies and mode shapes. In this study, the modal analysis has been accomplished by the



Commercial finite element packaged ANSYS. The model has been simulated with appropriate accuracy and with considering the effect of bolted and riveted joints. The chassis has been altered by some companies for using in After constructing finite element model of chassis and appropriate meshing with shell elements, model has been analysed and first 6 frequencies that play important role in dynamic behaviour of chassis, have been expanded. In addition, the relationship between natural frequencies and engine operating speed has been explained.

The results show that the road excitation is the main disturbance to the car chassis as the chassis natural frequencies lie within the road excitation frequency range. Finally advantages of the modified chassis which leads to the increase of the natural frequencies and placing them in the appropriate range, has been discussed.

Objective of this study

The research begins with having an idea about the existing work on chassis designs which can be helpful for project work. For this some research papers were studied and followed some of them are mentioned above.

After performing the literature review on some chassis designs it is concluded that the chassis frame should be rigid enough to withstand the applied stresses. The more rigid chassis structure the better option will be there to point the wheels of vehicle in the desired direction. This review paper presents an effort to design a lightweight weight chassis along with some other objectives such as:

- Propose a proper design of chassis
- Compilation of mechanical structure and mechanism suitable for electrical system
- Cost analysis of electrical and mechanical components.

Conclusion

After performing the literature survey and analysed the obtained results on designing of chassis it is concluded that the design of lightweight chassis can be modified as per the requirement of three-wheeler E-rickshaw vehicle. So many steps are taken to prevent the pollution caused by transportation means in India use of CNG in auto-rickshaw is one of them. Electric-rickshaw is efficient way to build a pollution free source of transport for which



the lightweight chassis design can provide excellent efficiency to overall performance of engine.

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