

# A Study of Literature Review on an Automotive Vehicle Chassis Structure Vibration Analysis and Fatigue Life by Finite Element Method

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## ABSTRACT

Recent days an automotive vehicles are important to transport or moving goods from one place to another place, particularly mining on-road and construction industry. In these vehicles chassis are one of the most important system in an on-road vehicles. The chassis carries mounting brackets and fasteners, entire powertrain unit, fuel tank, hydraulic tank and differential unit with rear axle. The vibration absorption theory is one of the methods for adding spring, mass and damper for minimize the vibration and also non-linear explicit vibration analysis for reduce vibration of an automotive chassis in the real world problem. The main objective of this paper is to get an idea about the study, dynamic vibration characteristics analysis of chassis and fatigue life of the chassis. The study may be experimental analysis about the crack and fatigue failure of an automotive chassis for different variant and applications.

**Keywords:** Vibration; FE analysis; Non-linear behaviour and automotive vehicle

## INTRODUCTION

Dynamic vibration analysis and fatigue life of a chassis structure plays a major in an automotive industry. When the vehicle in dynamic both loading and unloading condition, there are some free and forced vibration occurs due to this loosening fasteners, the failure happen on the bracket, support structure on the chassis and unwanted noise generated on the vehicle. The performance and efficiency was decreased due to fatigue failure. To eliminate or minimize the vibration by adding vibration absorbers such as rubber mounts, cushion washers and suspension mounts and also need to do fatigue failure analysis by numerical technique. Therefore, the vibration analysis require for development of chassis structure and vehicle safety and dynamic analysis for validation by finite element analysis. Many researchers done experimental analysis and arrive results but the cost is high as compare to FEA simulation.

Dynamic characteristics vibration analysis has been performed for solving the natural frequencies through modal analysis of an automotive chassis and fatigue analysis for number of cycles and stress distribution for life of a chassis. The current scenario customer demand for comfort, smooth running of a vehicle, improve and increase the vehicle performance and efficiency.

## LITERATURE REVIEW

There are many researchers and industrialist experts studied, experimentally analyzed and calculations about an automotive vehicles.

Rao SS [1] and Mehmood A, et al. [2] discussed about the vibration analysis and frequency response characteristics of a half car model subjected to different sinusoidal road excitation. The mathematical model of a car chassis were developed for understands the vibration excitation response behaviours and determines the random vibration of a chassis structure. To get the vibration amplitude vs. time graph for natural frequency and calculations of a damping properties of a car.

Zaman I, et al. [3] explained about the dynamic analysis of on-road and off-road vehicle chassis by using 3D finite element model for arriving dynamic characteristics of truck chassis. To reducing the weight and manufacturing cost of a chassis. Generally, lighter weight of the chassis gets larger deflection coming from engine mounting location due to road irregularities. The modification of a shape and size of a chassis to minimize a vibration by adding rubber mounts and get accurate results. The error was reduced upto  $\pm 2\%$  approximately through model updation and manufacture as per standard.

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Athikesavan D, et al. [4] deals with design and vibration analysis of ladder type chassis with riveted cross members and welded joints. The finite element technique effectively utilized for getting results of stress distribution and deformation, mode shapes and natural frequencies. The results and graphs were achieved within the standard and recommended values [5].

Raju AB, et al. [6] conversed about suspension system and its mounts of an automotive chassis for the effects of vibration with full model chassis and derived equation based model according to the equation of equilibrium conditions. The FEM software used to simulate with dynamic load and road conditions and got the results like frequencies, mode shapes and validate through experimental approach.

Renuke P, et al. [5] described about the vibration characteristics of the car chassis in a dynamic condition, various dynamic forces are acting on the chassis which includes road roughness, modal analysis by finite element analysis. The results obtained such as non-linear behaviour, force excitation frequency range etc.

Raju AB, et al. [6] and Sharma G, et al. [7] clarified about the vibration analysis of a loader chassis, the natural frequency of a chassis is far away from the excitation frequency of a chassis. The harmonic analysis were done through ANSYS and validate through theoretical approach.

Shubhan Bhise discussed about the study involved modal analysis and vibration characteristics analysis of a truck chassis. Mode shape and frequency response analysis of chassis and bracket structure. To provide rubber mounts for minimize the vibration based on recommendation from modal analysis results such as mode shape and frequency.

John George. et al, [8] illuminated about the cyclic test of a chassis model compare with monotonic test. The plasticity or plastic deformation resulting of stress concentration on the critical area of the chassis. The system studied and experienced about the plastic deformation. The software used Hypermesh and ANSYS.

Shivakumar MM, et al. [9] detailed discussion about the modal analysis for the prediction of dynamic characteristic of truck chassis such as mode shape and frequency response, stress and deformation. These are the important output results for design of chassis. The maximum distortion energy theory applied and determine the criterion for failure. The factor of safety assumed to be 2.0 and allowable stress is less than the yield stress. The fatigue failure behaviour is a most important parameter hence the fatigue life of excited shear force and bending moment diagram of a chassis.

Bayat SH, et al. [10,11-22] discussed about the static and dynamic analysis of a frame structure and factors affecting the fatigue life. The fatigue analysis conducted vehicle structural design, analysis and optimization. The main objective of finite element analysis is to predict the weak points and fatigue location. The study makes understand that further investigation on the design of truck chassis using fatigue life analysis.

## CONCLUSION

From the above study and review of automotive vehicle chassis, many of the researchers and engineering industry experts were studied, reviewed and tested automotive vehicle chassis for finding out the effects and fatigue failure analysis with varying capacity vehicles. The on-road and off-road vehicles chassis considered for analysis and validation through experimental and theoretical

approach. The different finite element techniques used for solving dynamic characteristics vibration analysis of a vehicle chassis and tested by experimental setup. Some of the research articles derive a mathematical model for a chassis and find out the vibration amplitude with respect to time and the calculations arrived for damping properties. The researchers further extended to found that the rubber mounts added to the mountings and bolted joints for avoid (or) minimize vibrations. The above study and review for the prediction of mode shapes, frequency responses, fatigue life of a chassis and dynamic characteristic analysis of vehicle chassis.

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