ISSN: 2277-9655
Impact Factor: 4.116

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

MODAL ANALYSIS OF TWO WHEELER CHASIS

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DOI: 10.5281/zenodo.56899

ABSTRACT

The frame is an important part in a Two Wheeler and it carries the load acting on the vehicle. So it must be strong enough to resist the shock, twist, vibration and other stresses. In vehicle frame different types of failure occur due to static and dynamic loading conditions. Natural frequency, damping and mode shapes are the inherent structural properties and can be found out by experimental modal analysis. Experimental Modal analysis (EMA) is the process of determining the modal parameters of a structure for all modes in the frequency range of interest.
The objective of this study is to determine the natural frequencies, damping and mode shapes of the both chassis of two wheeler namely as Pulsar 150cc and Passion by using experimental modal analysis. Our goal is to minimize the effect of these vibrations, because while it is undesirable, vibration is unavoidable. The dynamic characteristics of the two wheeler chassis such as the natural frequency and mode shape will determine by using finite element (FEM) method.

KEYWORDS: EMA,FEM,Natural Frequency .

INTRODUCTION

The frame is a skeleton upon which parts like gearbox and engine are mounted. So it is very important that the frame should not buckle on uneven road surface. Also it should not be transmitted distortion to the body. Two wheeler frames can be made of steel, aluminium or an alloy. Mostly the frame is consisting of hollow tube. If the natural frequency of two wheeler frame is coincides with excitation frequency then the resonance will occur. Due to resonance the frame will undergo dangerously large oscillation, which may lead excessive deflection and failure. To solve these problems, experimental modal analysis is very essential. Natural frequency, damping and mode shapes are the inherent structural properties and can be found out by experimental modal analysis. Experimental Modal analysis (EMA) is the process of determining the modal parameters of a structure for all modes in the frequency range of interest.

The main purpose of this paper is to find out natural frequency, damping and mode shape of two wheeler frame using experimental modal analysis. A chassis consists of an internal framework that supports a man-made object. It is analogous to an animal's skeleton. An example of a chassis is the under part of a motor vehicle. That mass or weight reduction is an important issue in automotive industry. Chassis is a prominent structure for a moped body, which takes the loads during serious accidents, costly recalls; chassis also has an impact on product image. There is a great potential for optimizing weight of chassis by using alternate material without affecting its structural behaviour. A chassis serves as the basic foundation on which all the parts of a machine rest. In any two wheelers, the chassis acts as a skeleton on which the engine, gearbox, driveshaft, transmission, driveshaft, differential, and suspension are mounted. The chassis should be structurally sound in every way and support the body over the expected life of the two wheeler and may be beyond expected. The engine generally sits inside the frame, the rear swing arm is attached by a pivot bolt and the front forks are attached to the front of the frame. The chassis also helps to protect the more sensitive parts of the motorcycle in any mishap.

Chassis:

A chassis serves as the basic foundation on which all the parts of a machine rest. In an automobile, the chassis acts as a skeleton on which the engine, transmission, driveshaft, differential, gearbox and suspension are mounted. The

chassis should be structurally sound in every way and support the body panels over the expected life of the vehicle and beyond.

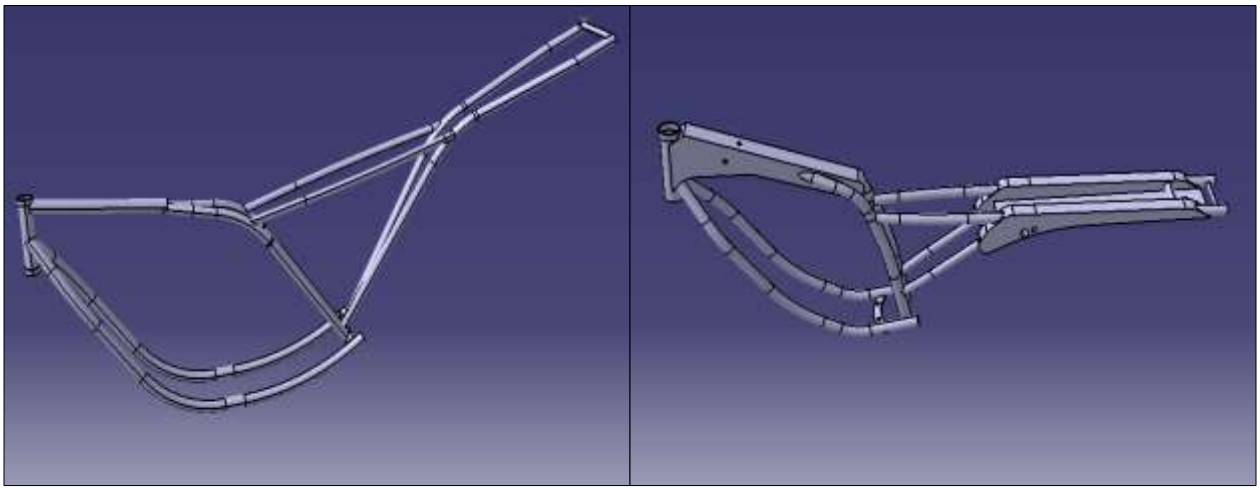
The engine generally sits inside the frame, the rear swing arm is attached by a pivot bolt (allowing the suspension to move) and the front forks are attached to the front of the frame. The frame can also help to protect the more sensitive parts of the motorcycle in a crash.
Any good chassis must do several things:

- Be structurally sound in every way over the expected life of the vehicle and beyond. This means nothing will ever break under normal conditions.
- Maintain the suspension mounting locations so that handling is safe and consistent under high cornering and bump loads.
- Support the body panels and other passenger components so that everything feels solid and has a long, reliable life.
- Protect the occupants from external intrusion.
- Help the wheels align on a single straight line.

DESIGN MODELING AND ANALYSIS

Harmonic analysis using Finite Element Method (FEM) can be used to determine natural frequencies and mode shapes. In this study, harmonic analysis has been accomplished by the commercial finite element packaged ANSYS. 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. Motorcycle frame are made of steel, aluminium or an alloy. In numerical analysis it is tested for Steel alloy. Its material properties are given below.
Material: Mild Steel
Young's Modulus: 1.90E+11 N/mm2
Poison's ratio: 0.29
Density: 7680 Kg/m3

Figure shows theCAD models of pulsar and passion vehicle chassis designed in CATIA software.

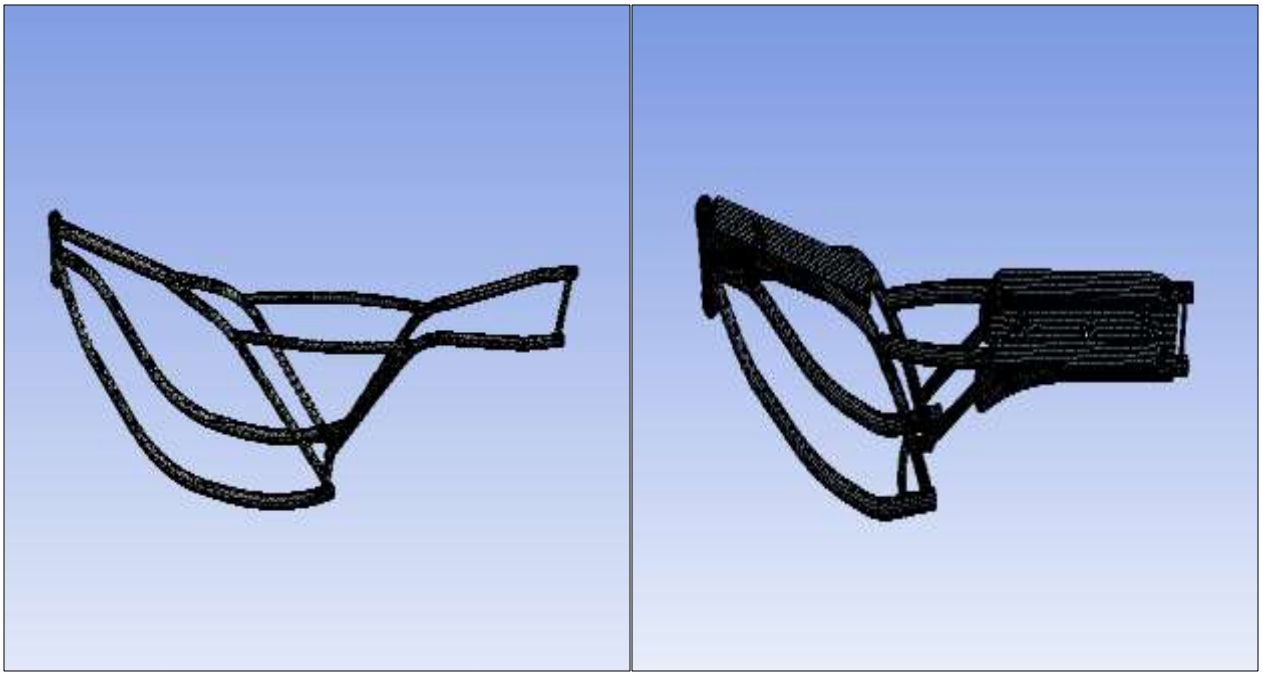


a) CAD-model of pulsar 150cc Chassis ***b) CAD-model of passion Chassis***

b)

The model ware meshed using tetrahedron elements with elemental size of 5mm. Fine mesh was required in order to improve solution accuracy. The meshed pattern of the model of two chassis is as shown in figure. Shell element has been used for analysis. This element has better and more disciplined meshing in comparison with other elements and has the capability of gaining more accurate results.

Figure shows the meshed views of pulsar and passion vehicle chassis.



a)Meshed model of pulsar 150cc *b) Meshed model of passion*

RESULTS AND DISCUSSION

Modal analysis is an efficient tool for describing, understanding, and modelling structural dynamics. The dynamic behaviour of a structure in a given frequency range can be modelled as a set of individual modes of vibration. The modal parameters that describe each mode are: natural frequency or resonance frequency, (modal) damping, and mode shape. The modal parameters of all the modes, within the frequency range of interest, represent a complete dynamic description of the structure. By using the modal parameters for the component, the model can subsequently be used to come up with possible solutions to individual

Problems. Modal frequency response analysis is an alternative approach to determining the frequency response of a structure. Modal frequency response analysis uses the mode shapes of the structure to reduce the size, uncouple the equation of motion (when modal or no damping is used), and make the numerical solution more efficient. Due to the mode shapes are typically computed as part of characterization of the structure, modal frequency response

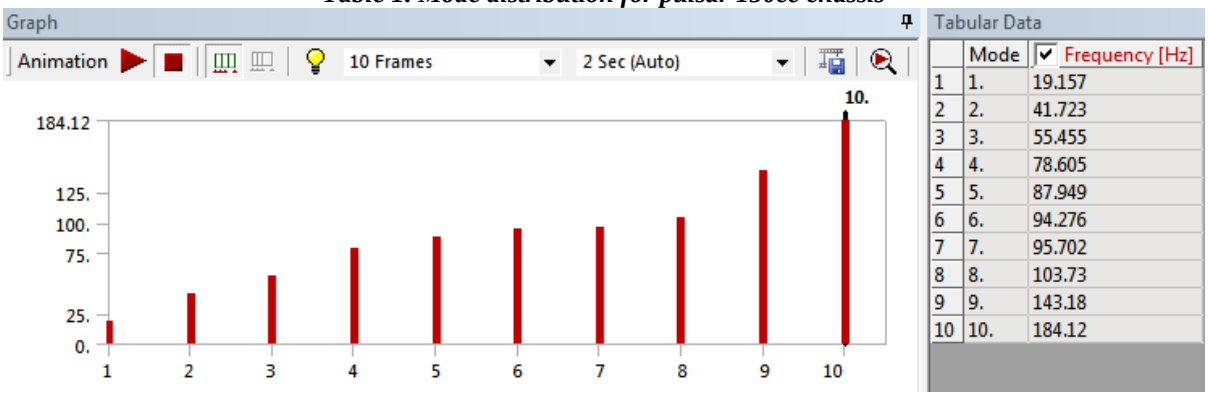
Analysis is a natural extension of a normal mode analysis.

Mode Distribution Table For Both Chassis

In comparison there are two table for pulsar 150cc and passion chassis as shown in below table.

ISSN: 2277-9655
Impact Factor: 4.116

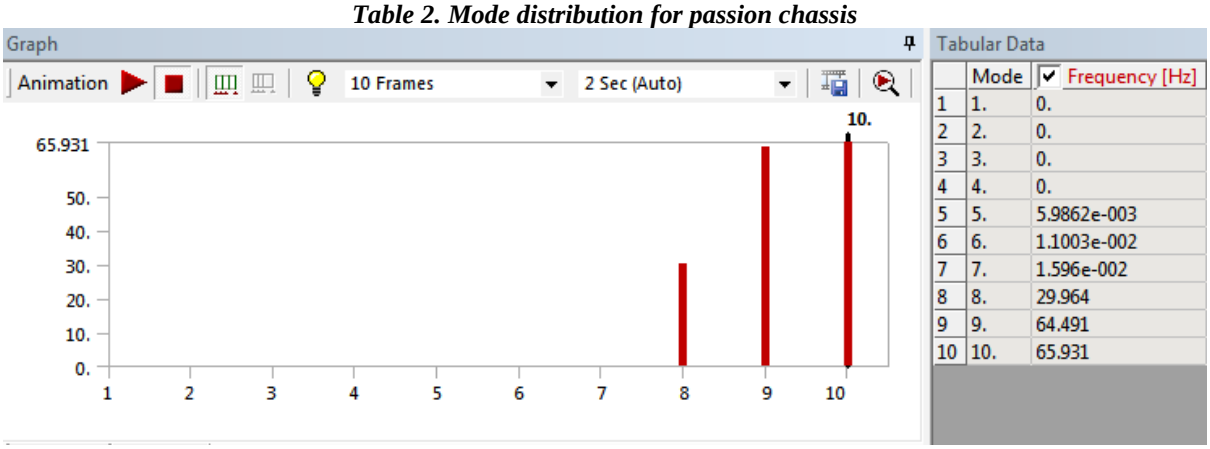
Table 1. Mode distribution for pulsar 150cc chassis



Tabular Data

	Mode	Frequency [Hz]
1	1.	19.157
2	2.	41.723
3	3.	55.455
4	4.	78.605
5	5.	87.949
6	6.	94.276
7	7.	95.702
8	8.	103.73
9	9.	143.18
10	10.	184.12

Table 2. Mode distribution for passion chassis



Tabular Data

	Mode	Frequency [Hz]
1	1.	0.
2	2.	0.
3	3.	0.
4	4.	0.
5	5.	5.9862e-003
6	6.	1.1003e-002
7	7.	1.596e-002
8	8.	29.964
9	9.	64.491
10	10.	65.931

Figure shows four different deformation under Modal Analysis Of Pulsar 150cc

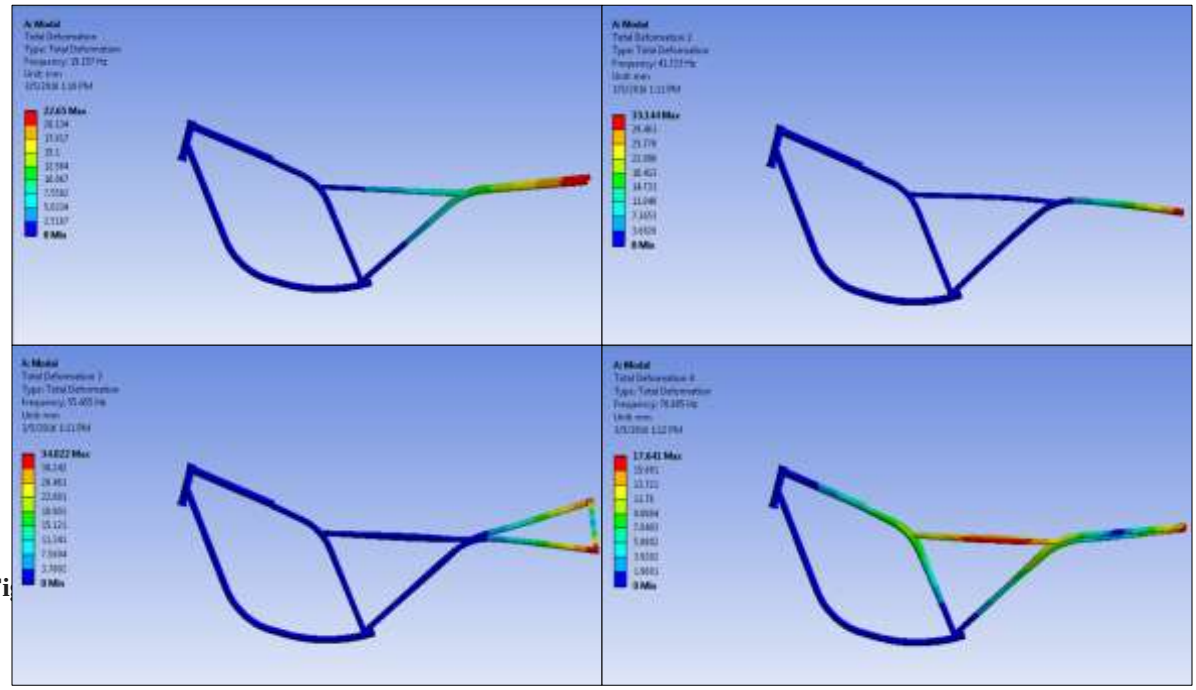


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Figure shows four different deformation under Modal Analysis Of Passion

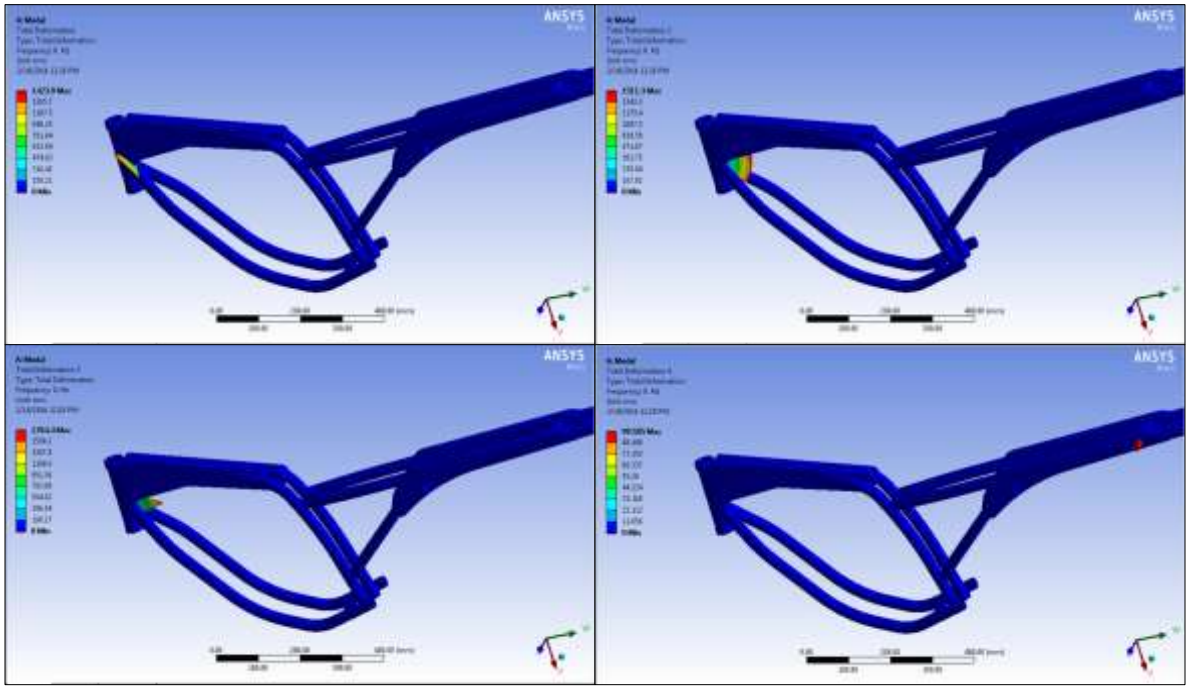

Table. Natural Frequency and Displaceents of Pulsar and Passion Vehicle

CONCLUSION

Analysis has been completed for doing modal analysis of the two-two wheeler chassis of pulsar 150cc and passion meeting all international standards of safety. The chassis with alternate material is performing better with a satisfying amount of weight reduction. The weight reduction will hence lead to better fuel of vehicle. Also the new chassis will have reduced vibration as compared to conventional model.Hence we concluded that the in comparison between the both two wheeler chassis of pulsar 150cc and passion out of them the better and safe design is pulsar 150cc chassis because of the deformation of the pulsar is less than that of the passion chassis as shown in above result.

ACKNOWLEDGEMENT

The researchers would like to sincerely thank the management of G H Raisoni College of Eng & Mgnt,Pune and Dr.Ramesh Rudrapati for technical support given during the study.

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