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DESIGNING OF VIBRATION ANALYSIS OF SCOOTER CHASSIS

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ABSTRACT:

The researcher has been made an effort to investigate the vibration analysis of scooter chassis. The analysis performed while doing research are of two types one static and other one is dynamic. The researcher has also made an effort to prove a validity of experimental and analytical results for two wheeler chassis for reduction in vibration. The chassis is considered to be one of the vital elements in building a vehicle and it is backbone of the any vehicle, as all other components attached to it. The movement of parts is always results in the vibration and according to well known rule of vibration "lesser the vibration better is the design". In this paper researcher has made an effort to model a scooter chassis in CATIA, CAD, Hyper mesh and ANSYS for various analysis and optimization of the model.

KEYWORDS: Vibration Analysis of a Scooter, ANSYS, different types of Chassis.

INTRODUCTION:

A chassis holds all the components together for any two or four wheeler. Chassis is a backbone of any vehicle and it must be developed in order to meet international safety standard. A chassis is always underneath the vehicle. Chassis can be divided in major types as follows:

SINGLE CRADLE FRAME: The single cradle is the simplest type of motorcycle frame, and looks similar to the world's first two wheeler frames. It is made from steel tubes that surround the engine with a main tube above and other under, smaller diameter tubes beneath. If a single cradle becomes double at the exhaust, as frequently occurs, it is general consideration referred to split single cradle frame. Single cradle frames are usually found in off-road motorcycles.

DOUBLE CRADLE FRAME: This are descended from single cradle frames. Double cradle frame consist of two distinct cradles that holds the engine one either side. Double cradle frames are commonly used in custom motorcycles and simpler road bikes. The advantage of using double cradle frame is, they offer a good compromise between lightness, rigidity and strength though they have now been technically surpassed by perimeter frames.

BACKBONE FRAME: These types of frames are most desirable amongst all other available frames. The backbone frame comprises a single wide main beam where engine is attached. The backbone frame allows for great flexibility in design, since it is concealed inside, used for two wheelers. The engine just seems to hang in mid air. It is simple and cheap to make, and is used mainly on naked and off-road motorcycles.

MONOCOQUE FRAME: The monocoque frame is used nearly exclusively on racer bikes and is very rarely found on daily used bikes. Monocoque frames act as a single piece unit that serves for seat mounting as well, tank and tail section. Though they offer certain advantages in terms of rigidity, monocoque frames are heavy and generally not worth the effort.

PERIMETER FRAME: Research on racing two wheelers has shown that major advantages are supposed to be in terms of rigidity and it can be achieved by joining the steering head to the swing arm in whit shortest distance. This is the concept behind the perimeter frame. The earliest perimeter frames were made from steel, but the need to improve rigidity to weight ratios led most manufacturers to adopt aluminum instead. Aluminum is now by far the most common road bike frame material and the aluminum perimeter frame is the most popular frame for modern super sports motorcycles.

TRELLIS FRAME: The trellis frame rivals the aluminum perimeter frame for improvement in rigidity and weight. A favorite of Italian and European manufacturers it has proved a great success in racing and competition. The Trellis frame uses the same principles as the perimeter frame, and connects the steering head and swing arm as directly as possible.

RESEARCH METHODOLOGY:

Phase I- Literature Survey

Using the knowledge from literature review, we can know how the CAD model is to be prepared. The conditions required for applying various constraints and how the loads are applied is briefed about in the technical papers refered.

Phase II- CAD Model Generation

- Getting input data on dimensions of chassis from market.

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- Creating 3D model in CATIA.

Phase III-Determination of loads

- Engine load and location.
- Fuel tank weight.
- Rider and pillion weight.
- Overall weight of the vehicle at CG.
- Loads acting during dynamic motion using vehicle dynamics.

Phase IV- Testing and Analysis

- Meshing the CAD model and applying the boundary conditions.
- Solve for the solution of meshed model using ANSYS.

Phase V- Re-Design, Analysis and Result with new alternate material

- Study various alternate materials and select some most appropriate materials.
- Analyse the model with selected alternative materials and finding out the best suited material.
- Check the maximum stress ensuring it is well within the safe region.

Phase VI- Fabrication, Experimental validation and Result

- Fabrication of prototype with new alternate material.
- Suitable experimentation and comparison with present chassis material.
- Validation of result by comparing with software results.

CAUSES OF VIBRATION:

The motorcycle is designed to run straight without vibration on a flat surface at a prescribed velocity by the scooter manufacturer in the user manual guide. For simplicity assumption is made for rigid suspension, by considering kinematics spatial system motions can be classified in below mentioned four coordinates.

- The steering angle.
- The yaw angle.
- The roll angle.
- The lateral displacement of the mass centre.

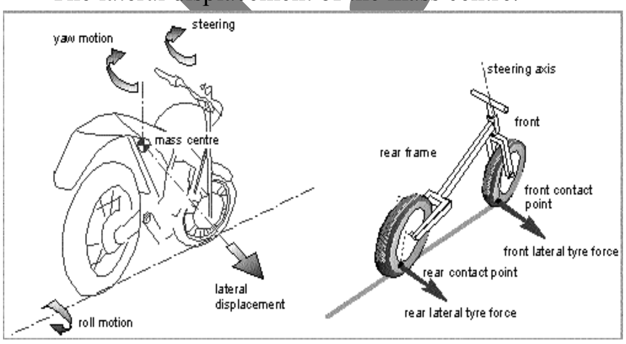

Figure 1: Different Motions of a Motorcycle

The system "motorcycle" may be considered to consist of two parts:

- The rear frame including the rider, the engine, the petrol tank and the seat and rear wheel.
- The front frame including the forks, the handlebars and the front wheel.

The rear frame and the front frame are hinged together at the steering axis by means of a revolute pair. During the motion, the tires are free to sideslip; so they produce lateral forces which are a linear function of the sideslip angles and the camber angle. These forces, from a practical point of view, may be considered to be restoring forces like those produced by springs.

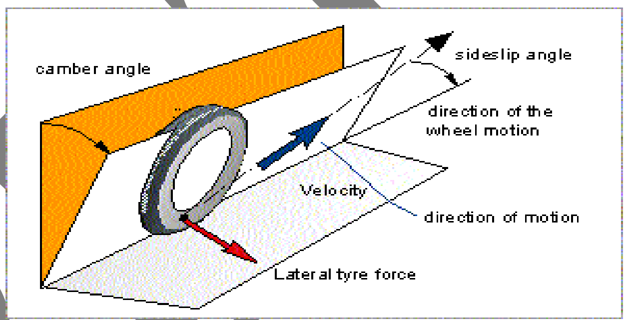

Figure 2: Forces Produced by Tire

Keeping the above simplification in mind, the steering axis is considered to be constrained so that it can't move laterally. So the motorcycle may be thought of as two decoupled systems each having only one degree of freedom:

- The front frame oscillating around the steering axis on which the lateral front tire force (with the normal trail as a lever) acts as a restoring force;
- The rear frame oscillating around the steering axis on which the lateral rear tire force (with a lever proportional to the wheelbase) acts as a restoring force

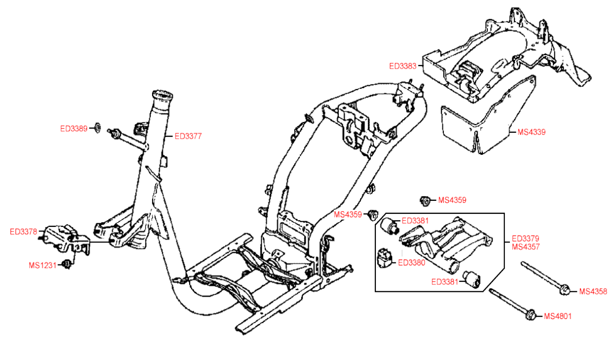

Figure 3: Image of a Scooter Chassis

MODAL ANALYSIS:

Modal analysis is an efficient tool for describing, understanding, and modeling structural dynamics. The dynamic behavior of a structure in a given frequency range can be modeled 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.

Tools Used:
Cad Software – CatiaV5R19
CAE software – Hypermesh 12.0, Ansys 13**.**
Testing: FFT Analyzer

GENERAL VIEW OF EXPERIMENTAL SETUP:

Measuring the magnitude of vibrations is a useful diagnostic technique for ascertaining that machinery is operating normally and checking for signs of possible problems. FFT analyzer can be used to measure vibration response of a system.

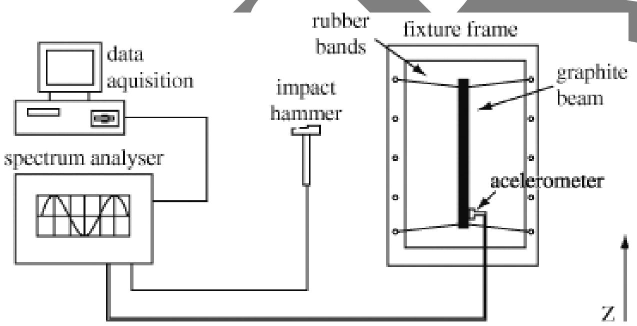

Figure 4: General View of the Test Assembly

DIMENSIONS OF CHASSIS:

The dimesions of chassis have been extracted from existing one by using reverse engineering. Dimensions are required for calculating of boundary conditions. Hence its CAD model is necessary. The conventional model of chassis used in Activa is taken. Dimensions are taken through reverse engg i.e. through hand calculations. CAD model then is made by the commands in CATIA of Pad, pocket, fillet, and geometrical selections in part design module. Parametric generation of drawings will help to get the dimensions useful in forces calculations in static and dynamic loading conditions on a component. Measurement is taken with Vernier caliper

IMAGES WHILE HAND MEASURING OF A CHASSIS:

Figure: 5 Hand Measuring of a Chassis

Top View

Side View

Figure 6: Different Views of Measured Chassis

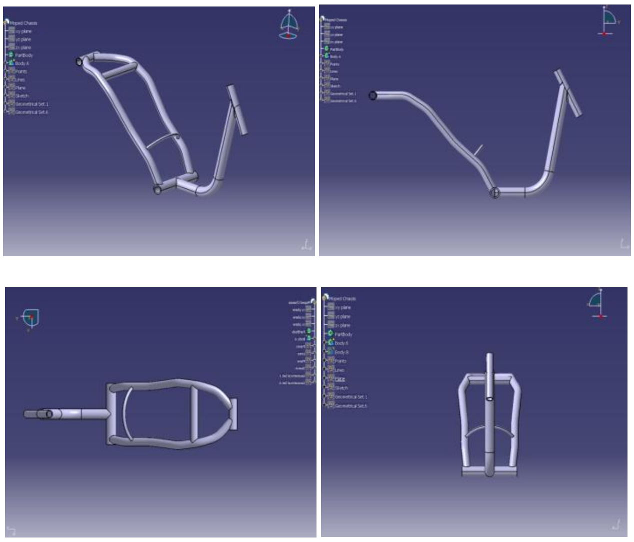

Figure 7: CAD Model in CATIAV5

CONCLUSION:

Research is been completed for doing weight optimization of the chassis 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.

REFERENCES:

1. S. Agostoni, A. Barbera, E. Leo, M. Pezzola, M. Vanali, *"investigation on motor vehicle structural vibrations Caused by engine unbalances"*, Proceedings of the SEM Annual Conference June 1-4, 2009 Albuquerque New Mexico USA

2. Carfagni, Monica. "*Virtual Scooter Prototype In The Design For Comfort."*

3. Li-rui, Wang, and Yang Xiao-long. *"Simulation and Improvement of Vehicle Frame Using FEM."* Proceedings of the 2012 International Conference on Mechanical

4. Nissar Ahamed, Brahmananda Reddy.K, *"Determination of Fundamental Natural Frequencies of the Motorcycle Chassis".*

5. Jakub Šmiraus1, Michal Richtář2, *"Design of motorcycle active chassis geometry Change system"*.Number 5, Volume VI, December 2011

6. Rajput, Yogendra S., et al. *"A Vibration Analysis Of Vehicle Frame*."International Journal of Engineering Research and Applications 3.2 (2013): 348-350.

7. Neeraja, C. H., C. R. Sireesha, and D. Jawaharlal. *"Structural Analysis of Two Wheeler Suspension Frame."* International Journal of Engineering Research and Technology. Vol. 1. No. 6 (August-2012). ESRSA Publications, 2012.

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