International Journal of Modern Trends in Engineering and Research
www.ijmter.com
e-ISSN No.:2349-9745, Date: 2-4 July, 2015

Analysis of Suspension System of HERO CBZ EXTREME 150 cc by Using FEA Approach

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Abstract- In this paper a shock absorber is designed for HERO CBZ EXTREME 150 cc and a 3D model is created using CATIA V5 R20. The model is also changed by changing the material of the spring. Structural analysis and modal analysis are done on the shock absorber by varying material for spring, Spring Steel and CFRP. The analysis is done by considering loads, bike weight, single person and 2 persons. Structural analysis is done to validate the strength and modal analysis is done to determine the displacements for different frequencies for number of modes. Comparison is done for two materials to verify best material for spring in Shock absorber. Modeling is done in CATIA V5 R20and analysis is done in ANSYS WORKBENCH. CATIA V5 R20 is the standard in 3D product design, featuring industry-leading productivity tools that promote best practices in design. ANSYS WORKBENCH is general-purpose finite element analysis (FEA) software package. The shock absorbers duty is to absorb or dissipate energy. In a vehicle, it reduces the effect of traveling over rough ground, leading to improved ride quality, and increase in comfort due to substantially reduced amplitude of disturbances. When a vehicle is traveling on a level road and the wheels strike a bump, the spring is compressed quickly. The compressed spring will attempt to return to its normal loaded length and, in so doing, will rebound past its normal height, causing the body to be lifted. The weight of the vehicle will then push the spring down below its normal loaded height. This bouncing process is repeated over and over, a little less each time, until the up-and-down movement finally stops. If bouncing is allowed to go uncontrolled, it will not only cause an uncomfortable ride but will make handling of the vehicle very difficult So the design of spring in suspension system is very important.

Keywords- *Ansys Work Bench, Catia, CRFP, FEA.*

I. INTRODUCTION

A suspension system or shock absorber is a mechanical device designed to smooth out and dissipate kinetic energy. The shock absorbers function is to absorb or dissipate energy. In a vehicle, it reduces the effect of traveling over rough ground, leading to improve ride quality, and increase in comfort due to substantially reduced amplitude of disturbances. Basic safety and also traveling ease and comfort to get a car's motorist are usually equally influenced by the particular vehicle's suspension method. Safety refers to the vehicle's handling and braking capabilities. Shock absorbers are a critical part of a suspension system, connecting the vehicle to its wheels. Basically shock absorbers tend to be products which lessen a good behavioral instinct skilled with an automobile, as well as properly absorb the actual kinetic power. Almost all suspension systems consist of springs and dampers, which tend to limit the performance of a system due to their physical constraints. Suspension systems, comprising of springs and dampers are usually designed for passenger's safety and do little to improve passenger comfort. One particular strategy to this can be the application of

productive suspension devices, wherever highway circumstances are generally found employing detectors, plus the technique in a flash adapts on the placing.

A shock absorber is a device which is designed to smooth out sudden impulse responses, and dissipate kinetic energy. Any moving object possesses kinetic energy, and if the object changes direction or is brought to rest, it may dissipate kinetic energy in the form of destructive forces within the object. The purpose of a shock absorber, within any moving object, is to dissolve the kinetic energy evenly while eliminating any decelerating force that may be destructive to the object. Shock absorbers are an important part of automobile and motorcycle suspensions, aircraft landing gear, and the supports for many industrial machines. Large shock absorbers have also been used in structural engineering to reduce the susceptibility of structures to earthquake damage. A transverse mounted shock absorber, helps keep railcars from swaying excessively from side to side and are important in passenger railroads systems because they prevent railcars from damaging station platforms. In a vehicle, it reduces the effect of traveling over rough ground, and leading to improved ride quality. Without shock absorbers, the vehicle would have a bouncing ride, as energy is stored in the spring and then released to the vehicle, possibly exceeding the allowed range of suspension movement.

II. APPROACHES FOR SHOCK ABSORPTION

There are several commonly-used approaches to shock absorption:

1. Hysteresis of structural material, for example the compression of rubber disks, stretching of rubber bands and cords, bending of steel springs, or twisting of torsion bars. Hysteresis is the tendency for otherwise elastic materials to rebound with less force than was required to deform them. Simple vehicles with no separate shock absorbers are damped, to some extent, by the hysteresis of their springs and frames.
2. Dry friction as used in wheel brakes, by using disks (classically made of leather) at the pivot of a lever, with friction forced by springs. Used in early automobiles such as the Ford Model T, up through some British cars of the 1940s. Although now considered obsolete, an advantage of this system is its mechanical simplicity; the degree of damping can be easily adjusted by tightening or loosening the screw clamping the disks, and it can be easily rebuilt with simple hand tools. A disadvantage is that the damping force tends not to increase with the speed of the vertical motion.
3. Solid state, tapered chain shock absorbers, using one or more tapered, axial alignment(s) of granular spheres, typically made of metals such as nitinol, in a casing. [1],[2] 6. Magnetic effects. Eddy current dampers are dashpots that are constructed out of a large magnet inside of a non-magnetic, electrically conductive tube.
4. Inertial resistance to acceleration, for example prior to 1966 [4] the Citroën 2CV had shock absorbers that damp wheel bounce with no external moving parts. These consisted of a spring-mounted 3.5 kg (7.75 lb) iron weight inside a vertical cylinder [5] and are similar to, yet much smaller than versions of the tuned mass dampers used on tall buildings
5. Composite hydro-pneumatic devices which combine in a single device spring action, shock absorption, and often also ride-height control, as in some models of the Citroën automobile.
6. Conventional shock absorbers combined with composite pneumatic springs with which allow ride height adjustment or even ride height control, seen in some large trucks and luxury sedans such as certain Lincoln and most Land Rover automobiles. Ride height control is especially desirable in highway vehicles intended for occasional rough road use, as a means of improving handling and reducing aerodynamic drag by lowering the vehicle when operating on improved high speed roads.
7. The effect of a shock absorber at high (sound) frequencies is usually limited by using a compressible gas as the working fluid and/or mounting it with rubber bushings.

III. PROPOSED SCHEME

When a vehicle is traveling on a level road and the wheels strike a bump, the spring is compressed quickly. The compressed spring will attempt to return to its normal loaded length and, in so doing, will rebound past its normal height, causing the body to be lifted. The weight of the vehicle will push the spring down below its normal loaded height. This, in turn, causes the spring to rebound again. This bouncing process is repeated over and over, a little less each time, until the up-and-down movement finally stops. If bouncing is allowed to go uncontrolled, it will not only cause an uncomfortable ride but will make handling of the vehicle very difficult. After some duration stiffness of spring is goes to decreases. It aims to investigate the effects of composite material and BUR structure outer layer on the mechanical properties of the for mentioned four helical springs.

The main objectives for this proposed scheme are:-
1) To replace the existing spring material with composite material carbon fibre helical composite spring without affecting natural frequency, stress values & geometry of existing spring.
2) To get required comfort, by increasing stiffness & mechanical properties.

IV. METHODOLOGY

To achieve the above mentioned objectives we have to go with following process:-
1. Disassemble shock absorber from particular vehicle.
2. To carry out 3D scanning of coiled spring.
3. Create a 3D geometry in CAD software from Scanned data.
4. Conduct a static stress analysis using FEA software.
5. Conduct a Modal analysis of the same.
6. Conduct a physical test using single axis strain gauge to validate FEA static stress analysis results with physical tests
7. Replace the existing material of the spring by best composite material.
8. Conduct a static stress analysis of the modified shock absorber.
9. Conduct a Modal analysis of the modified shock absorber.
10. Design Failure Mode Effective & Criticality Analysis (DFMECA) of the shock absorber.
11. Forces which are induced on shock absorber will be used for static stress analysis of modified roller.
12. Compare results of both static and modal analysis between shock absorber and modified shock absorber.
13.Conduct iterations if necessary (by changing the variables).

V. APPLICATIONS

Shock absorbers are an important part of automobile and motorcycle suspensions, aircraft landing gear, and the supports for many industrial machines. Large shock absorbers have also been used in structural engineering to reduce the susceptibility of structures to earthquake damage and resonance. A transverse mounted shock absorber, called a yaw damper, helps keep railcars from swaying excessively from side to side and are important in passenger railroads, commuter rail and rapid transit systems because they prevent railcars from damaging station platforms. The success of passive damping technologies in suppressing vibration amplitudes could be ascertained with the fact that it has a market size of around $ 4.5 billion.

VI. CONCLUSION

In this paper we have seen the different types and approaches of shock absorbing materials and their nature under different conditions ,and by studying all the types it is seen that CRFP material is having greater strength and also having more shock absorbing capacity than other conventional materials so it can be use as a alternative option in future for replacement of conventional suspension with more advantage. By varying the load and conditions it is seen that CRFP material sustains all loads without failure by providing more comfort & for long duration of time.

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