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DEVELOPMENT OF SHOCK ABSORBER IN CATIA

[1] BHUMIREDDY RAVINDRA REDDY, [2] B BHUPAL REDDY, [3] CH RAMESH, [4] CH SANJEEV KUMAR, [5] K SAI KIRAN,

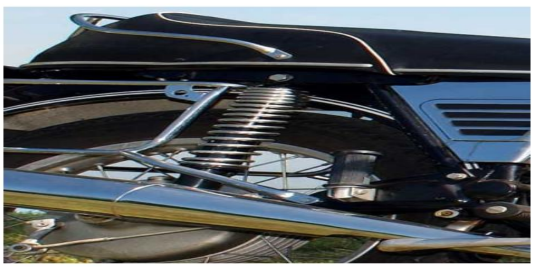
[1]Assistant Professor, Dept. Of MECH, DRK INSTITUTE OF SCIENCE & TECHNOLOGY, Hyderabad,

[2,3,4,5,]BTech Student, Dept. Of MECH, DRK INSTITUTE OF SCIENCE & TECHNOLOGY, Hyderabad

Abstract*: A shock absorbed or damper is a mechanical device designed to smooth out or damp shock impulse, and dissipate kinetic. The basic function of the shock absorbed is to absorb and dissipate the impact kinetic energy to the extent that accelerations imposed upon the air frame are reduced to a tolerable level. Existing shock absorbent can be divided into two classes based on the type of the spring being used: those using a solid spring made of steel or rubber and those using a fluid spring with gas or oil, or a mixture of the two that is generally referred to as oleo-pneumatic. The high gear and weight efficiencies associated with the oleo-pneumatic shock absorbed make it the preferred design for commercial transports. Based on the analysis procedure as outlined in this chapter, algorithms were developed to determine the required stroke and piston length to meet the given design conditions, as well as the energy absorption capacity of the shock absorbed.*

I. INTRODUCTION

Shock absorbents are an important part of automobile and motor cycles us pensions, aircraft gear, and the supports for many industrial machines Large shock absorbents have also been used in structural to reduce the susceptibility of structures to earthquake damage and resonance. A transverse mounted shock absorbed, called away helps keep railcard from swaying excessively from side to side and are important in passenger commuter railandrapid transit systems because they prevent railcard 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.



Rear shock absorbed and spring of a BMW R75/5 motorcycle

VEHICLE SUSPENSION:

In a vehicle, it reduces the effect of traveling over rough ground, leading to improve rid quality and increase in comfort due to substantially reduced amplitude of disturbances. Without shock absorbents, 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. Control of excessive suspension movement without shock absorption requires stiffer (higher rate) springs, which would in turn give a harsh ride. Shock absorbents allow the use of soft (lower rate) springs while controlling the rate of suspension movement in response to bumps. They also, along with hysterias are in the tire itself, damp the motion of the UN sprung weight up and down on the springiness of the tire. Since the tire is not as soft as the springs, effective wheel bounce damping may require stiffer shocks than would be ideal for the vehicle motion alone.

Spring based shock absorbent commonly use color leaf springs, though bars can be used intorsional shocks as well. Ideal springs alone, however, are not shock absorbents as springs only store and do not dissipate or absorb energy. Vehicles typically employ springs or torsion bars as well as hydraulic shock absorbents. In this combination, "shock absorbed" is reserved specifically for the hydraulic piston that absorbs and dissipates vibration.

STRUCTURES

Applied to a structure such as a building or bridge it may be part of seismic or as part of new, earthquake in this application it allows yet restrains motion and absorbs resonant energy, which can cause excessive motion and eventual structural

II TYPES OF SHOCK ABSORBERS

There are several commonly-used approaches to shock absorption:

Hysteresis of structural material, for example the compression of rubber disks, stretching of rubber bands and cords ,bending of steels rings, or twisting of 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 absorbents are damped, to some extent, by the hysteresis of their springs and frames.

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 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 easily rebuilt with simple hand tools. A disadvantage is that the damping force tends not to increase with the speed of the vertical motion. Solid state, tapered chain shock absorbents, using one or more tapered, axial alignment(s) of granular spheres, typically made of metals such as nitinol, in a casing.

Fluid friction, for example the flow of fluid through a narrow or if ice (hydraulics), constitute the vast majority of automotive shock absorbents. An advantage of this type is that using special internal valuing the absorbed may be made relatively soft to compression (allowing a soft response to a bump) and relatively stiff to extension, controlling "jounce", which is the vehicle response to energy stored in the springs; similarly, a series of valves controlled by springs can change the degree of stiffness according to the velocity of the impact or rebound. Specialized shock absorbents for racing purposes may allow the front end of a dragster to rise with minimal resistance under acceleration, then strongly resist letting it settle, thereby maintaining a desirable rearward weight distribution for enhanced traction. Some shock absorbents allow tuning of the ride via control of the valve by a manual adjustment provided at the shock absorbed. In more expensive vehicles the valves may be remotely adjustable, offering the driver control of the ride at will while the vehicle is operated. The ultimate control is provided by dynamic valve control via computer in response to sensors, giving both a smooth ride and a firm suspension when needed. Many shock absorbents contain compressed nitrogen, to reduce the tendency for the oil to foam under heavy use. Foaming temporarily reduces the damping ability of the unit. In very heavy duty units used for racing and/or off-road use, there may even be a secondary cylinder connected to the shock absorbed to act as reservoir for the oil and pressurized gas. Another variation is the Magneto damper which changes its fluid characteristics through an electromagnet

Compression of a gas, for example pneumatic shock absorbent, which can act like springs as the air pressure is building

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to resist the force on it. Once the air pressure reaches the necessary maximum, air dash pots will act like hydraulic dash pots. In aircraft landing gear air dash pots may be combined with hydraulic damping to reduce bounce. Such struts are called oleo struts (combining oil and air). Magnetic effects. Eddy current dampers are dash pots that are constructed out of a large magnet inside of a non-magnetic, electrically conductive tube.

Inertial resistance to acceleration, for example prior to 1966 the Citroën 2CVhad shock absorbents 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 and are similar to, yet much smaller than versions of the tuned used on tall buildings

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.

Conventional shock absorbent 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

The effect of a shock absorbed at high (sound) frequencies is usually limited by using compressible gas as the working fluid and/or mounting it with rubber bushings.

The detailed analysis of shock absorbed/isolation systems is very complicated and involves assessment of the dynamic response of the equipment to different types of activating energy inputs. The notes below relate only to illustrating the benefits of using shock absorbents to reduce the forces experienced by equipment to impacts. The more complicated scenarios involving systems continuously operating and withstanding sudden changes of loading and acceleration e.g. car suspension systems and aircraft landing gear, are outside of the scope of this work.

Moving objects have kinetic energy related to their velocity and their mass. If the velocity of an object is significantly changed in a short time span e.g. it impacts on a stationary body, then high forces result. These forces can be useful e.g. a forging press using the kinetic energy to form metal. However real life impact forces (shock loads) are generally very destructive and are avoided.

Kinetic energy increases in a direct ratio to the mass and to the velocity squared. The heavier the object or the faster it travels, the more energy it has. Methods of energy absorption include rubber buffers, metal springs, air springs, and hydraulic shock absorbents. When the system shave to continuously operate under the influence of shock loads the shock isolation system generally include spring-dash pot isolation systems. For simple shock absorbed applications required to mitigate the effect of a single events then viscous dampers which dissipate the energy, as heat rise of a fluid, are often preferred. In normal everyday life simple examples of shock absorbed systems include crash helmets, steel toe caps in industrial boots, collapsible bumpers on cars, motor way barriers. The notes below are general in nature provided to show the benefits of using shock absorbents. For more detailed information - links are provided to shock absorbed suppliers.

SHOCK ABSORBER TYPES

There are a number of different methods of converting an impact /collision into relatively smooth cushioned contact.

- Metal Spring
- Rubber Buffer
- Hydraulic Dash-pot
- Collapsing safety Shock Absorbents
- Pneumatic Cylinders
- Self compensating Hydraulic

METAL SPRINGS

Simply locating metal springs to absorb the impact loads are a low cost method of reducing the collision speed and reducing the shock loading. They are able to operate in very arduous conditions under a wide range of temperatures. These devices have high stopping forces at end of stroke. Metal springs store energy rather than dissipating it. If metal sprint type shock absorbents are used then measures should be provided to limit oscillations --- Metal spring is often used with viscous dampers.

There are a number of different types of metal springs including helical springs, Bellville washers(cone-springs), leaf springs, ring springs, mesh springs etc. Each spring type has its own operating

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characteristics. Elastomer Shock absorbents these are a low cost options for reducing the collision speed and reducing the shock loading and providing system damping. They are conveniently molded to suitable shapes. These devices have high stopping forces at end of stroke with significant internal damping. Elastomeric dampers are very widely used because of the associated advantages of low cost and mould ability together with performance benefits. The inherent damping of elastomer is useful in preventing excessive vibration amplitude at resonance - much reduced compared to metal springs. However elastomer based shock absorbents are limited in being affected by high and low temperatures are subject to chemical attack. Silicone rubber is able to provide reasonable mechanical properties between temperatures of -50^{O}to +180^{O}deg. C- Most other elastomer have inferior temperature tolerance.

HYDRAULIC DASHPOT

This type of shock absorbed is based on a simple hydraulic cylinder. As the piston rod is moved hydraulic fluid is forced through an orifice which restricts flow and consequently provides controlled resistance to movement of the piston rod. With only one metering orifice the moving load is abruptly slowed down at the start of the stroke. The braking force rises to a very high peak at the start of the stroke and then falls away rapidly. On completion of the stroke the system is stable - the energy being dissipated in the hydraulic fluid as heat. This type of shock absorbents are provided with springs sufficient to return the actuator to its initial position after the impacting load is removed. Collapsing Safety Shock Absorbent These are single use units which are generally specially designed for specific duties. They are designed such that at impact they collapse and the impact energy is absorbed as the materials distort in their inelastic/yield range. They therefore are more compact compared to devices based on deflections within their elastic range

Air (Pneumatic) Springs these devices use air as the resilient medium. Air has a high energy storage capacity compared to metal or elastomer materials. For duties with high loads and deflections the air spring is generally far more compact that the equivalent metal or elastomer device. Due to the comprehensibility of air these have a sharply rising force characteristic towards the end of the stroke. The majority of the energy is absorbed near the end of the stroke. The force on an air cylinder

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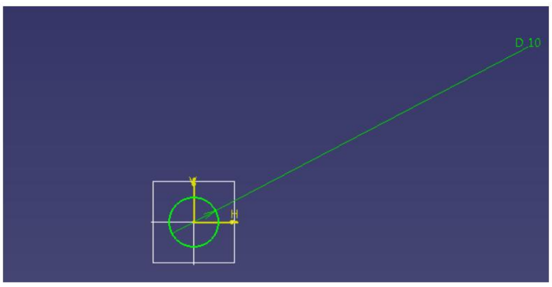
buffer is determined by the relationship Pa^n= constant.

Air springs require more maintenance than meal or elastomer based springs and the temperature range is restricted compared to metal springs. Self compensating Hydraulic these devices are similar to the hydraulic dash pot type except that a number of orifices are provided allowing different degrees of restriction throughout the stroke. These devices are engineered to bring the moving load is smoothly and gently to rest by constant resisting force throughout the entire shock absorbed stroke. The load is decelerated with the lowest possible force in the shortest possible time eliminating damaging force peaks and shock damage to machines and equipment. These type of shock absorbents are provided with springs sufficient to return the actuator to its initial position after the impacting load is removed

III MODEL OF SHOCK ABSORBER IN CATIA

MAKING SHAFT



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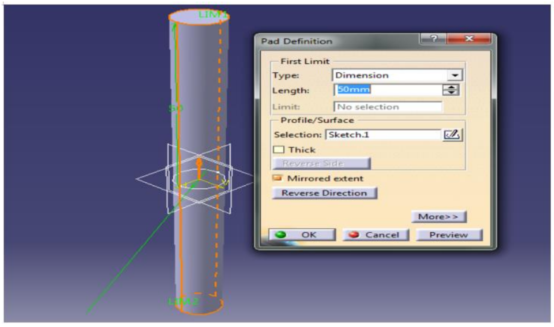

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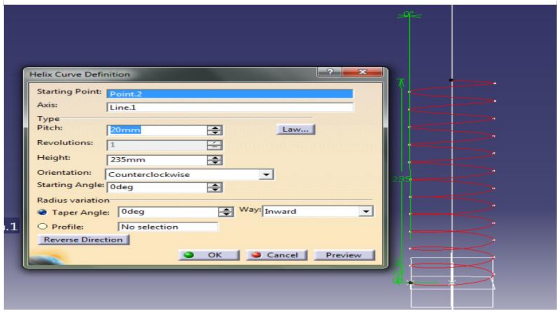

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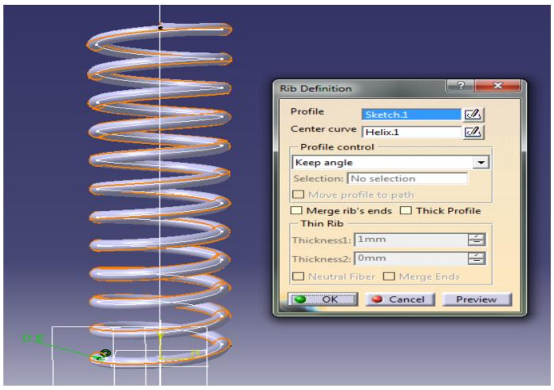
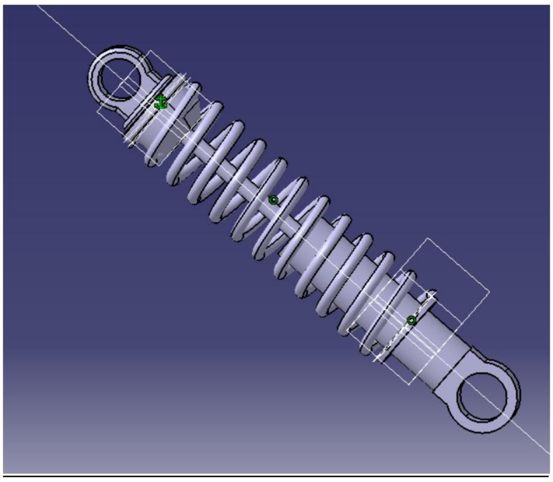


FINAL PART OF SHOCK ABSORBER:



IV CONCLUSIONS

In our project we have designed a shock absorbed used in a 150cc bike. We have modeled the shock absorbed by using 3D parametric software CATIA. While the design and manufacture of a new set of dampers is technically feasible, further Design work must first be undertaken. If a team were to manufacture a set, I would advise the manufacture of a piston and a test rig initially, such that the numerical model can be calibrated to the actual design. From here, alterations can be made prior to manufacturing an entire unit. Also, without dependable data acquisition, numerical modeling of the vehicles behavior serves as an engineering approximation and a starting point for vehicle setup. Consistent driving and lap times will provide the means of car setup from there. Suspension design is so critical to the performance of any racing vehicle, that its parameters drive the design of most others. This requires the component designs to be finalized early in the design phase. As damper performance is critical to the transient balance of the car, the dampers characteristics and quality must be known before it can be included in the design. I would recommend that if this were to be undertaken that provision be made to run other dampers in the case that problems occur, such that the schedule of the project is not delayed. Also the shock absorbed design is modified by reducing the diameter of spring by 2mm and structural, modal analysis is done on the shock absorbed. By reducing the diameter, the weight of the spring reduces. By comparing the results for both materials, the stress value is less for Spring Steel than Beryllium Copper. By comparing the results for present design and modified design, the stress and displacement values are less for modified design. So we can conclude that as per our analysis using material spring steel for spring is best and also our modified design is safe

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