"Design of a Hydraulic shock absorber for Car Front and Rear Bumpers"

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Abstract: As an engineer our first objective is to make a neighborly and safe condition to people. An Motor vehicle collision (MVC) among different terms, happens when a vehicle crashes into another vehicle, passerby, creature, street flotsam and jetsam, or other stationary block, for example, a tree, post or building. There are many ways which vehicles can collide. It may be front bumper collision, rear bumper collision or there is a possibility of rollover the vehicle. MVC accidents regularly result in damage, passing, and property harm. Around the world, engine vehicle impacts lead to death and incapacity and also money related expenses to both society and the people included. This Project manages the possibility of Hydraulic shock absorber utilizing guard in the front and back shade of the four wheeler, which decreases the misfortune and misshaping of the vehicle amid the mishap. It incorporates shock absorber spring as a functioning part in the Impact diminishing framework with the spring made-up of tougher material Si-Mg and hydraulic damper designed to absorb and damp shock impulses. It does this by converting the kinetic energy of the shock into another form of energy (typically heat) which is then dissipated. These Project models constructed utilizing the CATIA V5 R20Software and do investigation on ANSYS 15.

Keywords: spring, motor vehicle collision, safety, shock absorber.

1. Introduction

The Car collisions are going on consistently. Most drivers are persuaded that they can maintain a strategic distance from such troublesome circumstances. Anyway the insights demonstrates that ten thousand dead and a huge number of million injured every year. Hence, improvement in the security of cars is essential to diminish the quantities of mishaps. Car guard is an auxiliary segment of a car vehicle which adds to vehicle crashworthiness or inhabitant security amid front or back impacts. The guard framework additionally secures the hood, trunk, fuel, fumes and cooling framework and in addition wellbeing related hardware. Hydraulic shock absorber are normally made of steel, aluminum, plastic, or composite material. Guard pillars are likewise the foundation of the vitality retaining frameworks situated at both front and back on MVC. This vitality safeguard which resembles a safeguard, capacities as an associating part between a guard and front cross part to damp load and the stun stack amid a low speed impact between the engine vehicle and a snag. Under the guard affect circumstance these vitality safeguards are stacked in pressure or strain and also the guard moves from a planned external position toward the vehicle body and are agent to assimilate the vitality of the effect. After effect, these vitality safeguards recoup at different rates to return related with guard get together toward its unique pre-affect position.

Various physical wounds can usually result from the unpolished power injury caused by a crash, extending from wounding and injuries to cataclysmic physical damage or demise. The two fundamental variables are estimated in the damageability speaking to the dimension of outer chock that a vehicle can persist and fix capacity which estimates the conceivable reclamation of harmed vehicle.

Bumper:

A guard is a structure joined to or incorporated with the front and backsides of an engine vehicle, to ingest affect in a minor crash, in a perfect world limiting fix costs.

[1] Stiff metal guards showed up on cars as ahead of schedule as 1904 that had a mostly fancy function.

[2] Numerous advancements, enhancements in materials and innovations, and additionally more noteworthy spotlight on usefulness for ensuring vehicle parts and enhancing wellbeing have changed guards throughout the years.

Guards preferably limit tallness confuses among vehicles and shield people on foot from damage. Administrative measures have been established to diminish vehicle fix expenses, and all the more as of late effect on pedestrians. Most present day autos utilize a strengthened thermoplastic guard, as they are making shoddy to make, simple to fit and retain less vitality amid an accident. A lion's share of vehicle guards is uniquely crafted for an explicit model. In any case, numerous organizations currently offer elective plans in thermoplastic, with a scope of fittings intended for various models. Steel Bumper Originally plated steel was use for the whole body of a vehicle including the bumper. This material functioned admirably, as it was extremely solid in an accident, yet it was substantial and marked execution. As vehicle motor structure has enhanced, steel guard have basically vanished for anything aside from great autos. Supplanting one includes a great deal of looking for scrap vehicles or having one uncommonly made. Enhancing traveller vehicle damageability and fix capacity.

Shock absorber:

A safeguard (in actuality, a stun "damper") is a mechanical or pressure driven gadget intended to ingest and sodden stun motivations. It does this by changing over the dynamic vitality of the stun into another type of vitality (commonly warm) which is then disseminated. Most safeguards are a type of dashpot (a damper which opposes movement by means of thick rubbing). Water powered safeguards are utilized related to pads and springs. A vehicle safeguard contains spring-stacked check valves and openings to control the stream of oil through an inward cylinder.

The two safeguards are connected at the front and back guard fortification. Amid a front and backside affect, the vitality safeguards abbreviate, much the same as a telescope type safeguard. Following the effect, if the effect isn't past the structured furthest reaches of the vitality safeguards, they come back to their unique length. This activity of powers water powered liquid to stream around the metering pin and through the openings toward the finish of the cylinder tube. As the cylinder tube keeps on moving the stream of pressure driven liquid into the cylinder tube pushes the drifting cylinder to one side. This packs the oil in the cylinder tube car guard assumes a vital job in retaining sway vitality for unique motivation behind security and styling stand tasteful reason. Presently days, car industry focuses on advancement of weight and security.

Crush cans

Crush cans are located at the two ends of the impact bumper in order to absorb the energy of the impact and minimize the damage of the side members.

Hydraulic shock absorbers

Hydraulic powered safeguard help to make your assurance increasingly effective, forms quicker, delicate quiet wellbeing and progressively maintainable. A progression of holes is bored in the inward barrel divider at exponential interims. The purpose behind the exponential dispersing is gotten from the condition for dynamic vitality: KE= ½ mv2. The chamber is loaded up with liquid, and all air is seeped from the liquid since air bubbles cut the productivity of the safeguards by causing supple or sporadic activity. At the point when a moving burden contacts the cylinder pole, it moves the cylinder internal, compelling liquid through the openings in the inward barrel divider. The liquid is constrained through the oil return entries, into the space behind the cylinder head. As the cylinder withdraws, it shuts the holes behind it, decreasing the successful metering territory, and keeping up a uniform deceleration drive as the heap loses its vitality. Liquid weight is steady in a safeguard, giving consistent protection from the heap. Pressure driven safeguard parts are made in aluminum material like as cylinder head, cylinder bar, and chamber.

Grade of oil	I
Kinematic viscosity (100°C),mm^2/s)	3.364
Kinematic viscosity (400°C),mm^2/s)	11.36
Viscosity index	187
Flash point	182
Pour point	-56

Table 1 : Properties of hydraulic oil

Design Calculation

Mass :

Vehicle Class	**Weight (pounds) Approx..**	**Weight (Kg) Approx.**
Compact car	2979	1354
Medium size	3497	1590
SUV	4150	1882
Large size	4366	1985

Table 2 : Class and Type of a vehicle

Spring Specification:

Low speed = 10km/hr.
High speed = 100 km/hr.
Avg. velocity = 2.77m/s (10km/hr.)
Average weight = Avg. weight of the car + Weight of the person
= 1500 + 80
= 1580 Kg
Kinetic Energy = ½ mv^2
= ½ *1580*2.77^2, m = mass; v = Velocity
= 6061.5*10^3 N.mm
Strain Energy of spring (E) =2* (½ Pδ), P = load; δ = Deflection.

Deflection we take Approximate = 150mm
= 2*(½ *P*150) = 150 P.
Kinetic Energy = Strain Energy of spring

S no.	Specification	Dimensions
1	Spring Index (k)	1.252
2	Mean coil Diameter (D)	120mm
3	Wire Diameter (d)	20mm
4	Total No of coils (N)	15
5	Actual Deflection of spring (δ)	162mm
6	Solid length of spring (L)	300mm
7	Pitch coil (P)	35mm

6061.5*10^3 =150P
P = 40410N

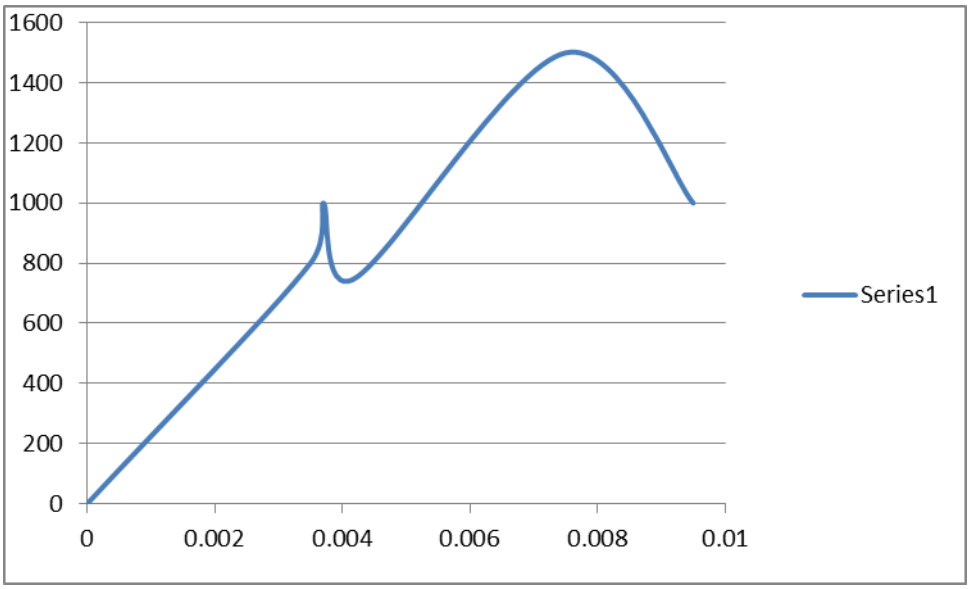
Table 3 : Spring Specification

Silicon manganese steel:

Ultimate tensile strength N/mm^2	Yield strength (Tensile) N/mm^2	Working stress (Tensile) N/mm^2	Ultimate shear strength N/mm^2	Yield strength (Shear) N/mm^2	Working stress (Shear) N/mm^2	Modulus of elasticity(E) N/mm^2	Modulus of rigidity(G) N/mm^2
1500	1000	700	900	600	420	2.0*10^5	0.8*10^5

(From Data book)

Table 4 : Mechanical properties Si-Mg



Graph 1 : Stress- Str ain curve

By this graph it shows that area below stress-strain gragh is high which directly related tto the toughness of the material. It will withstand maxmimum impact force collision without breaking by absorb maximum impact energy and transforms into heat energy dissipation.

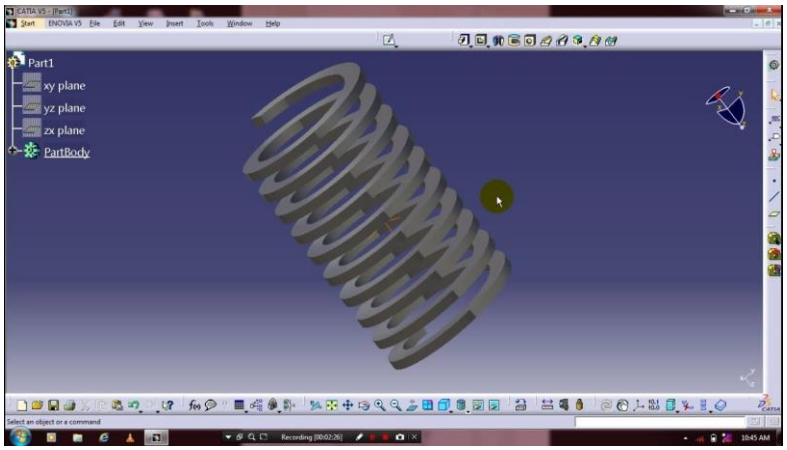


Fig 1: Spring CATIA model

Theoretical Calculation:

Impact force (F) = mass * acceleration
$F = m*v^2/2d$

Speed of the Vehicle (km/hr)	Weight (car + person(s)mass) (Kg)	Avg. Impact force (KN)	Stopping time (ms)
10	1500+80	152.4	29
20	1580	610	14.4
30	1580	1372	9.6
40	1580	2438	7.2
50	1580	3810	5.8
60	1580	5486	4.8
70	1580	7467	4.1
80	1580	9753	3.6
90	1580	12344	3.6
100	1580	15239	2.9

Table 4: Theoretical calculation of avg Impact force

Device construction:

Initially by using CATIA V5 software designed various parts of shock absorber and finally all the parts to be assembled, at the ends of parts plates to be designed to apply load test on ansys. This solid modeling is a lot of standards for numerical and PC displaying of three-dimensional solids and is recognized from related territories of geometric displaying and PC illustrations by its accentuation on physical constancy. At first the three dimensional illustration of the guard and safeguard is Assemble in settled front and rear over hang at the two ends of impact bumper in order to cushion the impact and avoid damage. In the middle of them utilization of fundamental advances like crush cans additionally vital for getting the ideal model of cushioning effect. The different perspectives of the safeguard guard are appeared from the changed materials used to this safeguard display are Silicon- Manganese steel alloy. The cost of the car by using this device increases due to setup of hydraulic shock absorber and also the cost of spring material but as compare to safety of a person and vehicle body protection it is helpful to take this type of preventive measures.

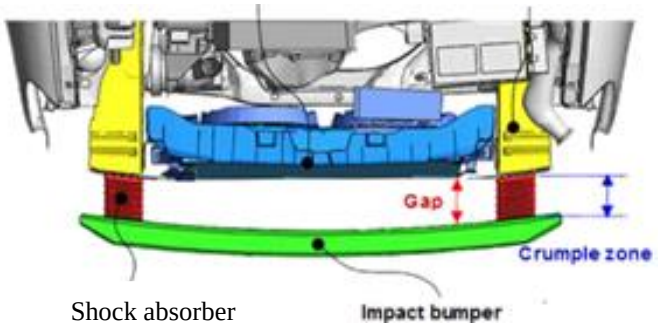


Fig 2 : structure

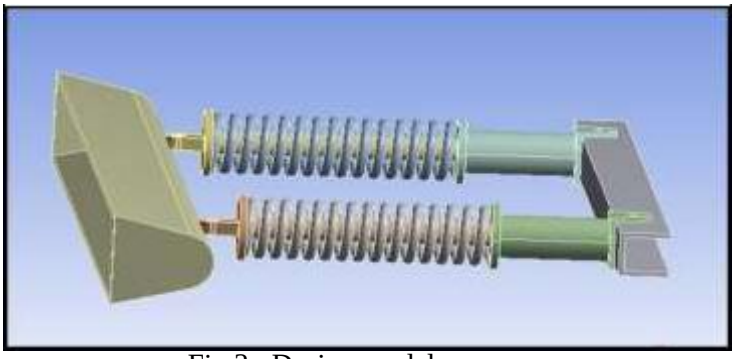


Fig 3 : Design model

Conclusion:

By considering the average vehicle mass and normal design circumstances. In this study the maximum possibility of crashes are seen in front and rear ends of the motor vehicles, which tends to loss of vehicle and to the passenger. In order to avoid such circumstances some preventive methods such as by using shock absorbers at two front and rear ends both in between we can use the crush cans which also helps to reduce the impact force. Hence in this undertaking, an impact of crash is abundantly lessened by actualizing the few units of Hydraulic shock absorber with spring in guard of vehicles. The spring is designed and made-up of a toughest material alloy of Silicon Manganese which can withstand 10 km/hr collision impact and remaining impact force get dissipated by heat energy in the Hydraulic shock absorber. Thus the development of toughest materials will be essential in this type of collision impact force to reduce the collision impact.

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