IOSR Journal of Computer Engineering (IOSR-JCE)
e-ISSN: 2278-0661,p-ISSN: 2278-8727, Volume 21, Issue 2, Ser. IV (Mar - Apr 2019), PP 104-108
www.iosrjournals.org

Spring Configured and Shock Absorber of an Atv

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Abstract: *Shock absorbers are a basic piece of a suspension framework, associating the vehicle to its wheels. The requirement for structuring the dampers emerges in light of the roll and pitches related with vehicle moving, and from the unpleasantness of streets. In the mid nineteenth century, street quality was commonly extremely poor. shock absorbers are gadgets that smooth out a motivation experienced by a vehicle, and properly disperse or assimilate the dynamic vitality. safeguards have become such a fundamental segment of a car and, after its all said and done there has been no specific strategy to test it utilizing Finite Element Analysis procedure and the majority of the testing is finished utilizing the physical tests. Subsequently this paper centers around to grow new connected procedures that will permit specialists to plan parts of Shock Absorbers by utilizing FEM based devices.*
Key words: *Muffler, Silencer, BSFC, BTE*

I. Introduction

The current world-wide production of shock absorbers, is difficult to estimate with accuracy, but is probably around 50– 100 million units per annum with a retail value well in excess of one billion dollars per annum. If all is well, these shock absorbers do their work quietly and without fail. Drivers and passengers simply want the dampers to be trouble free. In contrast, for the designer they are a constant interest and challenge. The need for dampers arises because of the roll and pitches associated with vehicle/bike maneuvering and from the roughness of roads. As there is growing demand for quality shock absorbers in India, design and construction of shock absorbers are demanding tasks that require advanced calculations and theoretical knowledge. There are two basic shock absorber designs in use today: the two-tube design and the mono-tube design.

II. Dampers

There are basically two type of dampers- mono tube and twin tube damper. Snubber, a device that controls unwanted spring motion through a process known as dampening. Shock absorbers slow down and reduce the magnitude of vibratory motions by turning the kinetic energy of suspension movement into heat energy that can be dissipated through hydraulic fluid.

Figure 1

A shock absorber is basically an oil pump placed between the frame of the car and the wheels. The upper mount of the shock connects to the frame (i.e., the sprung weight), while the lower mount connects to the axle, near the wheel (i.e., the unsprung weight). In a twin-tube design, one of the most common types of shock absorbers, the upper mount is connected to a piston rod, which in turn is connected to a piston, which in turn sits in a tube filled with hydraulic fluid. The inner tube is known as the pressure tube, and the outer tube is known as the reserve tube. The reserve tube stores excess hydraulic fluid.

When the car wheel encounters a bump in the road and causes the spring to coil and uncoil, the energy of the spring is transferred to the shock absorber through the upper mount, down through the piston rod and into the piston. Orifices perforate the piston and allow fluid to leak through as the piston moves up and down in the pressure tube. Because the orifices are relatively tiny, only a small amount of fluid, under great pressure, passes through. This slows down the piston, which in turn slows down the spring. Shock absorbers work in two cycles - the compression cycle and the extension cycle**.**

III. Maximum Applied Load

Based on amount of load applied on front wheels in different cases maximum applied force was calculated to design the spring .Now for designing of spring three cases were taken into consideration

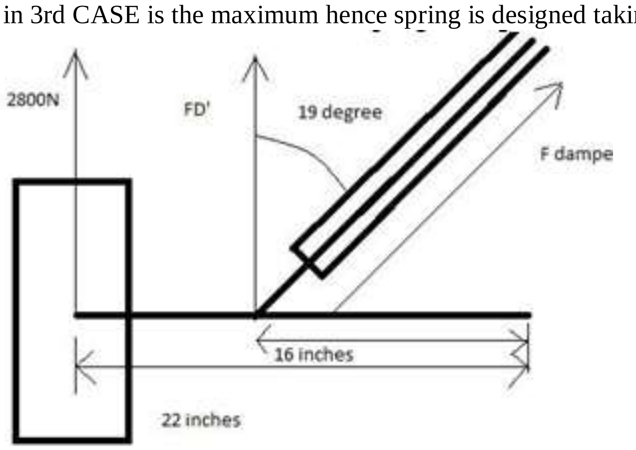
- Load transfer of front wheel due to braking
- Load transfer due to dropping the vehicle from certain height (4 G force applied)
- Load transfer if whole weight of the vehicle is transferred on one wheel

Vehicle dimensions and other parameters
Reaction at front wheels each (calculated by placing weighing machine under each wheel) = 450 N
wheel base b = 50 inches
Center of gravity Height h = 20 inches
Weight of vehicle w = 2800 N
Deceleration produced a = 1.5 g

CASE 1:
Longitudinal Load transfer on front wheel = w *a*h / b = 280 * 1.5 * 9.8 * 20 /
= 1646 .4 N
Net reaction at individual wheel = 450 + (1646.4 / 2) = 1273.2 N
Now taking Factor of safety as 1.5 Net reaction is taken as 2000 N at individual wheel

CASE 2:
If load isdropped from a given height, taking 4 G force as
the reaction, total reaction produced
=4 *9.8 * 280 =10976 N
Weight distribution front/rear is 40:60
net reaction at the front of the vehicle = 10976 *40 / 100 = 43904 N
hence reaction at individual wheel = 43904 / 2
=2195.2 N

CASE 3:
If whole weight is transferred on single wheel
Total load = 2800 N
Since the reaction produced in 3rd CASE is the maximum hence spring is designed taking the maximum load



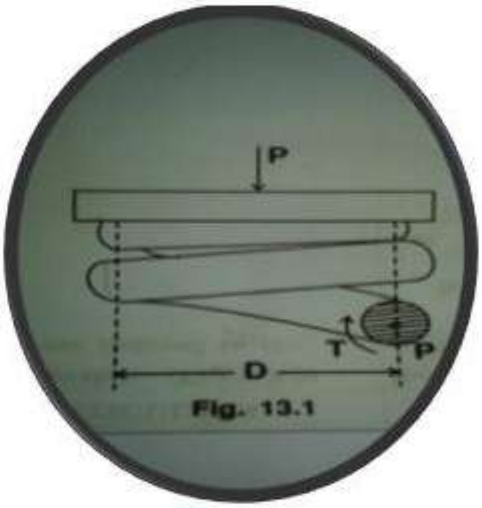
Distance between applied load at wheel and position of Damper
D1 = 22 inches
D2 = 16 inches

Now from the moment equation
=2800* D1 = FD' * D2   FD' =3850 N
F damper = 3850 / Cos (19)
= 4071.2 N
Travel of suspension damper is 5.5 inches
Stiffness k = 4017.2 / 5
=   32.06 N/mm

IV. Spring Designing According To Given Load

Since we were using Damper of TATA Indica, certain factors were kept constant such as mean diameter of spring, number of turns .
Material used was steel so the value of Modulus of rigidity was taken as 79241 N/mm^2
Mean Diameter of spring D = 99.91 inches
Number of active coils n = 8

stiffness as calculated taking maximum load k = 32 N /mm For safe design Maximum deformation is taken to be 5 inches
Now ,   k = G * d^4 /(8 * n * D^3)
here d is diameter of coil
hence d = 12.67 mm

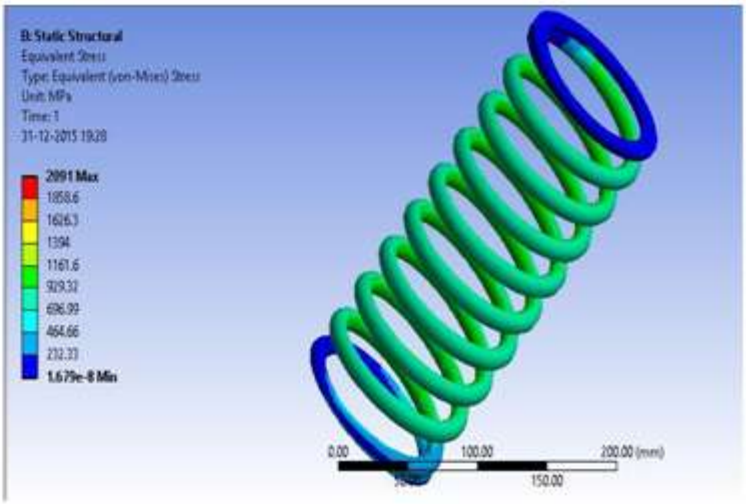


Solid Length of spring Ls = n*d
=   8 * 12.67
=   101.4 mm

Total number of turns N = N +2 (grounded at both the ends)
Max deformation = 8 * P *D^3 *n / G d^4 =8 * 4080*8 *100^3/(79241* 12.67^4) = 127.87 mm
Free length of spring = Nd + 1.15* 127.87
=   273.75 mm Spring Index = D / d
=   99.91 / 12.67
=   7.8
Pitch = Lf / (N -1)
= 30.4 mm

Wahl's shear stress factor K =(4C - 1 / (4C - 4)) + .615/C =1.1893
Now Maximum shear stress induced in spring = 8K*P*D/(π * d^3)

=5933.72 MPa

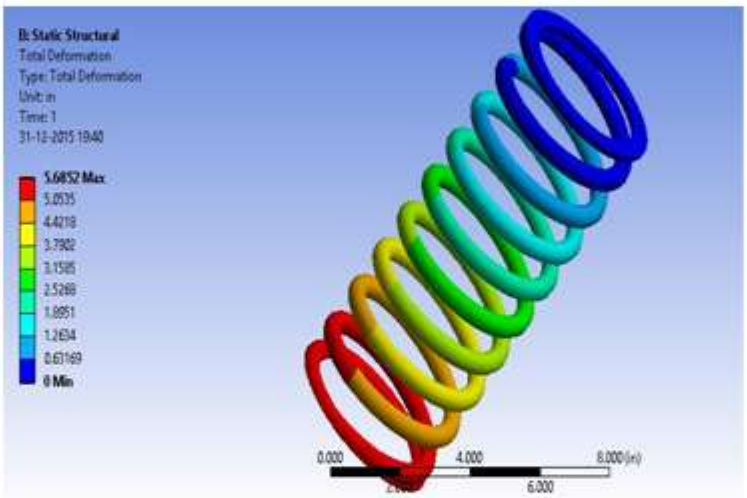


The Value of Max Von Mises stress as calculated from finite element analysis is 1626.3 MPa which is less than the Strength of material; hence spring designed is safe in all respect. Max deformation in the spring comes out to be 5.3 inches.

V. Damper Calculation

We are using twin tube dampers, the space above and below the piston are filled with oil and damping action arises from the viscous losses that occur in the orifice

Calculation
70 % of critical damping
That is damping factor is 0.7
damping coefficient C = 2*square root (K*m) *0.7
here K is stiffnessm is static load on damper
Hence C = 5.11 N/mm/s
Cc critical damping coefficient = 7.177
Wn undamped natural frequency =square root (K/ m)= .28 radian/s
Wd =square root (1- .7 ^2)= .199 radian/s



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