IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684, p-ISSN: 2320-334X
PP 47-51
www.iosrjournals.org

Design of Govern Arm Suspension System

A.Shyam[1], R.Pachaiyappan[2], Sa.Paveethrun[3], M.Srinath[4]
[1, 3] Student, Department of mechanical Engineering, Adhiparasakthi Engineering College, Melmaruvathur, Tamil Nadu, India
[4]Student, Department of Mechanical Engineering, Valliammai Engineering College,Tamilnadu,India
[2]Assistant professor, Department of mechanical Engineering, Adhiparasakthi Engineering College, Melmaruvathur, Tamil Nadu, India.

ABSTRACT: *As the name governor precise, GOVERN ARM SUSPENSION did not have governor which is used to maintain the speed of an engine within specified limits, whenever there is a variation in loads. In order to enhance the cushioning effect as compared to the normal mono cross rear suspension system, GOVERNARM SUSPENSION was designed by the multi body dynamics software called ADAMS. In motorcycles like HONDA, KAWASAKI, DUCATI, KTM etc., which have mono cross rear suspension that give comfort, look stylish but lags in load bearing capacity and cushioning effect as compared to swing arm suspension system. To overcome this suspension system in the shape of governor arm is yet to be unveiled. At the upper wish bone a hydraulic shock absorber is fixed following which an inverted V-shape link and a V-shape link to the lower wish bone. It will thus give equal balance, comfort, load bearing capacity and more cushioning effect contrary to mono cross suspension.*

Keywords: *cushioning effect; Load bearing capacity; Mono suspension; Govern arm suspension; ADAMS.*

I. INTRODUCTION

An Automobile suspension serves a dual purpose contributing to the vehicle's handling and braking. It also provides safety and comfort by keeping the vehicle's passengers comfortably isolated from road noise, bumps and vibrations. Motorcycles built in the 1950's or later, will most likely have some form of damped-fork suspension at the front and a swing arm and shocks in the rear. The suspension system allows the vehicle to corner with minimum roll or tendency to lose traction between the tires and the road surfaces. This provides a cushioning action so road shocks have a minimal effect on the occupants and load in the vehicle. Mono suspension was introduced in the year 1970’s by YAMAHA motors.YZM2SO won the world championship at 1974. Today, it continues to evolve as the world standard on sports bikes by all makers.

Nomenclature

C	spring index	G	modulus of elasticity	N	number of active coils
d	wire diameter	F_s	force in N	TC	total coils in a spring
D	mean coil diameter	K_s	Stress factor	X	length
τ	shear stress				

1.1. Hydraulic Shock Absorbers

In 1907, Foster created his most acclaimed invention, “The Snubber,” a direct acting shock absorber for automobiles, and the first of its kind, an achievement that throughout the years would become commonly associated with the Gabriel name. In 1918 the first hydraulic shock absorber was introduced and in 1956 the first adjustable shock absorber as well. In 1967 the first gas shock absorber came from Gabriel.

1.2. Function of a Shock Absorber

Shock absorbers slow down the vibrations generated by wheels, axles and the chassis. Therefore, the technically correct name is vibration damper. When driving over an uneven surface, the shock absorbers take up the impact of the shock. The damper then tries to transfer the incoming energy. In a short time span, these continuing shocks lead to a vibration. These movements are then transferred to the shock absorber by the piston rod. Thereby, the kinetic energy is transformed into heat by hydraulic resistance in the shock absorber valves. Therefore the vibrations are reduced to a minimum and can hardly be sensed.

1.3. Damper Rod

Today's dampers use valves instead of orifices, which allow them to be compliant over small bumps and yet provide enough damping for large ones. Motorcycle suspension uses springs and damping together, in the form of forks up front and shock absorbers in the rear to soak up bumps and keeps the wheels on the ground. Damping and spring rates must always be in balance.

1.4. Spring Rate

The distance a spring compresses under load. It's usually measured in kg/mm.

2. VIBRATION

Vibration is a mechanical phenomenon whereby oscillations occur about an equilibrium point. The oscillations may be periodic such as the motion of a pendulum or random such as the movement of a tire on a gravel road.

2.1. Free vibration & free vibration

Free vibration occurs when a mechanical system is set off with an initial input and then allowed to vibrate freely.

An alternating force or motion is applied to a mechanical system is Forced vibration. Examples of this type of vibration include a shaking washing machine due to an imbalance, transportation vibration (caused by truck engine, springs, road, etc.

3. GOVERN ARM SUSPENSION

As an advancement to mono suspension system govern arm suspension system was designed and yet to be unveiled with some better compact structure. As key notes in order to implement govern arm suspension system in bikes chassis set up is to be changed a little bit. To enhance the cushioning effect, Load bearing capacity and comfort as compared to the normal mono cross rear suspension systems Govern arm suspension was designed. At the upper wish bone shock absorber with hydraulic system is fixed. A spring with six numbers of turns is fitted with shock absorber. At the upper part of chassis an inverted V-shaped spring and link is fixed, at the lower part a V-shaped link and the spring is fixed. When the load gets acted in the vertical direction compression action takes place. When it gets rebound the upper and lower mount regains its own position. The link rod starts to pull the damper rod which is in an inverted V-shape link. Due to the availability of clearance gap, chassis setup is to be changed.

3.1. Adams views of govern arm suspension

Fig. 3.1(a) shows the failure model of govern arm suspension system. While modelling and simulating results are not positive. Also, if we manufacture a suspension system with more welds at joints definitely the strength of material will get reduced and fatigue may occur. It was complicated to weld the centre acting shock absorber and those links. So, we move on the modified view. Modified view has literal gaps at both top and bottom of the wish bone. So, when the load gets acted in the wish holder suspension action can takes place easily because of its literal gap.

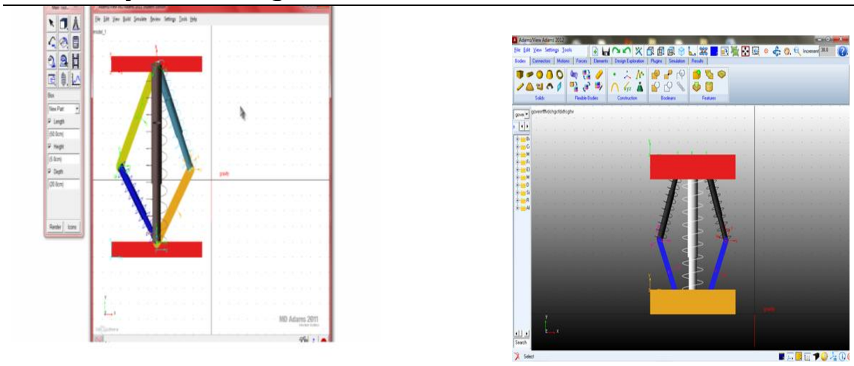

Fig3.1.a) Failure model in ADAMS view. b) Modified ADAMS view.

3.2. Modified Adams view

Fig 3.1(b) shows the modified view of the govern arm suspension system. Due to its literal gap cushioning action can takes place easily. Also the V-SHAPED link can also easily pull the small shock absorber. As said earlier chassis setup change is mandatory.

3.3. Simulation

GOVERN ARM SUSPENSION SYSTEM was analysed with the help of multi body dynamics software called ADAMS. The picture shows you that the simulation duration of 0.2 seconds. The graph shows you the force and velocity on x-axis and time on y-axis respectively. The graph also shows you the curve of deformation velocity, deformation and force.

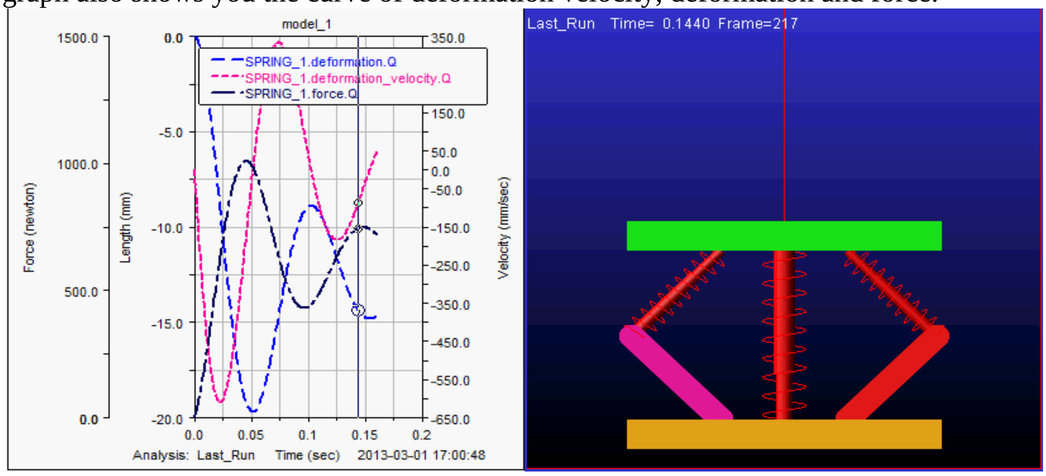

Fig. 3.3 simulation and graph

3.4. Load Required

Jacking forces are the sum of vertical forces component experienced by suspension links. The resultant force act to lift the spring mass if the roll centre is above ground, or compress it if underground Considering the force produced by the spring F_s=1000 N.

II. DESIGN OF SPRING

There are many different types of springs and spring materials. In the design calculations, the following assumptions are considered:

The type and form of the spring will be the Compression ground.

The material must be chosen for the maximum energy and mass, such as spring steel, Chromium Vanadium or Chromium Silicon steel wire.

The ends of the spring are to be closed and ground.

The spring is to have maximum energy for the limited space, while the stress level is not to exceed the maximum yield strength of wire.

The spring operates periodically with a long interval or rest.
The force F_s produced by a linear elastic spring along its length x with a constant K_s
$F_s = K_s \times x$
$K_s = Gd^4 / 8ND^3$
N = TC-2
TC = X/d
$D = D_o$-d
$S=8K_sDF/pd^3$
K_s = (4C-1/4C-4) + 0.615C

In the case that the spring works within a tube or cylinder, the spring outside diameter D must be less in diameter to keep the spring from jamming tin the bore when it is compressed.

Moreover, C must be in the range from 4 to 14. When the spring index is too low, stress problem occur, and when the index is too high, entanglement and the waste of material occur.
The working stress S is calculated using the appropriate equation with the working load F applied to the spring,
If the working stress of the spring is below the maximum allowable stress, the spring is properly designed in relation to its stress level duration operation. The potential energy E that can be stored in a deflected compression spring is given by the constant spring and by the distance that the spring is compressed.
GOVERN ARM suspension is to be manufactured by designing six number of spring turns at the centre. Load applied will be as 1000N, and 101.9368 in terms of kilograms. Wahl stress factor is mandatory while designing a spring. So, from the spring index value we can get the Wahl stress factor.

4.1. Design calculation

Load, P=1000N,
Diameter of wire, d=25mm,
Mean coil diameter,
D = (Di + Do)/2
= (100+120)/2
D=110mm.
Spring index, C= (D/d)
C = 4.4
Wahl stress factor, K_s = (4C-1) / (4C-4) + (0.615/C)
K_s = 1.3015
According to wahl's hypothesis, shear stress concentration factor was calculated.
Number of turns for plain spring, n=6
For Steel wire G=81370N/mm^2
Stiffness, $K = Gd^4/8ND^3$
$= (81370\times25^4) / (8\times6\times110^3)$
K = (497.5N/mm)
Shear stress, $\tau = (8\ K_s\ D\ P) / (\pi\ d^3$
$\tau = 200.61$ N/mm^2
$\tau_{max} = 900$ N/mm^2
Since the maximum allowable stress value is larger than calculated. i.e.) $\tau_{max} = 900$ N/mm^2
So, the design is theoretically safe. With this we can go ahead with the further work.

III. MATERIAL SELECTION

Table 1. Material selection

Material	Tensile strength	Modulus of elasticity (psi*10)	Modulus in tension (psi*10)	Max. Design temp (deg f)
Music wire	229-300	30	11.5	250
Chrome vanadium	190-300	30	11.5	425
Stainless steel	125-320	28	10	550
Stainless steel 1	235-335	29.5	11	600

IV. SPRING TESTING

Fig.6.1. Spring testing machine with mono spring

The figure shows you the spring testing machine with mono spring at 100 kilograms. Thus the spring was manufactured by the above mentioned specification. While testing the spring at the load of 100kg, Spring get compressed and rebounded.

V. ADVANTAGES AND DISADVANTAGES

It enhances cushioning effect than the normal mono cross suspension.
Bikes Load bearing capacity also gets increased due to the implementation of govern arm suspension system.
It also gives stylish look and comfort as compare to the mono suspension system.
GOVERN ARM suspension system can also be implemented in cars.
Chassis setup is to be changed due to the requirement of clearance gap.
Its cost will be comparatively high than other suspension system.

VI. CONCLUSION

The GOVERN ARM suspension system was analyzed, designed and then fabricated. Due to the implementation of govern arm suspension system in vehicles cushioning effect will be enhanced. It too gives stylish look and comfort. Thus the improvement of load bearing capacity will be analyzed at future. Thus this paper has proposed a newly designed suspension system as govern arm suspension system.

REFERENCES

Ben mrad, R., Fassois. S.D., Levitt, J.A., on “Board prediction of power consumption in Automobile Active suspension system-I: Predictor design issues”
Cormie, S.M., (1986) “The influence of friction in the guide bearing on the Damping characteristics of the suspension system”, Tribology International Volume 19, Pages 318-323.
Design data book, PSG College of technology, Coimbatore.
Fuentes, J.J., Aguilar, H.J., Rodriguez, .J.A., (2009) “Premature fracture in automobile leaf springs”, Engineering Failure Analysis, Volume 16, Issue 2, Pages 648-655
Gordan, T.J., (1997) “Non -linear optimal control of a semi active vehicle suspension system’, chaos, solitons and fractals, volume 5, Issue 9, Pages 1603-1617
John c. Dixon., ‘The shock absorber hand book’, second edition, Wiley professional engineering publication series.
William Crouse., Donald L. Anglin., ‘Automotive mechanics’