ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

PERFORMANCE ANALYSIS OF DOUBLE SPRING MASS DAMPER SYSTEM FOR VEHICLE SUSPENSION

Sibi George K.P*, Shajin Majeed, Pandiyan.A

* UG Student, Department of Mechanical Engineering, Saveetha School of Engineering, Saveetha University, Chennai, India.
Tech support Engineer, CAD solutions, Coimbatore, India.
Assistant Professor, Department of Mechanical Engineering, Saveetha school of Engineering, Saveetha University, Chennai, India.

DOI: 10.5281/zenodo.164913

ABSTRACT

The main objective of this paper based on suspension system is to obtain a result and analysis on new model of a suspension system. This model is designed with a normal spring and damper, where it contains two springs connected with a single damper. The drawback of this type of suspension system is the length of the damper is large, it cannot be connected to normal passenger type cars but it can be used to heavy vehicles like tractors and earth-movers. This type of suspension system gives higher efficiency and it can withstand rolling. Hence there is two springs, there will be comfort for the driver while driving and reduces the vibration during motion.

KEYWORDS: Spring, damper, suspension system, chassis

INTRODUCTION

The suspension of the vehicle is the very important system for an automobile. This is the one which helps to support the vehicle body, engine and passengers and at the same time absorbs the shocks which are produced due to roughness of the road [4]. The normal suspension system is mainly made of spring and damper and the types are different. This paper will be a detailed analysis on the suspension system, where there will be two springs connected to the either side of the damper. There will be only one damper present in between the springs. As we all know that when a vehicle is in motion, there will be vibrations and shocks and these are arrested by the damper known as the shock absorber. Suspension system of the automobile is the one which separates the wheel or the axle assembly from the body. The primary function of the suspension system is to isolate the vehicle structure from shocks and vibrations which happens due to the irregularities of the road surface. The general functions of the suspension system is to prevent the shocks being transmitted to the frame, preventing the stability of the vehicle in pitching or rolling and to provide comfort to the occupants from road shocks.

DESCRIPTION OF THE MODEL

Suspension is a term which is a combination spring, dampers or shock absorbers, linkages, fluid which connects wheel and the frame of the vehicle [3]. Spring is a normal term which will make us remember about elasticity, the one which comes back to its original position after compression or expansion. There will be two springs connected to the damper on is either side. The one which is present below will absorb all the vibrations and doesn't transmit any vibrations to the frame; this will isolate the vibrations in the region below. The above spring remains undisturbed unless there is an excited vibration due to bigger holes on the surface of the road. Damper is also known as shock absorber which consists of, cylinder, reservoir, the valve and the fluid. Reservoir is the place which is filled with the fluid and this is made with normal piston compression method. Whenever there is a vibration, the cylinder compresses the fluid and restricts the movement in the damper. This isolates the vibrations and gives comfort for the occupant in the vehicle. There will be two pistons present inside the damper which faces each other in the opposite direction and comprises the fluid together and reduces the

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

vibration. Two springs are separated by a platform and where the springs don't meet each other even at excited vibrations.

SUSPENSION

Before we enter in to the content of the paper, we should have the basic idea on spring and shock absorbers. Normally a suspension is comprised of springs, dampers or shock absorbers, fluids and the struts [3]. The performance of a vehicle's suspension is rated by its ability to provide improved road handling and improved comfort for the passenger. Current automobile suspension systems using passive components which can only offer compromise with the fixed rates between spring and damping coefficients [2]

SPRING

There are different types of springs based on the type of the vehicle. We normally use coil springs (also known as helical spring) for a passenger type automobiles and leaf spring for heavy vehicles. Coil springs are a torsion spring which can release energy later. When a spring is compressed or expanded, the force exerted by its force is proportional to the change in its length. Spring rate is the ratio of the force exerted to the change in deflection.

DAMPER OR SHOCK ABSORBER

Shock absorber is the one which supports the spring and reduces the vibration during motion. This works hydraulically and uses fluid inside which is stored in by means of a reservoir. When the suspension is compressed, the fluid present inside the damper will compress to a certain limit and stops at its limit. This will isolate the vibrations. Pistons are present inside to compress the fluid which moves out from the reservoir to the dampers.

MODELLING OF A DOUBLE SPRING SUSPENSION

This model is designed in CATIA V5 software and analyzed using ANSYS software.

Figures:

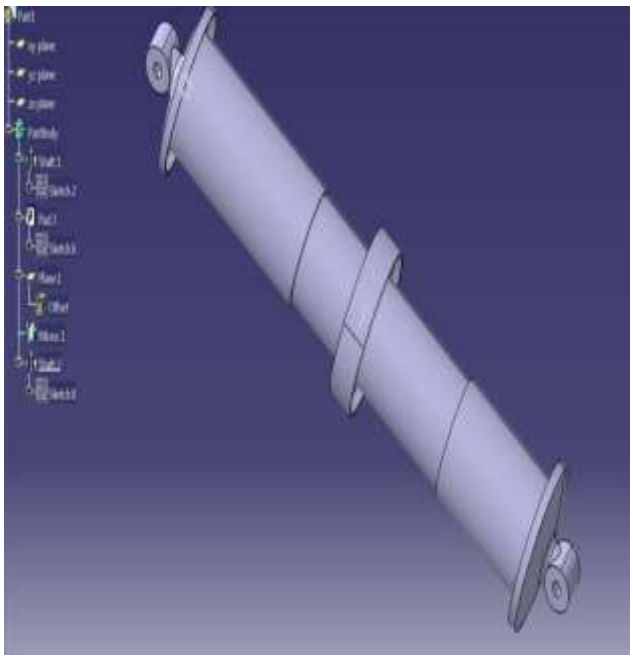

Fig.1 New model of Damper or shock absorber.

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

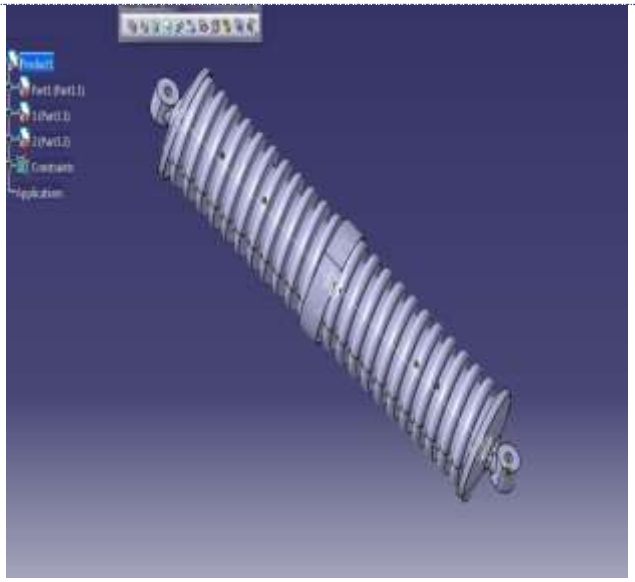

Fig.2 A complete suspension system

DESIGN ANALYSIS

Figure:

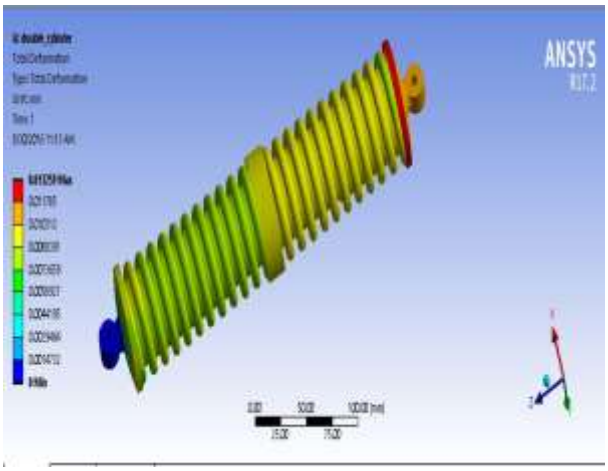

Fig.3 Total deformation of the double spring suspension system

Table- 1 Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]
1.	0.	1.3259e-002

One end of the suspension is fixed where on the other side is excited by the force of about 1500 N and thus it makes the springs to compress where there will be a maximum deformation of about 1.3259^{-002}during a certain time interval.
The material used for the spring and the shock absorber is structural steel, their ultimate strength, yield strength are tabulated below

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

Table- 2 Compressive Yield Strength

Compressive Yield Strength MPa
250

Table- 3 Tensile Yield Strength

Tensile Yield Strength MPa
250

Table- 4 Tensile Ultimate Strength

Tensile Ultimate Strength MPa
460

Table- 5 Isotropic Secant Coefficient Of Thermal Expansion

Zero-Thermal-Strain Reference Temperature C
22

The maximum equivalent stress and the equivalent strain is also analyzed by means of the software and the figure below shows the variations during different time intervals.

Table-6 Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]
1.	4.3108e-004	45.51

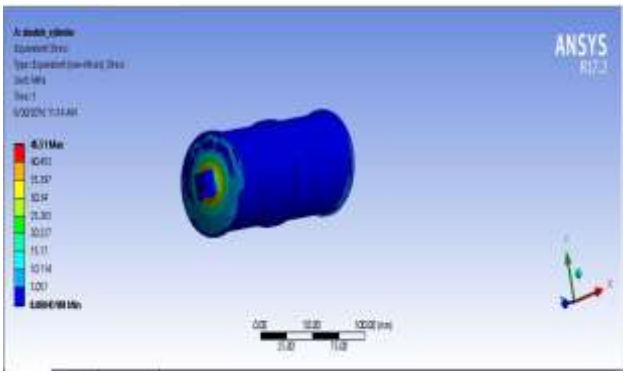

Fig.4 Analysis of equivalent (von misses) stress on the fixed end.

Table- 7 Equivalent Elastic Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]
1.	4.6028e-009	2.3114e-004

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

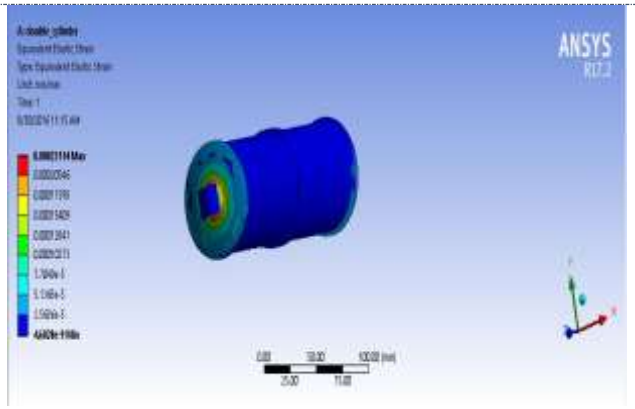

Fig.5 Analysis of equivalent strain on the fixed end.

Table -8Structural Constants

Density	7.85e-006 kg mm^-3
Coefficient of Thermal Expansion	1.2e-005 C^-1
Specific Heat	4.34e+005 mJ kg^-1 C^-1
Thermal Conductivity	6.05e-002 W mm^-1 C^-1
Resistivity	1.7e-004 ohm mm

Table 9 Results

Results			
Minimum	0. mm	4.6028e-009 mm/mm	4.3108e-004 MPa
Maximum	1.3259e-002 mm	2.3114e-004 mm/mm	45.51 MPa

Table 10 Specifications

Dimensions	Spring 1	Spring 2	Damper
Diameter (mm)	8	8	46
Length (mm)	220	138	313
Pitch	12	12	-

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

Figures:

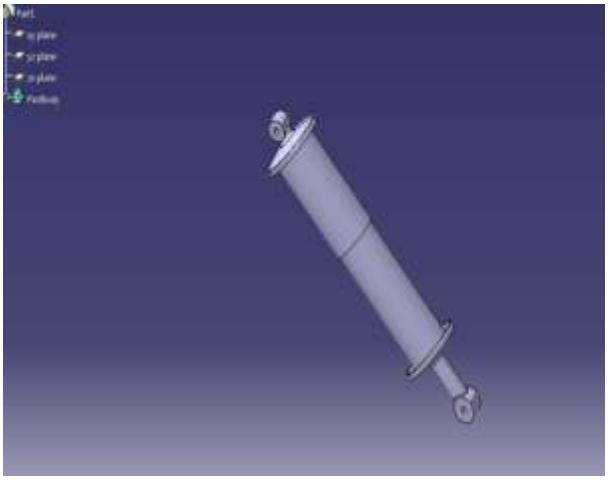

Fig.6 Damper Of Single Spring Suspension

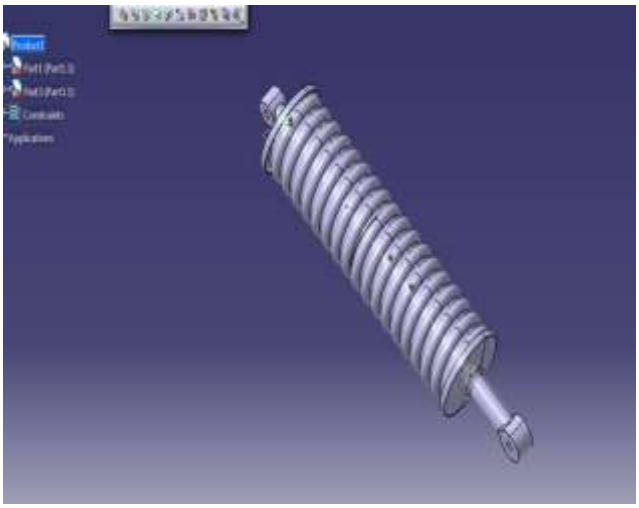

Fig.7 Single Spring Suspension System

DESIGN ANALYSIS

Table 11 Total Deformation

Time [s]	Minimum [mm]	Maximum [mm]
1.	0.	1.2398e-002

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

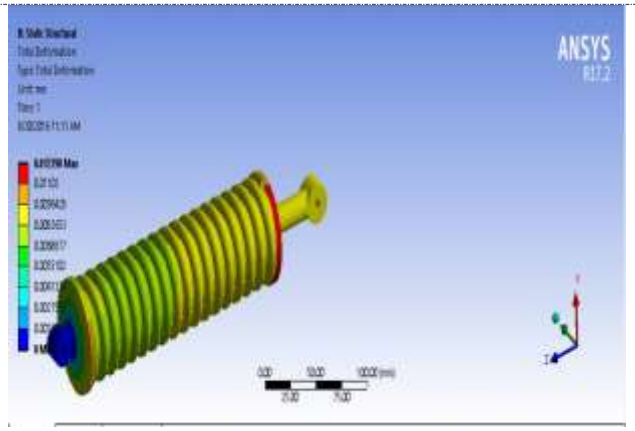

Fig.8 Showing Total Deformation Of Single Spring Suspension

Table 12 Equivalent Strain

Time [s]	Minimum [mm/mm]	Maximum [mm/mm]
1.	3.743e-008	2.246e-004

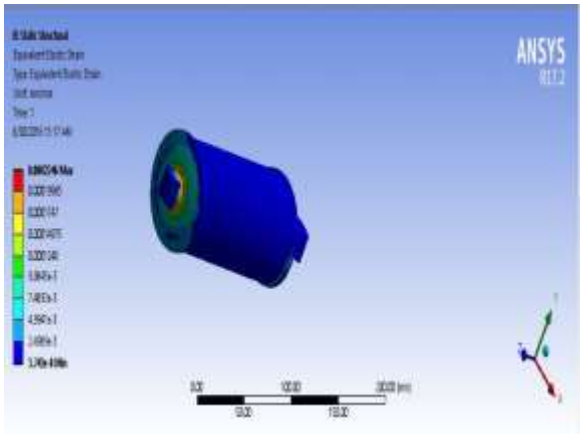

Fig.9 Showing Equivalent Strain On Single Spring Suspension.

Table 13 Equivalent Stress

Time [s]	Minimum [MPa]	Maximum [MPa]
1.	2.284e-003	43.367

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

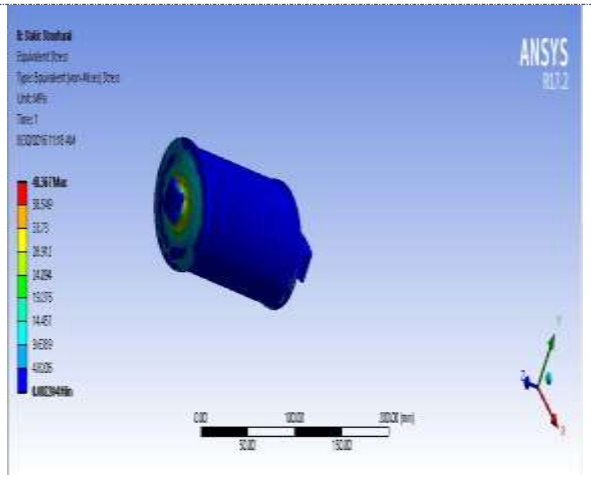

Fig.10 Showing The Equivalent (Von Misses) Stress On The Single Spring Suspension.

Table 14 Structural Steel Constants

Density	7.85e-006 kg mm^-3
Coefficient of Thermal Expansion	1.2e-005 C^-1
Specific Heat	4.34e+005 mJ kg^-1 C^-1
Thermal Conductivity	6.05e-002 W mm^-1 C^-1
Resistivity	1.7e-004 ohm mm

Table 15 Results

Results			
Minimum	0. mm	3.743e-008 mm/mm	2.284e-003 MPa
Maximum	1.2398e-002 mm	2.246e-004 mm/mm	43.367 MPa

Table 16 Specifications

Dimensions	Spring	Damper
Diameter (mm)	8	46
Length (mm)	220	280
Pitch	12	-

RESULTS AND DISCUSSIONS

Hence after the comparison between the single spring suspension and double spring suspension, we came to know that the double spring suspension system can withstand stresses more than single spring suspension system. Forces which exerted on both suspension systems is equal but the stress and strain we obtained is different. The dimensions which we given for both the suspension system is similar, where the force exerted on

the bottom side of both the suspension is 1500N and the stresses which we get is entirely different on the top of both suspension system. Hence the double spring suspension system can withstand heavy stresses; it can be used in heavy vehicles and even in sedans if it is made into a compact size.

CONCLUSION

The double spring mass damper suspension system is mainly created for the heavy vehicles with assumed values. To make it more efficient, the material selected for the fabrication of spring and damper should be different and it should be analyzed before manufacturing.

REFERENCE

[1] Ayman A. Aly, and Farhan A. Salem "Vehicle Suspension Systems Control: A Review" International Journal of control, automation and systems vol.2 no.2 July 2013.
[2] Ayman A. Aly "Car Suspension Control Systems: Basic Principles" International Journal of control, automation and systems vol.1, no.1, January 2012.
[3] Mr. Amit A.Hingane , Prof. S. H. Sawant , Prof.S.P.Chavan ,Prof. A.P.Shah "Analysis of Semi active Suspension System with Bingham Model Subjected to Random Road Excitation Using MATLAB/Simulink" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) ISSN: 2278-1684, PP: 01-06
[4] A.Bala Raju1 and R. Venkatachalam "Analysis of Vibrations of Automobile Suspension System Using Full-car Model" International Journal of Scientific & Engineering Research, Volume 4, Issue 9, September-2013 ISSN 2229-5518.