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DYNAMIC ANALYSIS OF LEADING ARM SUSPENSIONS SYSTEM WITH HORIZONTAL SPRING DAMPER ASSEMBLY

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Abstract: The suspension systems have been a economical choice for the vehicle designers. The suspension system have changed the scenario of the comfort of the vehicle ride and safety and road handling of the vehicle.

The horizontal orientation of the shock absorbers helps the designers to accommodate other parts and have a greater stability due to lower centre of gravity of the vehicle.

The leading arm has been previously checked for the static characteristics of the vehicle and the analysis of the suspension system, in this we have been considering the dynamic analysis of the suspension system and the consideration of the system in ADAMS and the failure and running conditions and the load and the transfer of forces have been considered to allow the suspension system to simulate and get the results of the working of the leading arm.

Keywords: Leading arm, horizontal spring damper assembly, ADAMS, deflection, loading conditions and equilibrium.

I. INTRODUCTION

ADAMS is multi-body dynamic simulation software. For doing analysis in ADAMS first 3-D modeling is done in Pro-e and importing the model to ADAMS. The suspension system analysis is done with the help of Automatic Dynamic Analysis of Mechanical Systems (ADAMS). For analysis we have imported Part from Pro-e and that are assembled using appropriate joints.

The dynamic analysis is carried out on the software MSC. ADAMS.

1.1 MSC.ADAMS as multi-body simulation software:

ADAMS is a sort form of **A**utomatic **D**ynamic **A**nalysis of **M**echanical **S**ystem. In automotive industry, predicting of durability performance at the early stage of design through simulation is very important. The reason is that it strongly affects on increasing reliability and reduction of weight, costs and time.

1.2. Procedure of analysis in adams:

The figure shows the step by step procedure for analysis in ADAMS.

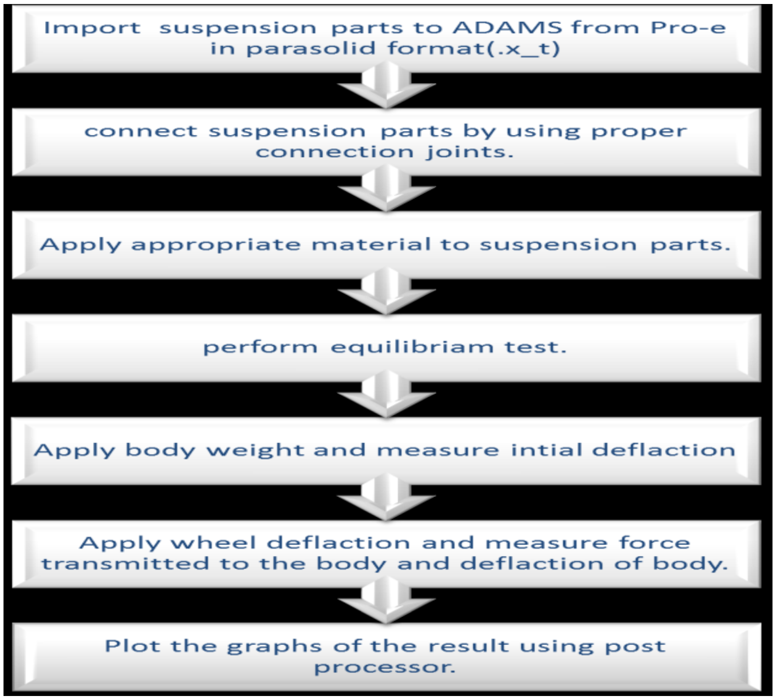

Figure 1.2 Procedure of analysis in ADAMS

II. DYNAMIC ANALYSIS

2.1 Model loading conditions:

Table 1 Values of deflection and road equivalents

Deflection (in mm)	Description
50	rambling strip, (small continuous bumps), height diff. while transferring from one to another road surface
100	Normal bumps
150	Heighted bumps (speed breaker)

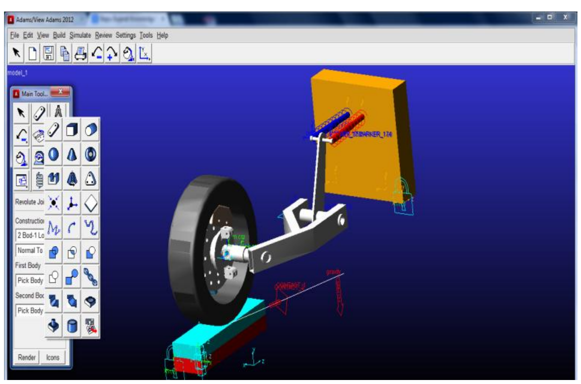

Figure2.1 Initial loading and deflection

The above values of the deflection are considered as the bump height for the vehicle and the results have been carried out. The bump height has been considered a variable and the same are varied and the processing is done.

2.2 Results of 50mm deflection:

The deflection of 50mm shows the following results encountered by a suspension of the vehicle during the vehicle motion. The graph here depicts the force exerted by a bump which causes 50 mm deflection of the wheel. This leads to the leading arm and the leading arm experiences deformation in the spring and this is shown on a graph. The graph here shows the deflection of the wheel under bump force which is encountered by a suspension of the vehicle during the vehicle motion. The graph here depicts the force exerted by a bump which causes 50 mm deflection of the wheel. The deformation of the spring under the force exerted by the deflection is shown in this graph above. The graph is plotted for force and deformation against a time scale

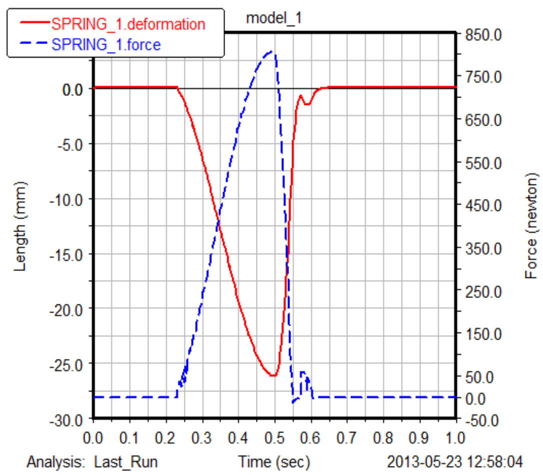

Figure 2.2 Deformation and force v/s time graph for 50mm deflection

The time is in seconds and the force is in Newton and the deformation is in mm. The deflection of the spring under the load of 800 N is 27 mm and this shows the deformation in the color red and the force is shown in color blue. The analysis here is carried out for the individual spring.

Force and deformation of spring:

The graph here shows the deflection of the wheel under bump force which is encountered by a suspension of the vehicle during the vehicle motion. The graph here depicts the force exerted by a bump which causes 50 mm deflection of the wheel. The force exerted lasts for about the time of 0.4 seconds and the force exerted is 800 N and the deformation in this spring is also equal to 27 mm. The deformation is in mm.

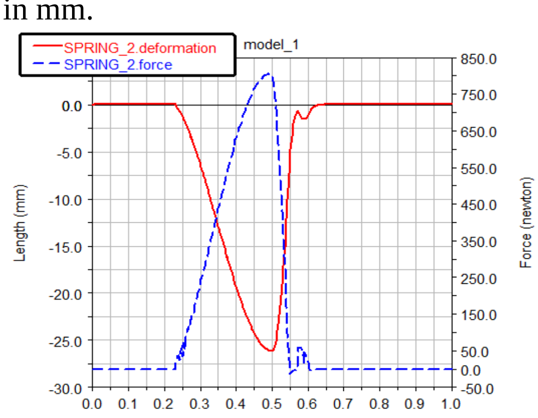

Figure 2.3 Deformation and force for spring 2 v/s time graph

2.3 Results of 100mm deflection:

Force on spring for 100 mm deflection:

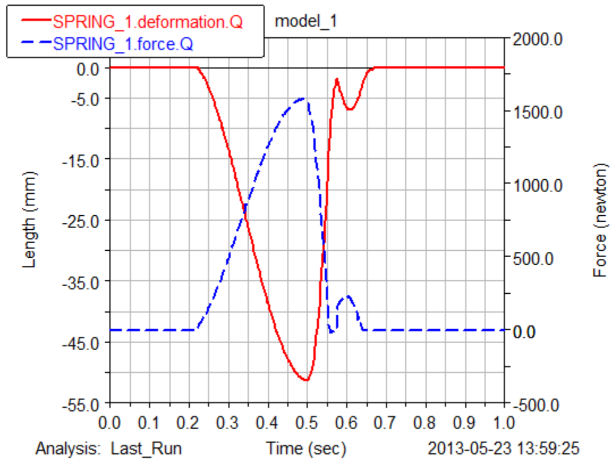

Figure 2.4 Spring and deformation and force v/s time graph for 100 mm deflection.

The graph here shows the deflection of the wheel under bump force which is encountered by a suspension of the vehicle during the vehicle motion. The graph here depicts the force exerted by a bump which causes 50 mm deflection of the wheel. The deformation of the spring under the force exerted by the deflection is shown in this graph above. The graph is plotted for force and deformation against a time scale. The time is in seconds and the force is in Newton and the deformation is in mm. The force of 1650 N is shown on the time scale and the force of rebound is 1500 N and this occurs after 0.35 sec and lasts for 0.2 seconds the time scale shows that the deformation caused is maximum at 0.3 sec after the start of the deflection. The deformation is 52 mm and is very much higher to the 50 mm deflection. The deflection of 100 mm takes 0.12 sec to rebound and the force is of 1500 N.

Force and deformation of the suspension:

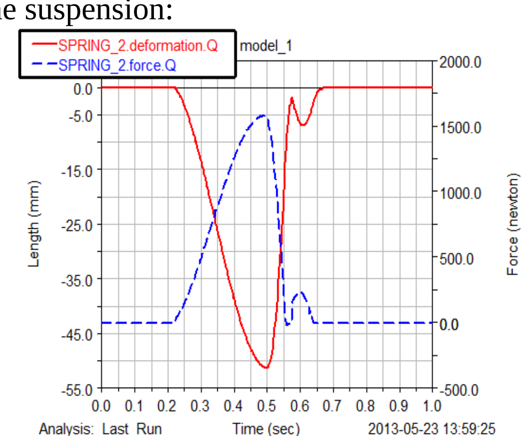

Figure 1 Spring force and deformation v/s time graph for 10mm deflection

The graph here shows the deflection of the wheel under bump force which is encountered by a suspension of the vehicle during the vehicle motion. The graph here depicts the force exerted by a bump which causes 50 mm deflection of the wheel. The deformation of the spring under the force exerted by the deflection is shown in this graph above. The graph is plotted for force and deformation against a time scale. The time is in seconds and the force is in Newton and the deformation is in mm. The force of 1650 N is shown on the time scale and the force of rebound is 1500 N and this occurs after 0.35 sec and lasts for 0.2 seconds the time scale shows that the deformation caused is maximum at 0.3 sec after the start of the deflection. The deformation is 52 mm and is very much higher to the 50 mm deflection. The deflection of 100 mm takes 0.12 sec to steady itself.

2.4 Results of 150mm deflection::

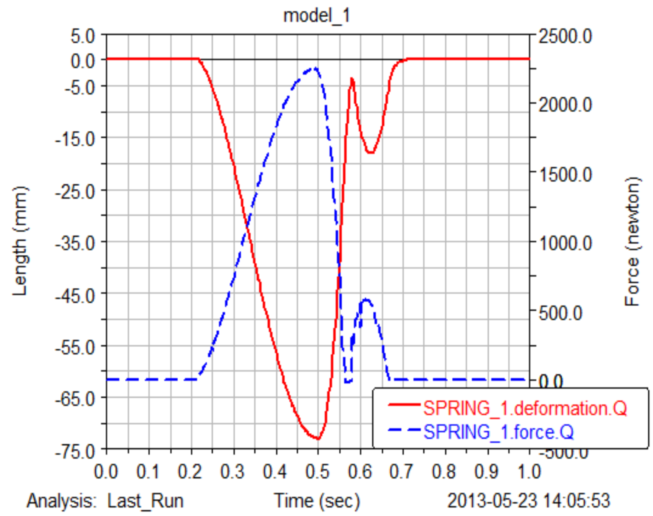

Figure 2.6 Spring deformation and force on time graph for 150 mm deflection

The graph here shows the deflection of the wheel under bump force which is encountered by a suspension of the vehicle during the vehicle motion. The graph here depicts the force exerted by a bump which causes 50 mm deflection of the wheel. The deformation of the spring under the force exerted by the deflection is shown in this graph above. The graph is plotted for force and deformation against a time scale. The time is in seconds and the force is in Newton and the deformation is in mm. The force and deformation lasts up to 0.6 sec on the suspension. The force exerted is 2300 N and the deformation is 74 mm. The force shown by blue color and the red color depicts deformation on the time scale graph.

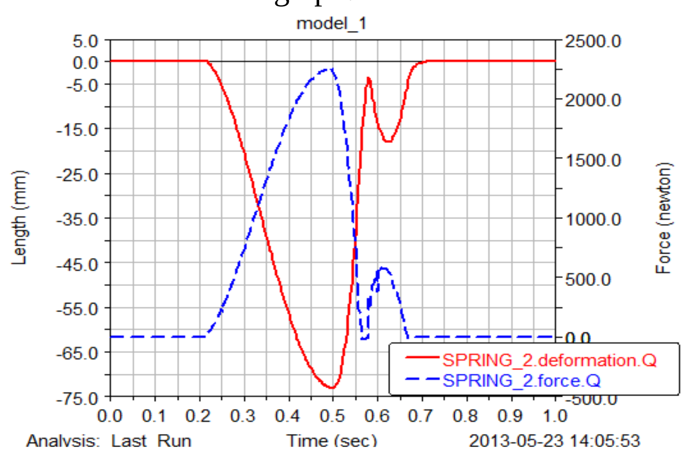

Figure 2.7 Spring deformation and force on time graph for 150 mm deflection

The deformation of the spring under the force exerted by the deflection is shown in this graph above. The graph is plotted for force and deformation against a time scale. The time is in seconds and the force is in Newton and the deformation is in mm. The graph here shows the deflection of the wheel under bump force which is encountered by a suspension of the vehicle during the vehicle motion. The graph here depicts the force exerted by a bump which causes 150 mm deflection of the wheel. The deformation of the spring under the force exerted by the deflection.

The graph is plotted for force and deformation against a time scale. The time is in seconds and the force is in Newton and the deformation is in mm. The force and deformation lasts up to 0.6 sec on the suspension. The force exerted is 2300 N and the deformation is 74 mm. The force shown by blue color and the red color depicts deformation on the time scale graph.

CONCLUSION

ADAMS as a analysis software has analyzed the leading arm and the leading arm works well with the horizontal spring damper system. The analysis of the leading arm we conclude that the leading arm is well designed and fabricated to decrease the overall weight. The analysis shows that the leading arm can work with well in the deflections up to 150mm and the leading arm suspension system works well with the vehicle. The deflection of steps of 50mm, 100mm, and 150mm was given to the wheel which in turn had reactions on the suspension system and the deflection of 27mm, 52 mm and 74 mm was experienced by the spring and damper assembly. The spring and damper assembly is good enough for up to 150 mm deflections of the wheel. The force of 800 N, 1650 N, and 2250 N was exerted by the deflection of 50mm, 100mm, and 150mm respectively. The spring and damper assembly and the leading arm work properly.

The future scope of the system is that the system can be put to further experimental work on test lab and the actual working conditions can be tested on test track. The full car model can be prepared on software and dynamic analysis can be carried out on the model for cornering and other aspects of the vehicle running conditions such as the race track and the harsh road undulations.

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