© 2017 IJSRST | Volume 3 | Issue 3 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science and Technology

Suspension System in Electric Solar Vehicle

Mohammed Anwar, Mohd Yousuf Ahmed, Mohammed Riyaaz, Md Shoaib Siddiqui, Mohammed Ahmed
Department of Mechanical Engineering, Lords Institute of Engineering & Technology, Hyderabad, India

ABSTRACT

If the suspension is too soft, energy is wasted by absorbing the motion of a car as it travels over bumps. For increased efficiency, most solar cars use a suspension that is stiffer than normal. For this project, the solar car has two front wheels and one rear wheel. The front wheels provide turning, so the front suspension needs to let the wheels turn. The suspension also allows the wheels to move up and down as the car runs over bumps. The type of front suspension for this project is a double wishbone system. It has a pair of an A-frames, one above the other, mounted to the top and bottom of the wheel hub. In order to improve handling and comfort performance, horizontal suspension system in front and vertical suspension system are being developed in our solar car. A suspension system has been proposed to improve the ride comfort. Horizontal suspension system is designed and constructed on the basis of the concept of a four-wheel independent suspension to simulate the actions of an active vehicle suspension system. The purpose of a suspension system is to support the vehicle body and increase ride comfort. The aim of the work described in this paper is to illustrate the application of intelligent technique to the control of a continuously damping automotive suspension system. The ride comfort is improved by means of the reduction of the body acceleration caused by the car body when road disturbances from smooth road and real road roughness.
Keywords: Spring Damper, Shock Absorber, Monocross Suspension

I. INTRODUCTION

What is suspension system?

1. **Suspension** is the term given to the system of springs, shock absorbers and linkages that connects a vehicle to its wheels
2. Serve a dual purpose – contributing to the car's handling and braking.
3. Protects the vehicle itself and any cargo or luggage from damage and wear.

Suspension is the term given to the systems of springs, shock absorbers and linkages that connect a vehicle to its wheels and allows relative motion between the two. Suspension systems serve dual purpose, contributing to the vehicle’s road holding/handling and braking for good active safety and driving pleasure, and keeping vehicle occupants comfortable and reasonably well isolated from road noise, bumps and vibrations. It is important for the suspension to keep road wheel and the road surface into contact as much as possible. The main objective of a suspension system to provide comfortable riding and reduce stresses and strains on the various components. Enhance the life of the vehicle’s components and maintain the stability in the moving vehicle by absorbing road shocks. It also damps down the amplitude of vibratory oscillations caused due to the road undulations. The suspension springs mounted between the vehicle’s body and the road wheels serve to store the strain energy by deflecting themselves when the wheels come across any bump on the road. As soon as the wheels go off the bump, the springs rebound back owing to their inherent elastic action. By doing so, the strain energy is released, and the spring starts vibrating. The amplitude of such vibrations decrease gradually due to internal friction in the spring material and in various joints. A system needs to be incorporated for sufficient and quick damping of the spring’s vibrations. This is provided by a device called damper. The device called leading arm holds the wheel on one side and on the other has a horizontal spring damper assembly which helps the suspension system and the whole suspension system is based on the leading arm transmitting forces from the vehicles bump and steers and the overall weight of the vehicle and rigidly support the vehicle.

II. METHODS AND MATERIAL

1. Types of Suspension

A. Non-independent suspension:

Many rear wheel drive cars have non-independent suspension, usually at the rear. A solid axle connects the wheels on each side. When one wheel is deflected by a bump the other wheel is deflected because of the solid connection between them. This can cause stability and traction problems. Non-independent suspensions are most commonly used in four wheel drive vehicles and trucks as they can carry heavy loads and are very rugged.

B. Independent suspension

The independent suspension offers a more comfortable ride and better handling characteristics simply because each wheel reacts separately from the others. When the wheel on one side hits a bump there is no reaction from any other wheel. Suspensions should be checked in accordance with the manufacturer's recommendations. There are a number of parts that are susceptible to wear particularly spring and suspension arm bushes.

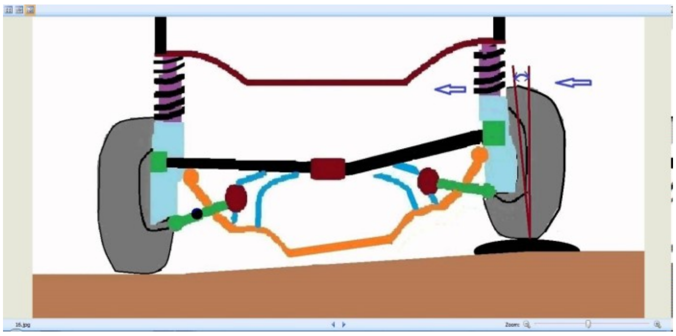

Figure 1. Suspension System

2. Advantage and Disadvantage of Suspension System:

ADVANTAGES:

- ✓ Bigger deflection of front wheels, no reaction on steering
- ✓ Greater distance for resisting rolling action
- ✓ Front axle (small-stub), improves road holding tendency of tyres.
- ✓ Minimum vibrations

DISADVANTAGES:

- ✓ Better shock absorber required.
- ✓ Expensive
- ✓ Tyre wear increases due to transmission of torque.

3. Selection of Suspension

Double Wishbone Suspension:

Type of double-A or double wishbone suspension. Wheel spindles are supported by an upper and lower 'A' shaped arm.The lower arm carries most of the load. If you look head-on at this type of system, parallelogram system that allows the spindles to travel vertically up and down.

This side-to-side motion is known as scrub.

4. Roll Centre

- ✓ Roll centre is defined as a location at which lateral forces developed by the wheels are transferred to the sprung mass.
- ✓ Each suspension has a roll centre.
- ✓ Lateral forces can be applied to the sprung mass at the roll centre without causing suspension roll.
- ✓ Each suspension has a roll axis about which un-sprung mass rolls when a pure moment is applied.
- ✓ Vehicle roll axis is the line joining the roll centres of the front and rear suspensions.

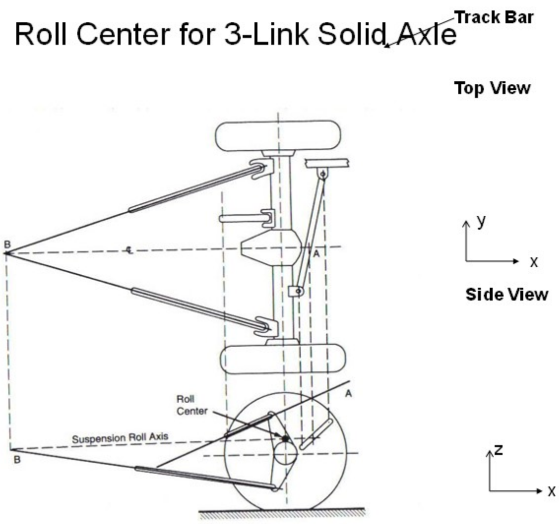

Figure 2. Roll Centre

III. RESULTS AND DISCUSSION

1. Arm Design

A model of the arm was developed first by the calculation of the weight of the vehicle under consideration and the requirements of the suspension systems and the space and geometric considerations and the design considerations for the vehicle. This model was considered and then model design was done in design software PRO-e. The model was constructed to help in the analysis of the arm in consideration.

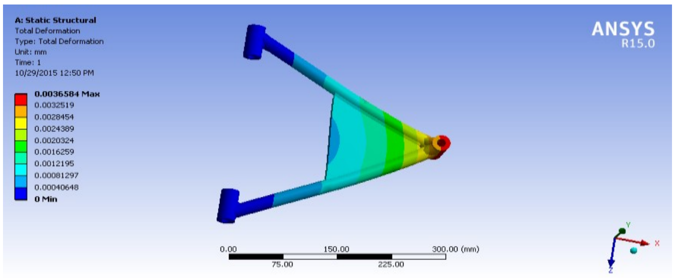

Figure 3. Front Wishbone/Arm

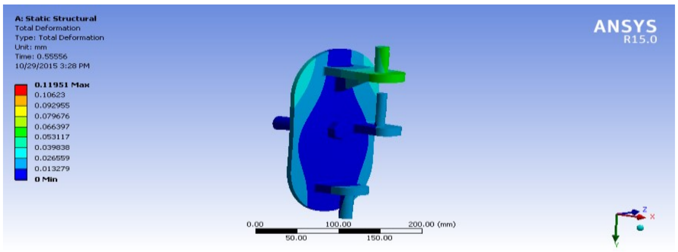

Figure 4. Front Knuckle

2. Analysis of Wishbone /Arm

An analysis of the leading arm was carried out with the help of a software ANSYS version 12. The model depicted certain characteristics under the analysis. The stress analysis and the failure analysis was carried out. The analysis of the arm with the forces acting upon the leading arm on the axis that acts on the direction of the wheel travel that is in the direction of the wheel travel. The model was analysed under different loading conditions and the leading arm tested in ANSYS for deformation and loading stresses in the different forces and direction of forces.

3. Design Calculation

Deceleration :=(V2-u2)/2X5=-48.16
V= 50 kmph = 31.06m/s
Turning Radius = 10.6inch.
Dynamic Weight Transfer =
(HXweightXDeceleration)/ (lX9.81)
= (0.1701 X 1078 X 48.16)/ (1.702X9.81) = 528.59N

Assuming worst case (Braking during cornering)
Total weight on each front wheel
= (0.4X1078)/2
=215.6 N
Due to the leverage, effect of the suspension system;
Force acting on each front spring is
=215.6N
Required Travel = 4 inches =101.06mm
Force on each wheel = 313.26 N
Deflection of spring due to sprung mass:
Static deflection = Static force
Spring Rate
= (313.26/7.357) = 42.54 mm
= 1.67 inch
Remaining spring travel = 2.32 inches =
Remaining wheel travel = 3.32 inches
Jounce = 3.36 inches
Rebound = 1.70 inches
For the rear;
Static weight on rear wheel =65.95kg
= 646.8 N
Assume the dynamic force to be
= 2 X static weight
= 2X646.8N
1293.6N
Target wheel travel = 5 inches
Spring deflection = 4 inches
Required spring rate= 1881.6
101.6
= 18.51 N/mm
Checking for the natural frequency,
wn = 1/2 √(ke/m)
Where ke= equivalent stiffness
= kskt
Ks+kt
Ks = Spring Stiffness = 7.357 N/mm
Kt = tire stiffness = approx... 200 N/mm
Taking motion ratio into consideration,
The frequency obtained = 1.68 Hz

Similarly the rear normal frequency
= 2.3 Hz

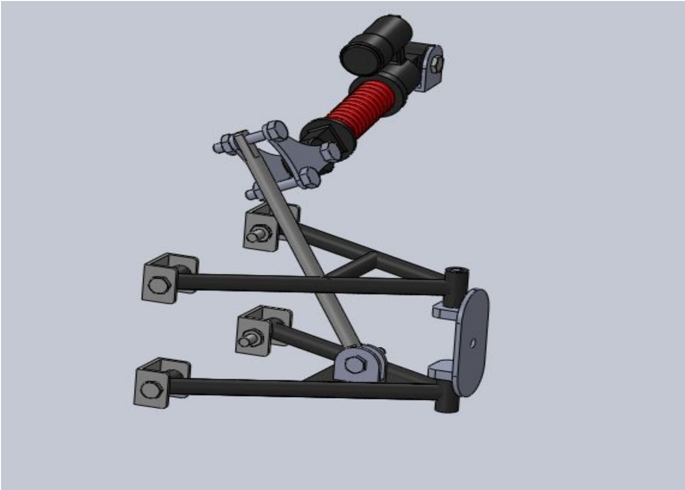

Figure 5. Final Cad Model of Suspension System

IV. CONCLUSION

The arm was modelled under the software and an analysis carried out with the ANSYS software and the leading arm shows proper working under different loading conditions. The axial load and the load in the direction of the bump travel was considered and the leading arm shows proper structure design with the results shown. The partially transmitted stress is redirected to the frame to reduce the impact to the user or rider by using a triangular link in between the wheel and suspension of the vehicle. When people think of automobile performance, they normally think of horsepower, torque and zero-to-60 acceleration. But all of the power generated by a piston engines useless if the driver can't control the vehicle. That's why automobile engineers turned their attention to the suspension system almost as soon as they had mastered the four-stroke internal combustion engine. The job of a suspension is to maximize the friction between the tire sand the road surface, to provide steering stability with good handling and to ensure the comfort of the passengers. According to Newton’s laws of motion, all forces have both magnitude and direction. A bump in the road causes the wheel to move up and down perpendicular to the road surface. The magnitude, of course, depends on whether the wheel is striking a giant bump or a tiny speck. Either way, the car wheel experiences a vertical acceleration as it passes over an imperfection. Without an intervening structure, all of wheel's vertical energy is transferred to the frame, which moves in the horizontal direction. In such a situation, the wheels can lose contact with the road completely.

V. ACKNOWLEDGEMENT

It gives us immense pleasure to present our research paper “Testing by Radiography on Welded Mild Steel (NDT Method)”. We are very thankful to the honourable Mechanical Department HOD Dr. Syed Azam Pasha Quadri and Asst. Professor Mohammed Anwar, LORDS Institute of Engineering and Technology.

VI. REFERENCES

[2] G.Ranjith Kumar & Dr.G.HarinathGowd,"Design Evaluation & Optimization of a Two-Wheeler Suspension System" International Journal of Emerging Technology and Advanced Engineering (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 4, Issue 8, August 2014)

[3] Lakshmana Kishore “Design and analysis of shock absorber" JRET: International Journal of Research in Engineering and Technology ISSN: 2319-1163

[4] Prince Jerome Christopher J &Pavendhan R, "Design and Analysis of Two Wheeler Shock Absorber Coil Spring" International Conference on Advances in Engineering and Management (ICAEM)

[5] P.R.Jadhav& N.P Dashi, “Analysis of Helical Spring in Mono suspension System Used in Motorcycle" International Journal of Research in Advent Technology, Vol.2, No.10, October 2014 EISSN: 2321-9637

[6] Prof. D. R. Cavan, "Suspension in Bikes Considering Preload, Damping Parameters and Employment of Mono Suspension in Recent Bikes "International Journal of Engineering Trends and Technology- Volume4Issue2- 2013

[7] P. S. Valsange, “Design Of Helical Coil Compression Spring" International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 vol. 2, Issue 6, November-December 2012, pp.513-522