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Design and Analysis of Ejection in Sub Wheel Assembly

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Traveling in remote areas at nights is very risky and tire getting puncture at that time is dangerous. To avoid any of this complications a sub wheel system is installed in the vehicle. Sub wheels helps to go to required destination and change the puncture wheel. The tires used in this system are mold tires so they don't get affected by the road conditions. The sub wheel is operated by means of a hydraulic system. Power for this sub wheel is provided from the engine placed in the back of the vehicle. This is system is very useful heavy weight vehicle which travel in difficult terrain (army vehicles).The height of the car is increased so that Sub wheels won't affect the chassis or the engine. This type of system is used in le24race but they only use hydraulic system to lift the car. The advantage of this system is its user friendly and effective to use. By pressing a button required sub wheel comes down and start to function. By using CATIA a diagram of this system is drawn to check it's various forces acting on it.

Keywords: four wheeler car, sub-wheel assembly, force analysis, design of wheel.

1. Introduction

In this 21^{st} century new products are invented every minute. There great leap in automobile industry in every aspect. But the materials used in tires for automobile can get damage. This is becoming one of the security reasons while travelling at night and remote areas. For this purpose our project "Design and Analysis of Ejection in Sub Wheel Assembly". This will be very useful for female while driving alone. by pressing a button sub wheel assembly gets down and works by the power of the engine.

1.1. *Mould tires*

Mould tires are tires that are not supported by air pressure. The tires are made of Elastomer. The size of front wheel is smaller than rear wheel. Rear wheel is larger because the entire load will be acting on the rear of the vehicle. The load is due to Gearless engine placed in the back of the car. These tires are used because the road conditions don't affect them. Front wheel diameter - 4.5 inches. Front wheel thickness - 2 inches. Rear wheel diameter - 6.5 inches. Rear wheel thickness - 2 inches.

1.2. *Gearless engine*

Engine used for operating of rear sub wheel is Air cooled, 4 - stroke, SI engine. The engine uses automatic transmission. Displacement - 125 CC. Maximum power - 8.6 BHP. Maximum torque - 10.12 MN. Stroke - 57.9 mm. Bore - 52.41 mm.

1.3. *Mild steel rod*

Mild steel (steel containing a small percentage of carbon, strong and tough but not readily tempered), also known as plain-carbon steel, is now the most common form of steel because its price is relatively low while it provides material properties that are acceptable for many applications. Low-carbon steel contains approximately 0.05–0.25% carbon. Making it malleable and ductile. Mild steel has a relatively low tensile strength, but it is cheap and easy to form; surface hardness can be increased through carburizing. Mild steel diameter - 25 mm, Front rod length - 11 inches, Rear rod length - 28 inches.

1.4. *Shock absorber*

A shock absorber it is a hydraulic device designed to absorb and damp shock impulses. It does this by converting the kinetic energy of the shock into another form of energy (typically heat) which is then dissipated. Most shock absorbers are a form of dashpot. Shock Absorber Height - 16 inches. Spring Coil Height - 10.5 inches. Spring Coil thickness - 0.4 inch. Number of coils in each spring - 15.

1.5. *Gear sprocket*

A Gear sprocket made of mild steel is welded to rear wheel arrangement. Chain is used a connection between the engine and the wheel assembly to transmission of power. Sprocket is water resistant and can handle any shocks produced while traveling. Sprocket Diameter - 2.4 inches.

2. Construction of sub wheel assembly

2.1. *Rear wheel*

Figure 1 shows on mould tires are fixed to mild Steel rod. Disc brakes are fixed on either sides of the rear wheel assembly. A Gear sprocket is welded on the rear wheel assembly. An Electric motor is placed in the rear side of the car. This electric motor is used to control the position of the Rear wheel assembly. Suspension rods are placed to withstand to load of the vehicle.

Figure 1 Sub wheel assembly

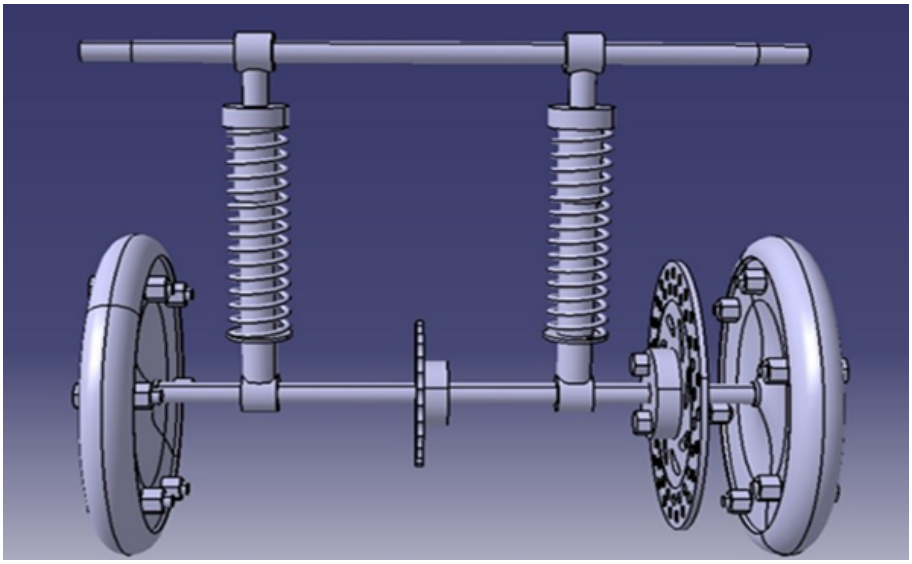

Figure 2 Model of sub wheel assembly

A Gearless Two wheeler engine is placed in the rare of the car. A steel frame is welded to the rear to support the engine. A chain is connected between engine and sprocket. A leaf support is placed between wheels and engine.

2.2. *Front wheel*

Front sub wheel assembly is fixed to the frame. The steering control is given to the front wheel. The mounded tires are fixed to the steel rod. The steel rod is fixed to the stub. And the other end of the stub is connected to the steering rod.

3. Working principle

Gearless engine is placed in the back of the car. A steel frame is welded at the rear to support the engine. The engine is used for motion of the rear sub wheel. The height of the car is increased so that sub wheels don't touch the engine or the driving shaft. The sizes of the front tires are smaller than the rear tires. The front sub wheel is moved by the power in the rear wheel. Steering control is alone given to the front wheel. An electric motor is fixed so that it is helpful for the ejection of sub wheels. Wheels used in this are moulded. Mould tires are used because they won't get punctured. The shock absorbers are provided to withstand the road conditions as shown in the Figure 2.

The design of sub wheel assembly is made by using CATIA V5 software, where the parts such as the wheel, mild steel rod, sprocket, disc, bolts, nuts, suspension rod, and spring are drawn separately. Then all the parts are assembled in a single plane by fixing the mild steel rod. Taking the required parts on the screen and fixing the faces of the parts that are to be fixed. This assembly design is made to analyse the system to withstand the required load. This assembly then can be exported to ansys software to analyse.

4. Calculation

- Weight of the material $W = 200$ Kg $= 1962$ N,
- Distance between two consecutive coils $= 15.5$ mm,
- Total number of coils, $n = 15$.
- Mean coil diameter, $D = 55$ mm,
- Diameter of wire, $d = 7$ mm,
- Modulus of rigidity, $C = 70.3 \times 10^3$ N/mm^2.
- Deflection = Distance between two consecutive coils × Number of coils:
  $d = 15.5 \times 15 = 232.5$ mm.
- Deflection $= \frac{8WD^3n}{Cd^4}$
  $d^4 = \frac{8\times1962\times55^3\times15}{232.5\times70.3\times10^3} = \frac{3.917\times10^{10}}{16344750} = 2396.488169$
  $d = 6.996 \approx 7$ mm

5. Results and analysis

5.1. *Force analysis with minimum load (200 kg)*

Analysis is made for the system to find out the load carrying capacity and the force withstand by the system. This force analysis gives out the load distribution over the system. This also shows the load acting point and the point where the maximum force is acted. In this method minimum load of 200 kg is given when there is no passengers in the rear seat. There is only a less deformation in the system when minimum load is applied. The red portion indicates the portion where load acting is maximum and the yellow region indicates the load is reduced the blue indicates that there is no load acted in that region as shown in Figure 3.

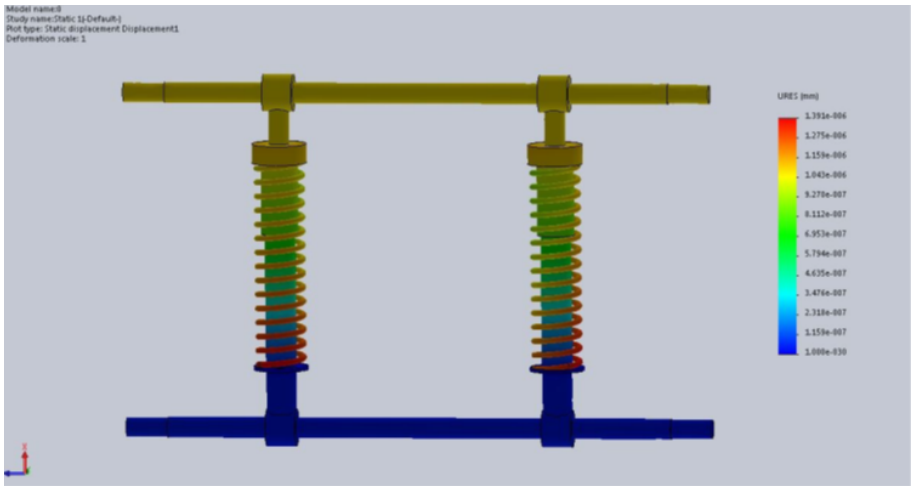

Figure 3 Force analysis with minimum load 200 Kg

5.2. *Force analysis with maximum load (400 kg)*

The analysis of the system is now made with the maximum load of 400 kg. This is by which three passengers of each 67 kg or a total of 200 kg is added. There is a great difference between two weights. In this the deformation of the coil is greater than the previous one. Major part of load acts on the suspension rod so that there is a less compression obtained in the system.

The load is placed on the top of the beam so that the real life load acting on the system is made possible. The red portion indicates the maximum load acting on the system and the yellow indicates the decrease in load that the red portion. Green indicates the load lesser that the yellow portion. Blue portion is the region free from the load. This analysis is made so that the design is safe to be used. as shown in Figure 4.

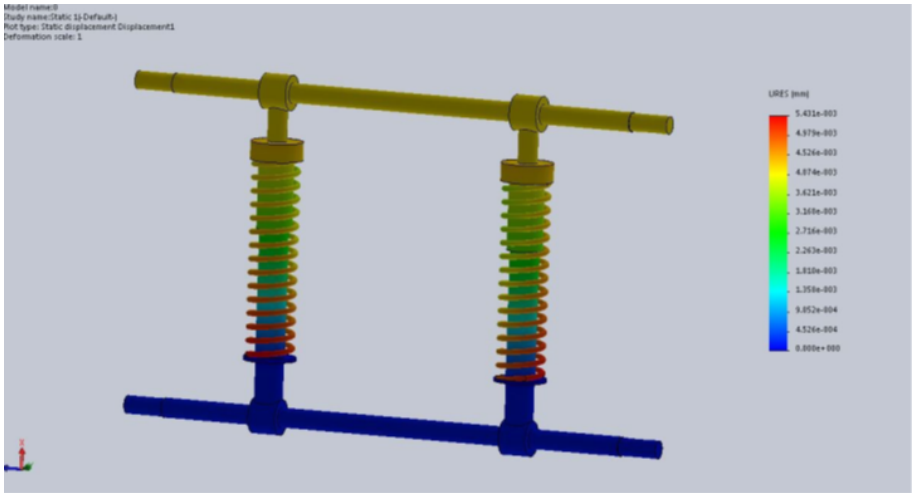

Figure 4 Force analysis with maximum load 400 Kg

6. Conclusion

Using the sub wheel assembly system the problem obtained during tire puncture is rectified. This system is very useful for women's and senior citizens travelling in remote areas during late hours. The secondary engine can also be used when the main engine gets failure or stops without fuel. This system can also be used in off road conditions. The mathematical calculation and the analysis prove that the design is safe after when a maximum load is applied on it. The maximum torque obtained from the secondary engine is transmitted to the vehicle so that a minimum speed of the vehicle is obtained. The ground clearance of the vehicle is increased using sub wheel assembly so that it can be used for any road conditions.

References

[1] **Stockel, M. W.**: Automotive mechanics fundamental, **1978**.

[2] **Zhao, J. S., Liu, X., Feng, Z. J.**: Design of Ackermann steering, **2013**.

[3] **Jayakumar, V.**: Design of Transmission System, *Lakshmi publication*, **2015**.

[4] **Samuel, K.**: Mechanics of pneumatic tires, *Clark*, **1981**.

[5] **Agrawal, M. S., Razik, M. D.**: Study of Analysis of Chassis, *IOSR Journal of Mechanical and Civil Engineering*, 6, 1, **2013**.

[6] **Genta, G., Morello, L.**: The Automotive Chassis, **2008**.

[7] **Gillespie, T.**: Vehicle dynamic, *Society of automotive engineers*, **1992**.