Design of Four Link Suspension System for Heavy Vehicle

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Abstract- *To avoid the transmission of road effects to the passengers while travelling in vehicles on uneven ground, it is, therefore, necessary that the wheels and the axels should be insulated from the frame. For this purpose, suspension systems are used. A good suspension should have springiness and damping. The occupants of motorvehicle would suffers everely as well as its structure would be subjected to excessive fatigue loading if the chassis is provided with direct transmission of the loads carried by rolling wheels of the vehicle. To safeguard the working parts of the motorvehicle against fracture or break down due to continued and severestresses on the engine and the transmission systems as well as body work the vehicle components or axels should be properly suspended. More over if the front and the rear wheel axels are allowed to runin bearings rigidly attached to the frame, extremely uncomfortable rides would be resulted. Springs are mounted on a rubber packing to reduce noise and add more softness. In order to provide a comfortable ride to the passengers and avoid additional stresses in motorcar frame, the car should neither bounceor roll or sway the passengers when cornering or pitch when accelerating. For this purpose the virtual proto type of suspension systems were built in software MSCADAMS/CAR and suspensions for truck were analyzed keeping in mind the optimization of suspension parameters.*

Keywords- Suspension system, four link configuration.

I. INTRODUCTION

Suspension system plays an important role for comfortable ride passengers besides protecting chassis & other ~~working~~ parts from getting damaged due to road shocks. If in a vehicle both front & rear axles are rigidly fixed to the frame. While vehicle is moving on the road, the wheels will be thrown up & down due to their regular ities of road, as such there will be much strain on the components as well as the journey for the passengers in the vehicle will also be very uncomfortable.

The frame as well body of vehicle is attached to there araxle & front axle by springs. These springs damped roads hocks transmitted to the body structure by the wheels. In this way the springs are the protecting units supported directly by the frame of vehicle. Therefore all the parts, which perform the function of protection, are collectively called as suspension system. These springs are generally of leaf springs, coil springs, torsion bar or any other type. To prevent damage to the working parts, to provide riding comfort & safe guard the occupants from road shocks, to give stability to the vehicle in case of rolling, pitching, to provide ground clearance& bear torque & braking reactions, suspension system is employed A dependent suspension normally has alive axle (a simple beam or 'cart' axle) that holds wheels parallel to each other and perpendicular to the axle.

When the camber of one wheel changes, the camber of the opposite wheel changes in the same way. In contrast to solid axles, independent suspension allows each wheel to move vertically without affecting the opposite wheel. Nearly all passenger cars and light trucks use the independent front suspension, because of the advantages in providing room for engine, and because of the better resistance also has the advantage that it provides inherently high erroll stiffness relative to vertical spring rate. Future advantages included easy control of the roll center by the choice of the geometry of the control arms, the ability to control of the roll center by the choice of the geometry of the control arms, the ability to control tread change with jounce and rebound, larger suspension deflections, and greater roll stiffness for given suspension vertical rate.

II. DESIGNOF FOUR LINK

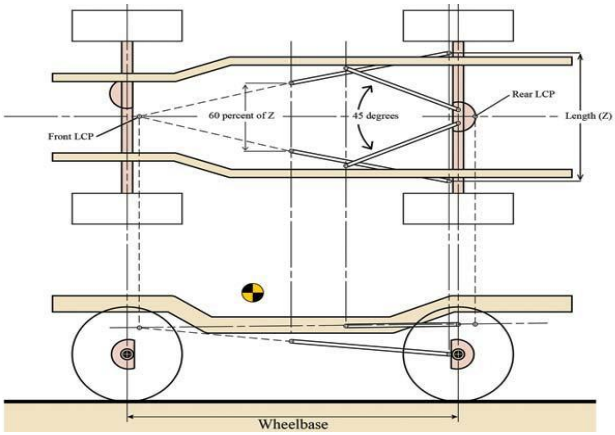


Table 2.1 –Input Dimensions

Sr.No.	Description	Symbol	Value
1	Rear axle weight	W	3102.5 Kg
2	Length of link	L	1150mm
3	Outside diameter	OD	63.5mm
4	Thickness	Th	12.7mm
5	Inside Diameter	ID	38.1mm

III. SPRING CALCULATIONS

a) Wire Diameter of Outer Spring (d_1) = $\frac{D_{01}}{(C+1)}$ ..

$= \frac{220}{(5.9+1)} = 31.88$ mm. ≅32 mm.

b) Mean Diameter of Outer Spring (D_1) = $D_{01} - d_1$

= (220 – 31.88) = 188.12 mm. ≅ 188 mm.

c) Inner Diameter of Outer Spring (D_{i1})

= $D_1 - d_1$ = (188 – 32) =156 mm.

d) Wire Diameter of Inner Spring (d_2) = $Zd_1 \frac{(C-1)}{(C+1)}$

…

$= 0.92 * 32.35 * \frac{(5.9-1)}{(5.9+1)} = 20.83$ mm. ≅ 21 mm.

e) Mean Diameter of Inner Spring (D_2)

= C d_2 = (5.9 * 21) = 121.8 mm.

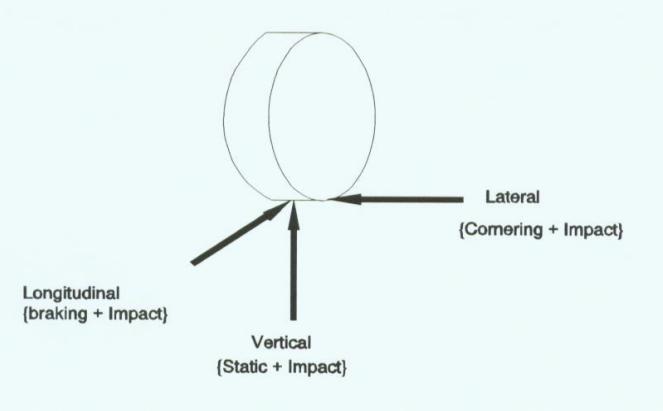
f) Outer Diameter of Inner Spring (D_{02})

= $D_2 + d_2$ = (121.8 + 21) =142.8 mm. ≅ 143 mm.

g) Inner Diameter of Inner Spring (D_{i2})

= $D_2 - d_2$ = (121.8 – 21) = 100.8 ≅ 101mm.

IV. FORCE CALCULATION



*F*B= μ/2[Static+ dynamic load]

= μ/2[W* bcg/l + m* ā *hcg/l]

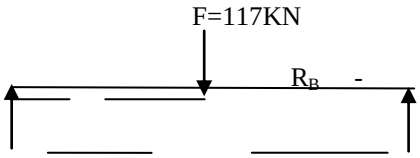
= μ/2 W [bcg/l +ā/g hcg/l]

To find b_{cg}:-

Consider a simply supported beam, where force F= 117KN which acts at a distance X from point A.

Xs

R_A4500mm



$R_A = F_2$= 61KN, $R_B = F_1$= 56KN

Taking moment at point A,

∑mA= 0,

117 * X - 61 * 4500 = 0, X= 2346.15mm.

b_{cg} = 4500 – X,

= 4500-2346.15

= 2154.84mm

Now breaking force FB can be calculated as,

FB=51KN

V. CONCLUSION

High mobility is the prime requirement in cross country terrain for off road vehicle. The technical parameter considered for improving the mobility of vehicle was wheel travel. Four link suspension for rear axle of the truck was designed. The leaf spring were remove dand instead the nested

coil spring were designed. Since the leaf spring was to be removed the axle was provided with longitudinal and lateral Support with the help of four links. Calculation for estimation of length and cross section was also undertaken as part of this project. Different design of coil springs were evolved viz. twin coil spring, single coil spring and nested coil spring design. Due to design constraint the nested spring was chosen and designs subsequently.

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