DESIGN ANALYSIS OF DOUBLE WISHBONE SUSPENSION

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Abstract

The paper deals with study and analysis of the suspension parameters. The suspension design is very important to control the vehicle in motion. The automobile is moving machine it is not static machine. The vehicle while in motion encounters pitching, Rolling, Bouncing, yawing. These motions are initiated from the suspension system. In this paper double wishbone type of suspension system is considered for the analysis. we hierarchically structured design items from design variables that represent suspension geometry to evaluation criterion related to practical operation situations. Some of the crucial parameters are considered for the analysis and result is tabulated. Finally we showed that the optimal design solutions can be obtained.

Keywords: *Double Wishbone, Independent Suspension, Suspension Analysis, Small Car Suspension, Small Car Suspension.*

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1. INTRODUCTION

Suspension used in an automobile is a system mediating the interface between the vehicle and the road, and their functions are related to a wide range of drivability such as stability, comfort and so forth. Since the total optimization of such contents requires much of design freedom, a multilink suspension system, that is principally a parallel six-bar universal linkage, is getting installed to passenger cars, mainly to high-grade cars. On the other hands, such design freedom makes the design process for determining link geometry, etc. more complicated, and it is not so easy to design the suspension system with promising insights. This leads the necessity of a new generation of design methodology that can realize a potential of the complicated system toward total optimality. Since this problem includes many evaluation items, and multi-link suspension system has interconnected behavior, the optimization is so complicated.

1.1 Objectives

1. Analyze the Effect of Mass on the CG of a Small Car.
2. Effect of Speed on the Roll Angle of the small Car.
3. Analyze the Effect of Roll Angle over the Lateral force.
4. Compare the Sprung Mass V/s Un-sprung Mass frequency of small Car.

2. CENTER OF GRAVITY CALCULATION

The Analytical method is followed for calculating the CG of the vehicle. The Mass on the chassis frame is not equally distributed. The CG of the Vehicle is supposed to be with the safer distance from its location.

Analysis of CG calculation shown in Table (1) for different front to rear weight distribution the vertical height of the CG is measured. and Graph (1) the Vertical height of the CG V/s Mass of the vehicle. It is observed that the weight distribution does not have any effect on the vertical height of the small car. The Car will be safe even if the weight distribution is uneven of the vehicle.

3. SPEED AND ROLL ANGLE

The Roll Angle in the range of 3 to 7 degree for passenger cars. Sports cars are offer in 1 to 2 degree range Vehicle roll angle is one of the most important values for lateral vehicle dynamics. Electronic lateral dynamic control system operates only as desired during all driving maneuvers on all road surfaces, if the vehicle roll angle is known. Due to economic reasons, the vehicle roll angle is not measurable in series-produced vehicles. Not only more precision of vehicle roll angle estimation, but also evaluation of estimation error are demanded by automobile industry. In this contribution a new concept, which allows a specification of the estimated angle statistically, is presented. The Analysis of the speed V/s Roll Angle is shown on Table (2) Shows as the car speed is increasing the Roll Angle increases. It is because of this reason the vehicle skids at high speeds. Because the stability of the vehicle depends on the safer location of the Roll angle. Which is justified in the graph (2)

4. ROLL ANGLE AND LATERAL FORCE

Selecting a suitable suspension system is most critical part of the design process. Motion ration depends on the type of suspension system. The suspension system encounters vertical load driving thrust braking load lateral load the suspension motion ration determines how the spring will operates and shock control the springs reaction to those above inputs. To overcome the above inputs a desired suspension system component is the starting point of the suspension system. Hence motion ration, spring rate and shock damping need suitable design.

Analysis of the Roll Angle and the Lateral force shown in table (3) the lateral force is calculated separately. For different Roll Angle calculations the Roll angle and lateral forces are compared. Up to certain value the lateral force is positive and at some value it becomes negative. The negative sign indicates the direction of the change of lateral force. This is unsafe situation. With reference to the graph (3) the decrease in the lateral show an increase in the Roll angle. At the Roll angle 2.9 the lateral force cross from positive to negative value. Hence the safe Roll angle should be 2.9 for the car specification which I took for the calculation.

5. SPRUNG MASS AND SPRUNG FREQUENCY

The wheel hop frequency is the frequency associated with the un-sprung mass it is usually around 10Hz. The body motion frequency is the frequency associated with the sprung mass and it is usually around 1 to 1.25 Hz. The natural frequencies are calculated by neglecting damping in the system and neglecting any excitations. The sprung mass and sprung calculations are tabulated in the table (4) the sprung mass is increased from 300 kg to 600 kg and un-sprung mass is kept constant. The sprung and un-sprung mass frequencies are calculated. Even if the sprung mass is increasing from 300 to 600 the un-sprung frequency does not change. But in the ratio of 600:200 suddenly the un-sprung frequency is reduced. The graph (4) show the relation between the sprung mass and sprung frequency. It is calculated that the increase in the sprung mass reduces the sprung frequency.

The Natural frequency of sprung mass will never coincide with un-sprung mass. Hence Resonance will not occur. Increase in sprung mass will reduce the sprung mass frequency. Hence, vehicle is safe.

6. CONCLUSIONS

1. Increase in the car mass or variation of weight distribution does not have much effect on the vertical height of the CG.
2. As the speed is increasing the Roll angle increases. Hence it effects on the stability of the vehicle.
3. Lateral force need to be kept under control and if we can tilt the vehicle more which increases the Roll angle.
4. Increase in the sprung mass decreases the sprung frequency.

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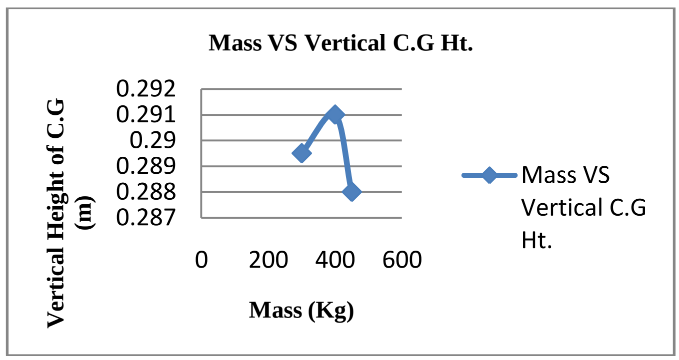
TABLES AND GRAPHS

Table (1)

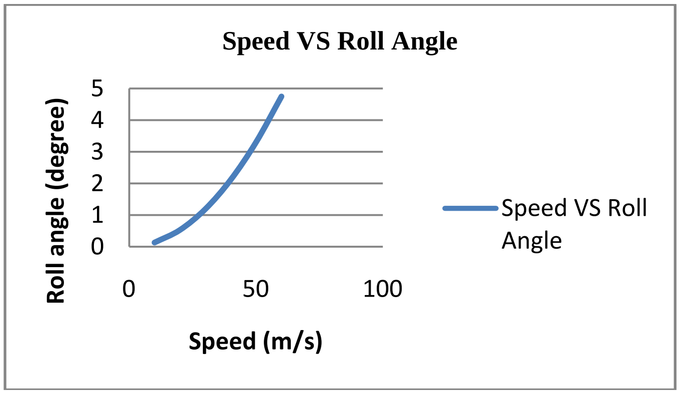
Mass (Kg)	% Weight Distribution		Distance Of C.G (mm)		Elevated Angle	Vertical Height of C.G (m)
	Front	Rear	Front	Rear	In degree	
300	35	65	975	525	20	0.2895
400	30	70	1050	450	20	0.291
450	40	60	900	600	20	0.288



Graph (1)

Table (2)

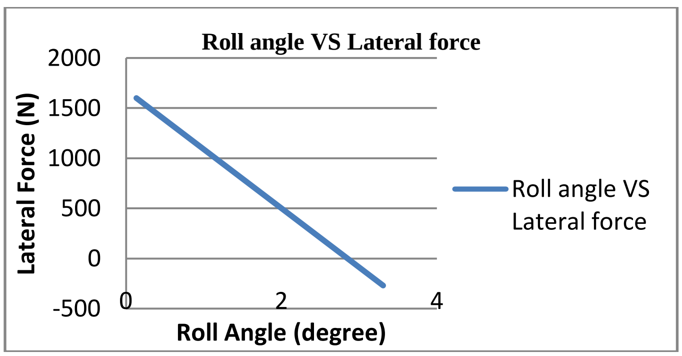
Speed (m/s)	Roll angle (degree)
10	0.1322
20	0.5288
30	1.189
40	2.115
50	3.305
60	4.75



Graph (2)

Table (3)

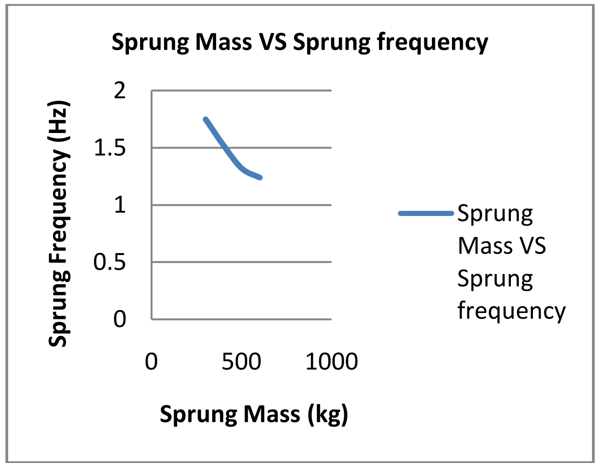
Roll Angle (degree)	Lateral Force (N)
0.1322	1600
0.5288	1366
1.189	977
2.115	432
3.305	-269



Graph (3)

Table (4)

Spring Constant (N/m)	Tyre Stiffness(N/m)	Sprung Mass (kg)	Unsprung Mass(kg)	Sprung Frequency (Hz)	Unsprung Frequency (Hz)
52705	120000	300	100	1.75	6.617
52705	120000	400	100	1.52	6.617
52705	120000	500	100	1.32	6.617
52705	120000	600	100	1.24	6.617
52705	120000	600	200	1.24	4.670



Graph (4)