DESIGN AND ANALYSIS OF SUSPENSION SYSTEM FOR STUDENT FORMULA CAR

NITHIN B GOWDA [1], VAGEESH P[2]

[1] *Mechanical Engineering Department, Bangalore Institute of Technology, Bangalore, INDIA*
[2] *Mechanical Engineering Department, Sri Sairam College of Engineering, Bangalore, INDIA*

Abstract - *In our time it is very usual to see numerous cars, from commercial cars to sports cars fitted with different types of suspension on them. The exterior fashioning and aerodynamically well-organized design for reduction of engine load which reflects in the reduction of fuel consumption and producing the down force for the stability are the two essential factors for an effective operation in the modest world. An aerodynamically optimized car body will result in a change of lift and drag forces the car experiences and thus influence the cars overall performance, fuel consumption, safety, and stability.*

Key Words**: Pushrod suspension, CAD, Lotus Suspension analyzer, Ansys, A-arms.**

1. INTRODUCTION

Suspension is a very important component of any car as it should keep the tire in contact with the road while encountering forces acting on the tires. The type of suspension used decides how these forces are transferred from the tires to the chassis. Suspensions vary from simplistic leaf springs to complicated electromagnets to dampen the forces acting on the chassis. Pushrod suspension designs are used mostly among open wheel race cars because of the aerodynamic and adjustability advantages it gives. They consist of an inboard mounted spring a push rod and a bell crank assembly.

Fig 1: CAD Model of Student formula car

Materials Used for Construction Of A-arms is AISI 4130

1.1 CHEMICAL ANALYSIS OF 4130CHROMOLY:

Sl No.	MATERIAL	MIN VALUE	MAX VALUE
1	CARBON	0.28	0.33
2	MANGANESE	0.40	0.60
3	PHOSPHOURS	0.020	0.035
4	SULPHUR	0.20	0.40
5	CHROMIUM	0.80	1.10
6	SILICON	0.20	0.35
7	MOLBDNENUM	0.15	0.25

1.2 MECHANICAL PROPERTIES

Tensile strength, ultimate	560Mpa
Tensile strength, yield	460Mpa
Modulus of elasticity	190-210Gpa
Bulk modulus	140Gpa
Shear modulus	80Gpa

2. SUSPENSION

The team decided to maintain the use of 13" wheels, to provide the room for the upright and A-arm Configuration, despite the added weight of this larger wheel. Pushrod suspension was chosen because of the wide range of adjustability and packaging options that it provides. Unequal A-arms have been used for stiff independent suspension. The suspension mounting points were changed owing to the change in track for both front and rear.

2.1 SUSPENSION GEOMETRY

Wheel base: 1549mm
Front Track width: 1371.6mm
Rear Track width: 1270mm
Track ratio: 92.59%

Double Wishbone Suspension System consists of two lateral control arms i.e., (upper arm and lower arm) usually of unequal length.

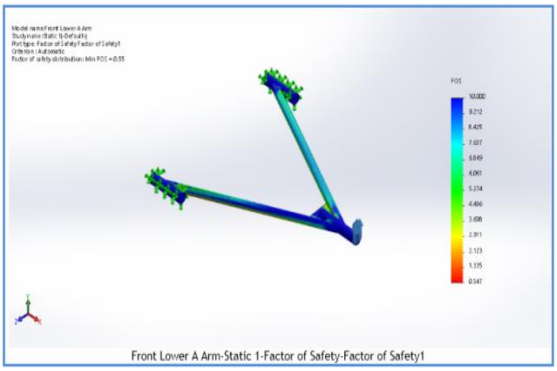

Fig 2: Analysis of Upper Arm

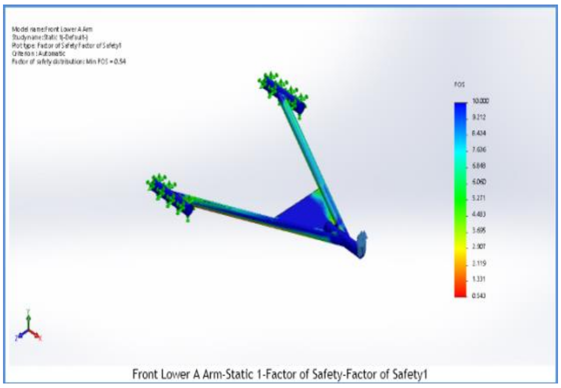

Fig 3: Analysis of Lower Arm

2.2: FRONT SUSPENSION

Double Wishbone unequal A-arms with Push rod suspension system were used. Bell crank Assembly type suspension was used with customized rocker arm.

Spring Calculations:

- Eye to Eye Length: 12 inch
- Wire diameter: 10 mm
- Mean coil diameter: 60 mm
- No. of Active turns:12
- Total no. of turns: 14
- Spring Stiffness: 33.60N/mm
- Deflection: 59.61mm

2.3 REAR SUSPENSION

For rear suspension it should be rigid enough to provide more stiffness to wheel travel otherwise it may create problems for transmitting power to the wheel from gearbox. To meet all these requirements the suspension was directly attached to the upper A-arm.

Spring Calculations:

- Eye to Eye Length: 13.5 inch
- Wire diameter: 12 mm
- Mean coil diameter: 72 mm
- No. of Active turns:18
- Total no. of turns: 20
- Spring Stiffness: 31.36N/mm
- Deflection: 66.95mm

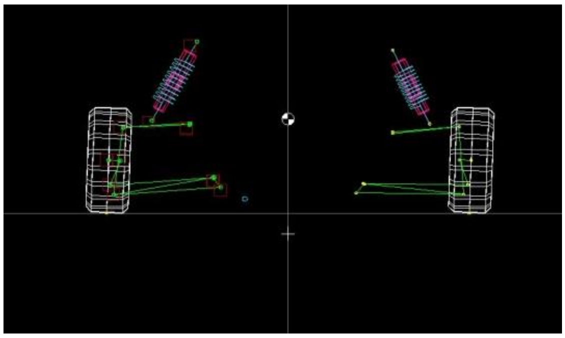

Fig 4: Rear Suspension Using lotus suspension Analyzer

Wheel Alignment was done using lotus suspension Analyzer and the graph of Caster, Camber & Toe angle was plotted.

Chart 1: Graph of Camber Angle

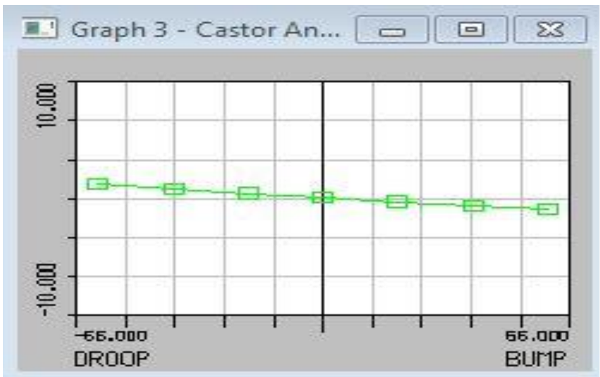

Chart 2: Graph of Caster Angle

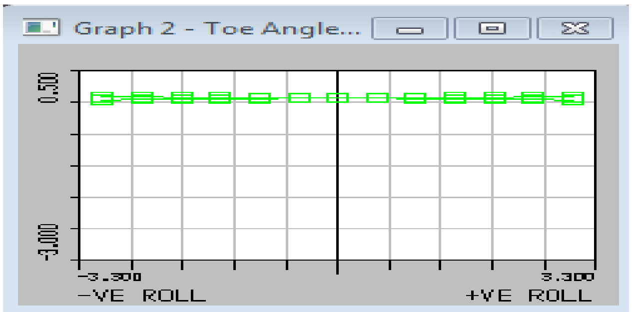

Chart 3: Graph of Caster Angle

3. CONCLUSIONS

This paper sums up the basic design and analytical concepts of the suspension system used in student formula car. The concept of optimization for design validation is elaborated in this paper. The results of spring calculations were used to design and optimize the suspensions of student formula car. The goal being, to design and fabricate the formula car for the Final event.

REFERENCES

[1] 2017 Student Formula SUPRA SAE Rule book, SAE Inc, INDIA
[2] W.F. Milliken and D.L. Milliken, 'Race Car Vehicle Dynamics', SAE International 1995
[3] T.D. Gillespie, 'Fundamentals of Vehicle Dynamics', SAE International 1992
[4] V.B. Bhandari, "Design of Machine Elements".
[5] K.R Gopalkrishna, "Engineering Drawing".

BIOGRAPHIES

Final year Mechanical Engineering student, automobile enthusiast

Final year Mechanical engineering student