International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 02
February 2017

Design of Steering Components for a Race Car

Bridjesh.P[1], Venkat Krishna.B[2] , Venkat Reddy.K[3], Vamsidhar Reddy.M[4], Sudeep Kumar.Y[5], & Madhu.S[6]
[1]Department of Mechanical Engineering, MLR Institute of Technology, Hyderabad 500043, India
[1]meetbridjesh@gmail.com,[2]venkat.b.krishna@gmail.com,[3]k.venkireddy32@gmail.com, [4]vamshidharreddy4337@gmail.com,[5]sudeepkumar.prince@gmail.com.

Abstract:

This present study addresses the issue of efficient turning radius by discussing the design of steering arm, rack and pinion gears and its position. A focus on design of steering arm, rack and pinion gears and the materials selected in manufacturing and factors that leads to failure. This is an approach to invent the effective technologies and methodology available to enhance the turning radius and to avoid steering system failure due to wear and tear of gears and tie rod failure. In particular, the effectiveness of certain alloys in resisting shear force on steering arm and its fracture .The effectiveness of hardening in protecting the rack from wear and tear when exposed to load acting on them.

Keywords

Design; Rack & Pinion; Steering arm; Race car.

1. Introduction

The steering system used in a race car is customized rack and pinion which is generally mounted to the base of the frame [1]. The rack is bottom mounted to lower the C.G of rack, pinion and tie rods. The chosen housing inner diameter designed to optimize steering responsiveness, allowing minimal steering wheel input to steer the car. High speed cornering is important factor for optimum performance in the race track [2]. It can be achieved only with Reverse Ackermann type steering geometry which compensates for the large difference in slip angle between the inner and outer front tires while cornering at high speed [3]. It was also decided to attain responsive steering at the expense of steering effort to the driver by varying the gear ratio of the simple rack and pinion assembly used [4].

2. Design and analysis of steering components

Table1 illustrates the input data required for design and analysis of steering components to reduces its steering ratio from 15:1 to 7.86:1, by this ratio we can obtain a turning radius of 2.5m by adjusting steering links

Table. (1): Description and specifications of steering components.

Particulars	Values
C-factor	75mm
Rack travel	35mm
Steering ratio	7.86:1
Turning radius	2669.075mm
Inner wheel angle	38.59deg
Outer wheel angle	27.881deg
Steering arm length	78mm
Ackermann percentage	99.96%
Lock to lock	0.93 rotation

Design parameters of cad model for gear profile [5]
Pitch circle diameter
Root diameter
Addendum circle
Pressure angle
Design of rack and pinion

Constraints for both gears, Pitch geometry (D) = 37.56 mm, Pressure Angle (ψ) = 20° Module (m) = 2mm,

Calculate Diametric Pitch (P)
P = N/D = Number of Teeth/Pitch Diameter
Chosen N & D = 12/37.56 = 0.32
P = 0.32
Calculate Addendum (a)
a = 1/P = 1/0.32 = 3.125
Calculate Whole Depth (ht)
ht = (2.188/P) + 0.002
ht = (2.188/0.32) + 0.002 = 6.83
Calculate Dedendum (b)

International Journal of Research
Available at https://edupediapublications.org/journals
p-ISSN: 2348-6848
e-ISSN: 2348-795X
Volume 04 Issue 02
February 2017

b = ht – a
b = 6.83 – 3.125 = 3.714
Base Circle Diameter (Db)
Db = D*cos(20)
Db = 37.56*cos(20) = 35.3
Root Diameter
Dr = D - 2b
Dr = 37.56 – 2(3.125) = 31.31

3. Modeling

After creating a cad model of gear rack and pinion with the help of provided data it is mandatory to perform analysis of components to obtain a solid model of the designed gears. Therefore we constructed gears model in Solidworks. We carried out analysis of gear tooth in hypermesh by importing IGES file from Solidworks. Modeling being the firestone followed by geometric clean up, element property definition and meshing. Furthermore solutions embedded by boundary constraints and by applying loads on the model runs the solution the process end with post processing that include analyzing the result plotting different parameters like Stress, Strain [5,6].

4. Finite element analysis and results

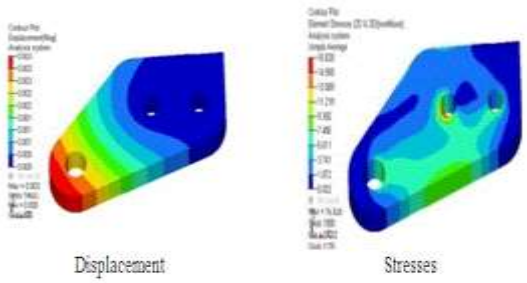

Figure 1. Finite element analysis of steering arm.

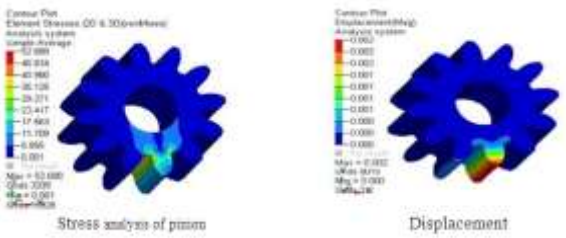

Figure 2. Finite element analysis of pinion.

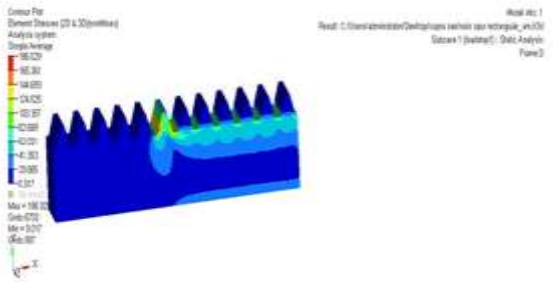

Figure 3. Finite element analysis of rack.

5. Conclusion

In this present work, design and analysis of steering components for Race Car is presented. Different materials like Plain carbon steel, Aluminum Alloy & en8 . Structural analysis are carried out to identify the suitable material considering, displacement, stress, weight etc., Observation stated that structural analysis using aluminum alloy surface of steering arm values of stress ranging with in permissible stress value. we conclude by saying that Aluminum can be used safely for steering arm, steel for gears and the values were found satisfactory. So using aluminum alloy is more convenient due to its light weight which reduces almost 3 times when compare to three materials because of its less density there by mechanical efficiency for gears as it requires high strength so medium carbon steel alloy is used.

6. References

[1] Khurmi, R. S and Gupta, J. K., *A Textbook of Machine Design*, 25th Ed, S Chand publications.
[2] Bhandari, V. B., *Design of machine elements*, 3rd Ed, Mc Graw hill publications.
[3] Gillespie, T., *Fundamentals of vehicle dynamics*, Society of automotive engineers, 1992.
[4] Milliken, W., and Milliken, D., *Race car vehicle dynamics*, Society of automotive engineers, 1995.
[5] Wong, J. Y., *Theory of ground vehicles*, 3rd Ed, John wiley & sons.
[6] *Design data hand book*, PSG Coimbatore, kalaikathir Achchagam