Development of Adjustable Steering System

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Abstract— The main aim of the paper is to develop a adjustable Trackwidth, Camber and Kingpin Inclination in Steering Mechanism of Go-Kart. Instead of using Aniok, we use Hinge Joint in steering mechanism. Conventional steering involve either the Ackermann or Davis steering system which has major disadvantages that it can't take minimum radius turn. We try to solve the problem of fixed Trackwidth, Camber and Kingpin Inclination by using Heim Joint. The main purpose of this project is to reduce the turning radius and to improve the performance of vehicle during different tests as well as reduce the efforts on the steering wheel. To increase the quality performance of vehicle on straight and turning track Trackwidth, Camber and Kingpin Inclination is needed. To overcome the problem like need of camber, kingpin inclination during turning or straight track, we need the adjustable trackwidth, camber and kingpin inclination in steering mechanism.

Keywords: Turning Radius, Adjustable Trackwidth, Camber and Kingpin Inclination, Two-Wheeled Steering, Efforts on Steering Wheel

I. INTRODUCTION

In present world, Go-Kart driving is more essential to become a F1 driver. Karting is a form of racing in a small Four-wheel vehicle is known as Go-Kart.In the beginning, the first ever Go-Kart was created in Los Angeles by Art Ingels in 1956.The first official organized race took place with several dozen home-built machines in 1957 in the parking lot of the Famed Rose Bowl in Pasadena, California. Now, it has been estimated that over 1.6 billion people worldwide have raced Go-Kart.Ingel's one of two-stroke creation was the inspiration for Duffy Livingstone and Roy Desbrow to start Go-Kart manufacturing, Co.,Inc in 1958.

Generally, In racing cars, Ackermann steering geometry is used.The Ackermann Steering Principle defines the geometry that is applied to all vehicles(two or four wheel drive) to unable the correct turning angle of the steering wheels to bbe generated when negotiating a corner or a curve.`In Go-Kart, Pitman Steering mechanism is used because it gives quick response than Rack and Pinion Steering mechanism.

We know that, In Go-Kart in steering mechanism, Knuckle is held in Aniok. But Aniok is weleded to the chassi. Due to welding, Aniok gives you fixed trackwidth, camber and kingpin inclination. To increase the performance of Kart on straight and turning track we need the camber and kingpin inclination and also for increasing the stability of Kart we need more trackwidth. At turning, camber is more useful to take turn. Trackwidth is more useful to increase turning radius. Increasing Kingpin inclination increases cornering stiffness. So, to overcome this problem, adjustable trackwidth, camber and kingpin inclination provided and also we focus on to reduce the efforts on the steering wheel.

A. *What is Steering?*

Steering is the collection of components, linkages, etc. Which allows any vehicle to follow the desired course. An exception is the case of rail transport by which rail tracks combined together with railroad switches provide the steering function. The primarily purpose of the steering system is to allow the driver to guide the vehicle. The most conventional steering arrangement is to turn the front wheels using a hand-operated steering wheel which is positioned in front of the driver, via the steering column, which may contain universal joints, to allow it to deviate somewhat from a straight line.

The basic aim of the steering is to ensure that the wheels are pointing in the desired direction with less efforts. The most conventional system is two wheel system.

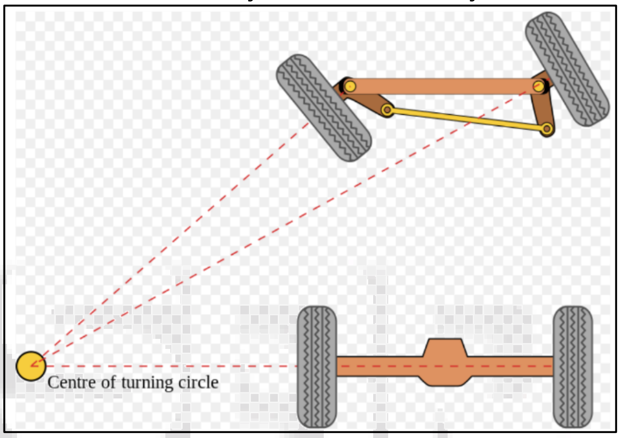


Fig. 1: Steering Geometry

One of the basic principle is that of caster angle-each wheel is steered with a pivot point ahead of the wheel, this makes the steering tend to be self-centering in desire direction of travel. We have to consider that in a turn, the inner wheel is actually travelling a path of smaller radius than the outer wheel, due to which the degree of toe appropriate for the driving in a straight path is not suitable for turn. Another thing influence the steering dynamics is angle make by wheels to the vertical plane.

II. PROBLEM DEFINITION

In moderns cars, Ackermann steering geometry is used because Ackermann is simplier than Devis steering geometry. Generally, In cars Rack and Pinion mechanism is used, but in Go-Kart Pitman Steering mechanism is used because pitman mechanism gives quick response than rack and pinion mechanism. In Go-Kart, Knuckle is held in an Aniok by using Kingpin. Aniok is welded to the chassi. Due to this, Trackwidth, Camber and Kingpin Inclination is fixed. We need, Camber during turning, due to this we get the turn faster than the car which has camber is neutral. But at straight track, we need camber neutral for higher speed. Increase in Trackwidth, turning radius also increases, it is helpful for the stability of car at a higher speeed. Due to increase in Kingpin Inclination, Cornering Stiffness increases.

Fig. 2: Turning Problem

III. OBJECTIVES

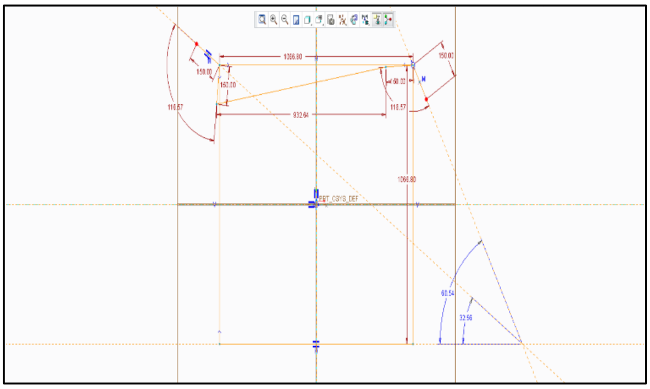
- Designing prototype system.
- Reduction in efforts on steering wheel.
- Increasing stability of car.
- Increasing performance of car.
- Overcome fast turning problem.

IV. METHODOLOGY

Generally, The Pitman Steering mechanism is simpler than any other mechanism. This mechanism gives quick response than any other mechanism. Hence, we use pitman steering mechanism. The manufacturing of Pitman Steering mechanism is simple. For development of adjustable steering mechanism, we use simple MS Plate with hole of 14mm instead of Aniok as shown in figure. For adjusting the camber, we use Heim Joint which is placed in that hole.

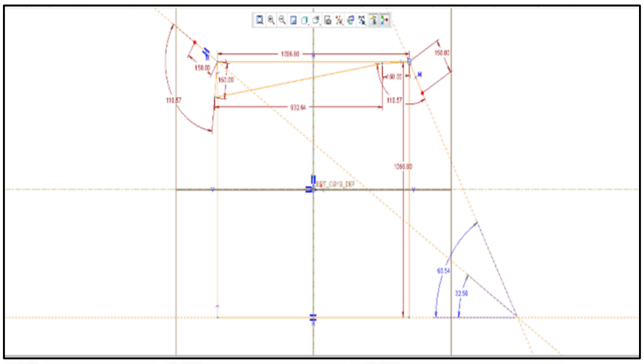
Fig. 3: Aniok Assembly

A. At Initial Condition, Trackwidth=1193.8 mm



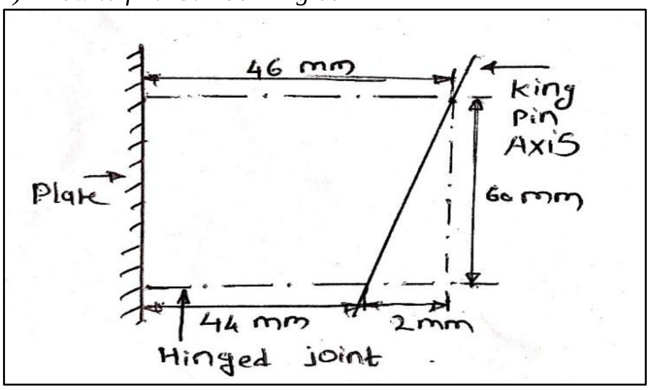
α= front outer turning angle
β= front inner turning angle
C =distance between KPI to KPI
R1= (wheelbase/sinβ) -(track width-c/2)
Where R1 = inner front wheel turning radius
= (1066.8/sin48.13)- ((1193.8-635)/2)
R1 = 1153.19 mm
R2 = (wheelbase / sinα) +(track width-c/2)
Where R2 = front outer turning radius
= (1066.8/sin33.84) + ((1193.8-635)/2)
R2 = 2195.08 mm
R3 = (Wheel base/tanβ) -(track width-c/2) +c/2
Where R3 = Rear wheel turning radius
= (1066.8/tan48.13) – ((1193.8-635)/2) +635/2
R3 = 994.677 mm
R_{mean} = (R1 + R2 + R3)/3
= (1153.19+2195.08+994.677)/3
R_{mean} = 1447.6 mm

B. At Last Condition, Trackwidth= 1244.6 mm



R1= (wheelbase/sinβ) -(track width-c/2)
Where R1 = inner front wheel turning radius
= (1066.8/sin48.13)- ((1244.6-635)/2)
R1 = 1127.79 mm
R2 = (wheelbase / sinα) +(track width-c/2)
Where R2 = front outer turning radius
= (1066.8/sin33.84) + ((1244.6-635)/2)
R2 = 2220.488 mm
R3 = (Wheel base/Tanβ) -(track width-c/2) +c/2
Where R3 = Rear wheel turning radius
= (1066.8/tan48.13) – ((1244.6-635)/2) +635/2
R3 = 968.877 mm
R_{mean} = (R1 + R2 + R3)/3
= (1127.79+2220.488+968.877)/3
R_{mean} = 1439.05 mm

1) How to find Camber Angle?



Let θ= Camber Angle
tanα = 60/2
α = tan^-1(30
α = 88.09°
θ = 180°-(90°+88.09°)

$\theta = 1.91°$
Now, for getting Camber= 3°,
$\tan\alpha = 60/3.15$
$\alpha = 86.99°$
$\theta = 180° - (90° + 86.99°)$
$\theta = 3°$

V. APPENDIX-1: DESIGN VIEWS AND PHOTOGRAPHS

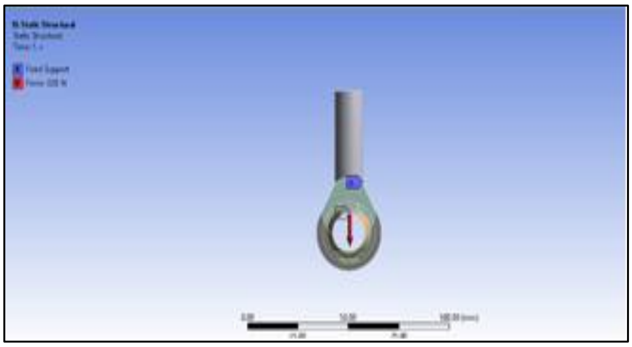


Fig. 7: Boundary Condition

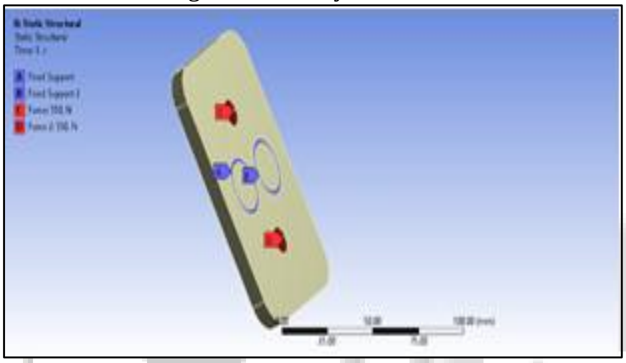


Fig. 8: Boundary Condition

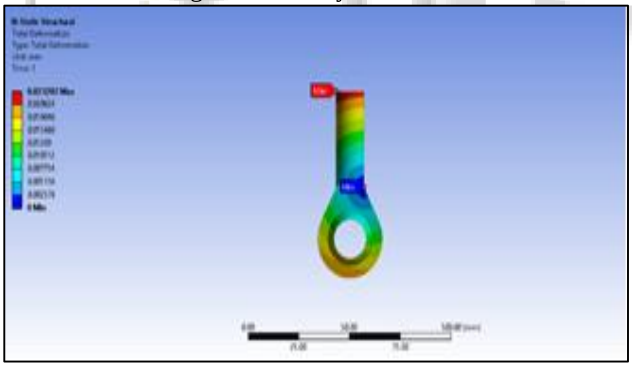


Fig. 9: Deformation

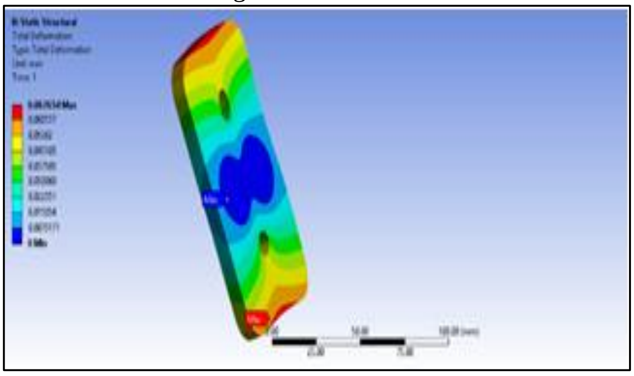


Fig. 10: Deformation

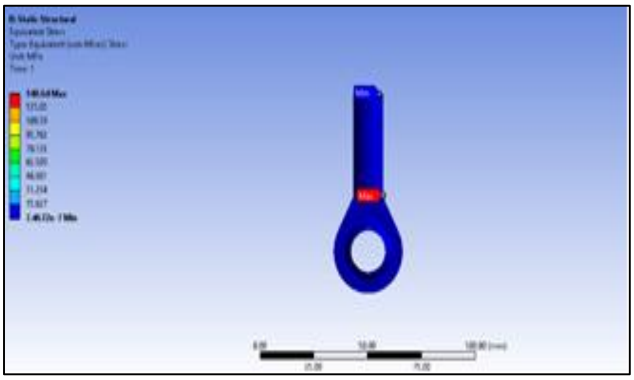


Fig. 11: Stresses

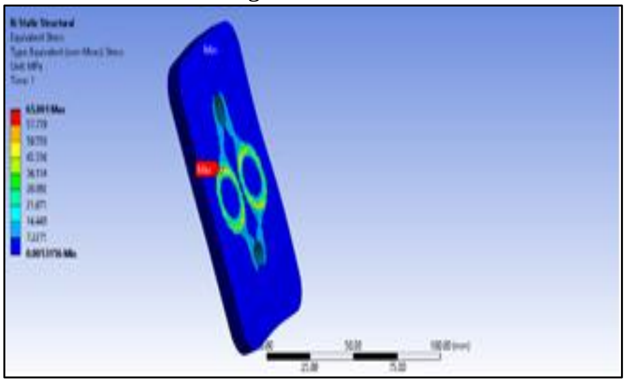


Fig. 12: Stresses

FOS= Yield Strength/ Max working stress = 370/140.64 = 2.6

FOS= Yield Strength/ Max working stress= 370/65.001 = 5.6

VI. RESULT

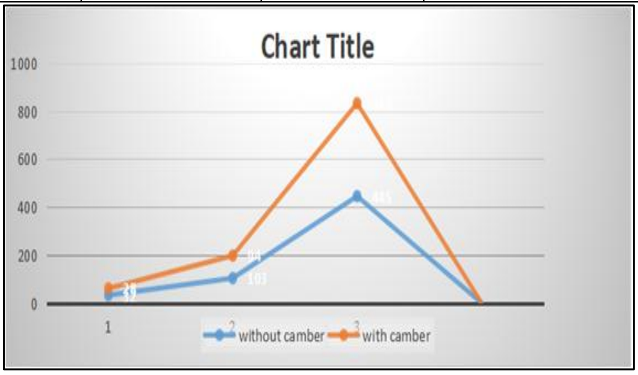
You can expect to see several innovations that will improve vehicle stability and performance during different test like Figure of 8, Brake test, Acceleration Test, Drive Excellence Test and Endurance. One of the coolest ideas is that steer by adjustable trackwidth, camber and Kingpin Inclination. These systems would completely eliminate the problem of vehicle performance during turning and straight track. They also decrease the efforts occurs on steering wheel. Essentially, the steering wheel would work like the one you can buy for your home computer to play games. The output of this system is used to increase stability of vehicle, increase the performance of vehicle as well as increases the cornering stiffness. It will also reduce the vibration in the vehicle.

An innovative feature of this steering mechanism and its ability to drive front two-wheel using a single steering actuator. Its successful implementation will allow for the development of four-wheel, perfect steering mechanism base with maximum manoeuvrability, uncompromised static stability and optimum obstacle climbing capacity.

VII. CONCLUSION

By using adjustable steering system, we get more improvement in our vehicle performance. During testing we get the following reading with or without camber.

Sr. No.	Test	Without Camber Time (s)	With Camber(3deg.) Time (s)
01.	Figure of 8	32	28
02.	Drive Excellence	103	94
03.	Endurance (1 lap)	445	388



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