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# DESIGN AND ANALYSIS OF GO-KART STEERING SYSTEM

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**ABSTRACT**

This workincludes the theory, design and analysis of go-kart Steering system. Usually a go-kart or owner who wants to improve the handling of the vehicle will have to purchase the latest in wheels, tires and other optional equipment, but end up finding that those things in fact handles worse. The first stage in achieving a good handling kart that will provide the greatest percentage of power efficiency is to go right back to basics.

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 (which may also be part of the collapsible steering column design), to allow it to deviate somewhat from a straight line. From the work steering ratio 3.8376 :1 is achieved, Ackerman angle 13.52̊ And turning radius of 3.8255m to enhance the steering effect.

**KEYWORDS: -** Go-Kart, Steering, Universal Joints, FEA, ANSYS.

## INTRODUCTION

In this chapter explains about literature review would be done, which include the theory about go-kart Steering. Usually a go-kart or owner who wants to improve the handling of the vehicle will purchase the latest in wheels, tires and other optional equipment, but end up finding that those things in fact handles worse. The first stage in achieving a good handling kart that will provide the greatest percentage of power efficiency is to go right back to basics.

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1. Steering wheel
2. Steering Rod
3. Rack & pinion
4. Connecting Link
5. Universal Joints


Fig. 1 Details of Steering Mechanism

## METHODOLOGY

- ***Steering Design***

Many modern cars use rack and pinion steering mechanisms, where the steering wheel turns the pinion gear; the pinion moves the rack, which is a linear gear that meshes with the pinion, converting circular motion into linear motion along the transverse axis of the car (side to side motion). This motion applies steering torque to the swivel pin ball joints that replaced previously used kingpins of the stub axle of the

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steered wheels via tie rods and a short lever arm called the steering arm.The rack and pinion design has the advantages of a large degree of feedback and direct steering "feel". A disadvantage is that it is not adjustable, so that when it does wear and develop lash, the only cure is replacement.

A Rack and Pinion is a type of linear actuator that comprises a pair of gears which convert rotational motion into linear motion. A circular gear called "the pinion" engages teeth on a linear "gear" bar called "the rack"; rotational motion applied to the pinion causes the rack to move relative to the pinion, thereby translating the rotational motion of the pinion into linear motion.

For example, in a rack railway, the rotation of a pinion mounted on a locomotive or a railcar engages a rack between the rails and forces a train up a steep slope.

For every pair of conjugate involute profile, there is a basic rack. This basic rack is the profile of the conjugate gear of infinite pitch radius.(I.e. a toothed straight edge.)A generating rack is a rack outline used to indicate tooth details and dimensions for the design of a generating tool, such as a hob or a gear shaper cutter.

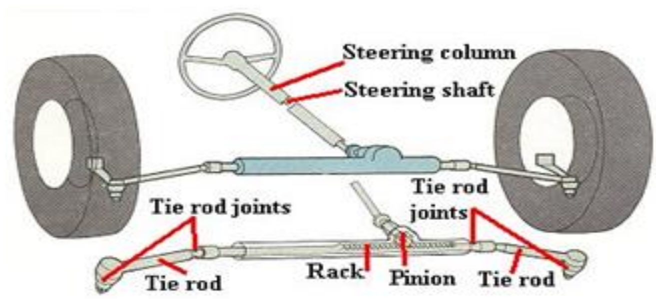


Fig 2:- Rack And pinion steering

- **Design :-**

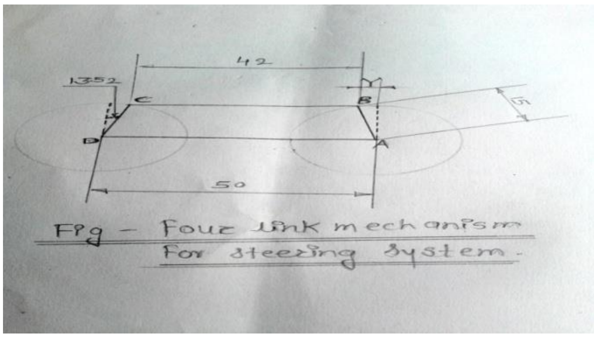


**Fig.3 shows the geometry of the four bar mechanism for the steering**

Fig. 4 Steering System

Front track width = 840 mm

Distance between the pivots = 50 cm

Fig.3 shows the geometry of the four bar mechanism for the steering part of the Kart.

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While taking the left turn

Let A (0,0), D (50,0)

$$\text{Point B's X coordinate} = R_{AA}[\sin(AA + SA_l)]$$
$$\text{Point B's Y coordinate} = R_{AA}[\sin(AA + SA_l)]$$

Where $R_{AA}$ is the Ackerman Arm Radius

AA is the Ackerman Angle

$SA_L$ is the steering angle of the left wheel

Zero degree is straight ahead.

Above B's coordinate has been solved and it is B (12.506,8.28)

We can project straight to the left of point B and straight up from point A to create a new point called point E. Also, because point E falls on segment AD, we can calculate distance ED:

ED = AD – AE

ED = 50 – 8.28 = 41.72cm

$DB^2 = (DE^2 + EB^2)^{1/2}$

DB = 42.53 cm

$\tan k = \frac{EB}{ED}$

k = 11.225 deg

$$\cos\gamma = \frac{(DB^2 + AB^2 - BC^2)}{2(DB\ x\ AB)}$$

$\gamma$ = 80.830 deg

For Ackerman Arm Angle,

$$\tan\alpha = \frac{King\ Pin\ c - c\ Distance/2}{Wheel\ Base}$$

α = 13.52 deg

Ackerman arm angle, α=13.52

Steer angle = k + ϒ + α – 90 = 15.56 deg

Arm base, Y = Ackerman arm radius*sinα

= 3.506 cm

Verifying ackerman arm base Y,

Y = (King pin c-c distance) - (Length of tie rod)/2

= (50-42.784)/2

= 3.608cm

Therefore, Arm Base (Y) is nearby the calculated value and is thus verified. Expressed mathematically:

$L_T = D_{KC} – 2R_{AA}$[Sin(Ackerman angle)]

= 50-2*15(Sin 13.52)

= 42.784cm

Where: $L_T$ = length of the tie rod

$D_{KC}$ = distance between kingpin's center to center

$R_{AA}$ = radius of the Ackerman Arm (Assumed) =15cm

Length of Tie Rod = 42.784cm

Turning Circle Radius :

From fig.1, if one link is adjusted at 20 deg then other angle turns out to be 15.562 deg. Then,

Turning Radius = [ (Track Width/2) + (wheel Base/ sin (Average Steer Rate) ]

=[ (84/2) + (104 / sin[ (15.56 + 20)/2] }

= 3.8255m

Steering ratio :

$R = s / [(2 - 2\cos(2a/n)^{1/2}]$

Steering Ratio, n = 3.8376 :1

**Free-play:**

Free-play has been adjusted at steering wheel rod by giving the space to the stud for its free movement upto certain angle. This has been managed by drilling the hole of larger diameter with respect to the stud. This adjustment is shown in fig.5

**Results :-**

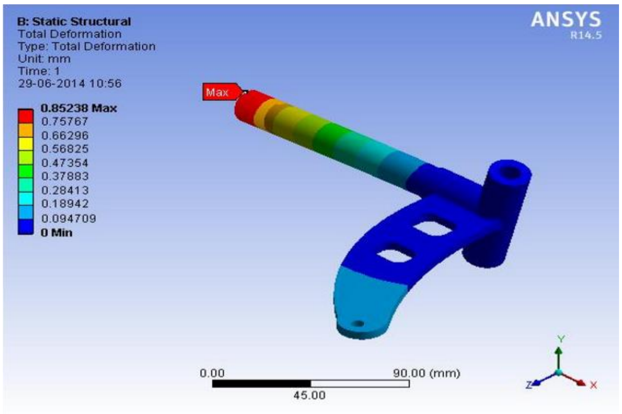


Fig 3:- deformation of steering knuckle

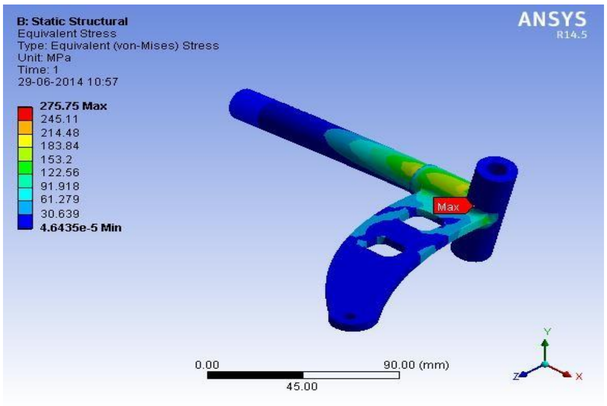


Fig 5- Von-Mises stress of steering knuckle

| | |
|---|---|
| Max. deformation | 0.8527 mm |
| Max. stress | 275.75 Mpa |
| FOS | 1.59 |

**CONCLUSION**

From these paper we can conclude that we have achieved steering ratio **3.8376:1**.
We have also achieved ackerman angle **13.52°** And turning radius of **3.8255m**.

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