Design of Braking System for Go-Kart

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Abstract

This paper aims to design for the Braking system of Go-Kart Vehicle. There are involvement of many system in manufacturing of Go-Kart, but the most important requirement is braking system. Without braking system every vehicle is incomplete, and the vehicle cannot function properly. It is righteous to say that without the braking system in vehicle the passenger's life is in danger. Therefore Braking system plays the major role in the manufacturing of vehicle. Not surprisingly, braking is an exciting area for development within the automobile industry with a number of technologies competing to improve safety and overall efficiency.

Keywords: Go-Kart, Disc Brakes, Caliper, Master Cylinder.

Introduction

In selection of braking system , Hydraulic Disc brake we have used in our Go-Kart vehicle to decelerate or decrease the speed of a vehicle. By stepping on the brake pedal, the brake pads compress against the rotor attached to the wheel, which then forces the vehicle to slow down due to friction. Mostly all of go-kart have disc brake on only rear axle because disc brake mechanism is simple than other brake and moderate weight and easier mechanism . All of these components need to be in good shape and working properly for the vehicle to have 100% brake system effectiveness while driving.

Braking System

1. Purpose:

   I. To decrease the speed of a vehicle using kinetic friction and keep it from rolling when stopped using static friction.

   II. To design a braking system which take least time to bring the vehicle to stop.

   III. To ensures safety of the driver.

2. Selection of Brakes:

   We had used a Hydraulic Disc Brake considering the following advantages, availability, and their limitations .

   For selection of best braking system in go-kart you have to kept some points in your mind:

   a) **Hydraulic system**
   b) **Disc brake -** appache RTR rear 200mm
   c) **Master cylinder-** appache RTR rear master cylinder

d) **Brake lines-** appache RTR front
e) **Caliper-** appache front double piston caliper
f) **T-joint**- for transferring fluid and pressure valve (brake light).

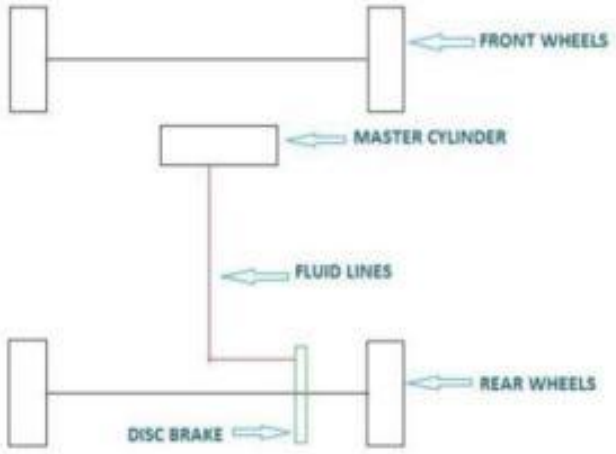

Figure 1: Layout of braking circuit

3. Parts and Specifications:

Terms	Used
Front axle static load	74kg
Rear Axle Static load	111kg
Gross Weight(kerb+driver)	185kg
Stopping distance	12m
Weight Transfer	26kg
Leverage	5:1
Load applied by the driver	100N
Braking Force	1269.1N
Braking Torque	105Nm
Stopping Time	1.8s

Calculations:

Every racing vehicle requires good brakes to have control over the speed and stop the vehicle at any point of time within shortest time period and stopping distance. In order to achieve maximum performance from the braking system, the brakes have been designed to lock up rear wheels, while minimizing the cost and weight. To achieve best braking parameters in our Go Kart all the static and dynamic loads were calculated at the rear and front wheels.

Type - Hydraulic, disc
Brakes Calliper- Both rear wheels TVS Apache rear calliper
Master cylinder -Maruti 800 TMC

Retardation of the body at any given time is: (co-eff of adhesion)*(acc. Due to gravity) = K*g
K: 0.7 for dry roads
Therefore retardation (a): 0.7*9.81 =6.867 m/s2
Front axle dynamic load is given as (Wf):

Wf = w1 + (a/g) ×W× (h/L)

Rear axle dynamic load is given as (Wr):

Wr = w2 - (a/g) ×W× (h/L)

Where,

w1 = Static load on the front wheels = 74 kg
w2 = Static load on the rear wheels = 111 kg
a = retardation of the vehicle
W = Weight of the vehicle = 185kg
h = Distance of C.G from ground = 0.29 m
L = Wheel Base = 47inch= 1.19m

Now,

Braking Force(Fb)

Fb=(W*a/g)=1269.1N

Braking Efficiency

(Fb/W)*100=69.2%

Stopping distance d = v^2 /2 a
v = 40 km /h = 11.1 m/s (as per rulebook)
d = 12 m (maximum)

Now the dynamic loads,

Wf = 105.52kg
Wr = 79.47kg

Therefore weight transfer of **26kg** takes place from rear axle to front axle.
Now we calculate the forces applied by the driver on the brakes and the final force available at the calliper.

Force applied by driver (Fd) - 100N (assumed)
Leverage- 5:1
No. of pistons per calliper- 1

calliper:

Bore of calliper piston - 32mm
Bore of TMC- 19.08mm
Co-eff of friction of brake pads (μ) -0.4
Effective disc diameter- 190mm
Net force applied at the master cylinder: 50*leverage = 100*5 = 500N
Area of master cylinder (Am) : π*(19.08/2)2
= 2.86x10-4 m2
Pressure developed in the system (P):force / Am
500/2.86x10-4
= 1748251.75 N/m2

Since the pressure in the system is entirely same so the brake force at the calliper can be calculated as follows:

Area of the calliper piston (Ac) : π*(32/2)2
= 8.04x10-4 m2

Therefore,

The force on calliper (Fc): P*Ac
(1748251.75)*(8.04x10-4)
= 1405.6N

This is the force acting on one rotor but we are using 2 rotors (one on each rear wheels), so the total force:

2* Fc = 2*1405.6 = 2811.2N

Total frictional force = Fc*μ = 2811.2*0.4
=1124.8N

Braking torque produced: (frictional force)*(effective disc radius)
1124.8*0.09 = 105Nm

Braking torque - 105Nm
Stopping distance: 12m
Stopping time :1.8s

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