# Monowheel Motorcycle

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**Abstract -** *The monowheel is a one wheel which is driven by four stroke petrol engine; the power is transmitted from engine to friction wheel by using chain sprocket. There are outer wheel, inner frame and three rollers. The three rollers mounted between the outer wheel and inner frame. The outer wheel rotates relatively to the inner frame by using three rollers*

**Key Words: Four stroke engine, Rollers, Inner Frame, Outer Wheel and Friction Wheel.**

## 1. INTRODUCTION

The monowheel history begins in the second half of 19th century, when there were manufactured some vehicle, driven by pedals. The first motor driven monowheel was the "petrol monocycle" of caravaglia presented in 1904. The principal is easy to understand, the outer wheel with tyre which may rotate relatively to the inner frame being fitted with three rollers as its 120 degree between them, the inner frame supports the driver and petrol engine and all the arrangement like seating, engine, petrol tank, inside the inner frame. The friction wheel engages to the outer wheel which receive the power from engine and transmitted to outer wheel and that's why, outer wheel rotate around the driver.

## 2. CONSTRUCTION

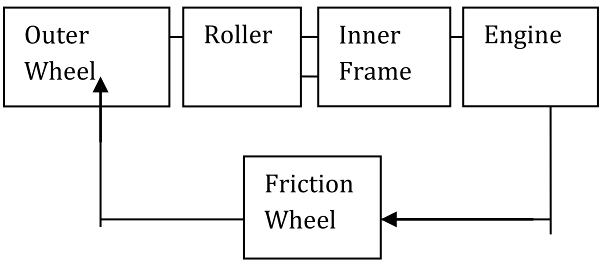


Fig. 1: Block Diagram of Monowheel.

1. Outer wheel; It is made up of mild steel having cylindrical cross section. Diameter of mild steel pipe is 4cm. Diameter of outer wheel is 140cm.
2. Rollers; Rollers are made up of nylon. This material maintains good tensile strength, chemical resistance, stiffness, flexural memory. Nylon is excellent in high temperature application.
3. Inner frame; It is also made up of mild steel. The inner frame takes weight of driver, engine and all other system. The engine is mounted on inner plate attached to the inner frame. The handle and driver seating position also on inner frame.
4. Friction wheel; It is made up of rubber. It transmitted power from engine output shaft to outer wheel by chain sprocket.

## 3. DESIGN AND CALCULATION

Then monowheel motorcycle with an effective power transmission system has to be designed such that it can be handled and controlled by a single person even in the rest position. The main and basic factor that are being taken into consideration are

1. Height of the person riding the vehicle

2. Maximum weights that the vehicle can withstand

3. Power Transmissions

### 3.1 Important Dimension

1. Outer wheel ring diameter : 140cm
2. Circumference of outer wheel :439cm
3. Diameter of outer wheel : 4cm
4. Square cross section of inner frame : 2×2cm
5. Width of outer wheel : 1cm
6. Length of roller : 8cm
7. Diameter of roller : 6cm
8. Length of friction wheel : 7cm
9. Diameter of friction wheel: 12cm

### 3.2 Solid modelling

The monowheel motorcycle is modeled by using CATIA. It is one the world's leading CAD/CAM/CAE packages.

Following fig shows component of monowheel motorcycle

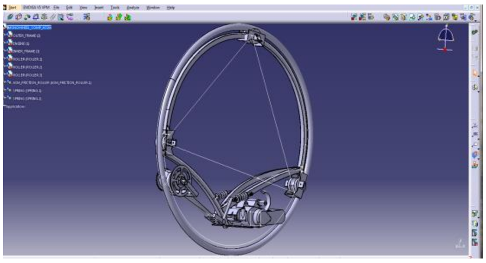

Fig. 2: CATIA Model

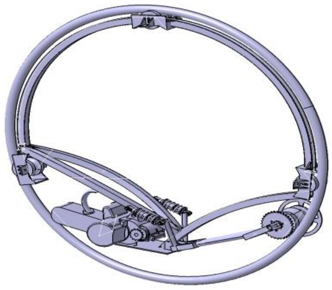

Fig. 3: Assembly of Monowheel

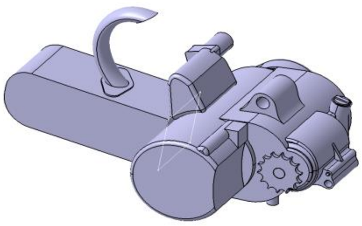

Fig. 4: Four Stroke Engine

Fig. 5: Inner Frame

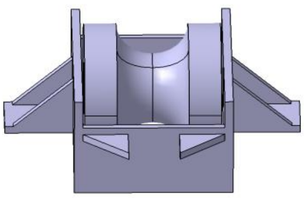

Fig. 6: Roller

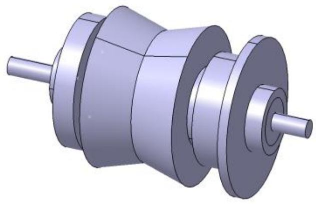

Fig. 7: Friction Wheel

### 3.3 Calculation

1) Engine maximum rpm- 8000rpm.
2) Ratio between engine output and friction wheel input is 4:1.
3) So friction wheel rpm is 8000/4 = 2000
4) Circumference of friction wheel is 37cm.
5) Circumference of outer wheel is 408cm.
6) So ratio of friction wheel and outer wheel is 408/37 = 11.02.
7) Then rpm of outer wheel is 2000/11 = 182.

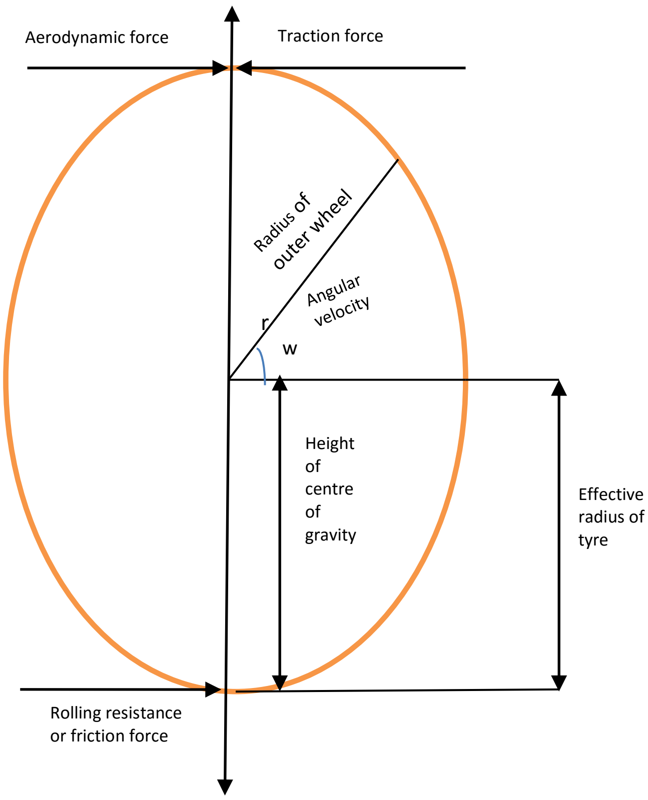


Fig. 8: Forces Acting On Monowheel

1) Center of gravity:

$$C.G. = \frac{M1 \times X1 + M2 \times X2}{M1 + M2}$$

Where, M1 = mass of left half side of monowheel

M2 = mass of right half side of monowheel

X1 = X2 = radius of outer wheel

$$\text{C.G.} = \frac{90\times65+50\times65}{90+50}$$

= 65 cm from the side

2) Height Of Centre Of Gravity

$$\text{H} = \frac{M1\times Y1+M2\times Y2}{M1+M2}$$

Where, M1 = mass of left half side of monowheel

M2 = mass of right half side of monowheel

X1 = X2 = radius of outer wheel

$$\text{H} = \frac{90\times65+50\times65}{90+50}$$

H = 65 cm from the ground

3) Rolling Resistance Force

$$F_R = \text{P} \times f_R$$

Where, $F_R$ = Rolling resistance force

P = Normal load on vehicle

$f_R$ = Coefficient of friction

$= 110 \times 9.81 \times 0.013$

$F_R =$ 14.02N

4) Aerodynamic Drag = Negligible

5) Cross Section Area Of Outer Wheel

$$\text{A} = \frac{\pi}{4}( D_0{}^2 - D_1{}^2)$$

Where, A = Cross section area of outer wheel

$D_0$ = Outer diameter of outer wheel

$D_1$ = Inner diameter of outer wheel

$$\text{A} = \frac{\pi}{4}(40^2 - 20^2)$$

$$\text{A} = 942.47\ mm^2$$

6) Stress On Outer Wheel

Assume,

$\sigma_c = 200\ \text{N}/mm^2$

$$\sigma_c = \frac{P}{A}$$

Where, $\sigma_c$ = Tensile stress on outer wheel

P = Load acting on outer wheel

A = Cross section area of outer wheel

$$\sigma_c = \frac{110\times9.81}{942.47}$$

$200 = 1.14\ \text{N}/mm^2$

$200 > 1.41$

7) Torque On Drive Wheel

$$T_w = \frac{Ix\times Io\times Te}{2}$$

Where, $T_w$ = Torque on drive wheel

$I_x$ = Ratio between engine output and friction wheel input

$Io$ = Final drive ratio

$T_e$ = Engine torque

$= Ix \times Io \times Te$ For Monowheel

$= 4 \times 11 \times 7.95$

$T_w$ = 349N-m

8) Wheel Force

$$F_W = \frac{Tw}{Rw}$$

Where, $F_W$ = Wheel Force

$T_W$ = Torque on wheel

$R_W$ = Radius of outer wheel

$F_W$ = 349/0.65

$F_W$ = 536. 92 N

9) Stopping Distance

$$\text{D} = \frac{v^2}{2\times\mu\times g}$$

Where, D = Stopping distance

$v^2$ = Velocity of vehicle

$\mu$ = Coefficient of friction

$g$ = Acceleration due to gravity

$$\text{D} = \frac{11.11^2}{2\times0.8\times9.81}$$

D = 7.86 m

9) Braking Force

$$\text{K.E.} = \frac{1}{2}mv^2$$

Where, K.E. = Kinetic energy

$m$ = Mass of vehicle

$v^2$ = Velocity of vehicle

$= \frac{1}{2} \times 110 \times (11.11^2)$

= 6788.7 J

$$= \frac{Kinetic\ Energy}{Stopping\ Distance}$$

$$= \frac{6788.7}{7.86}$$

= 863.70 N

## 4. ADVANTAGES

1) Fuel efficiency is more.
2) As compared to two wheeler, weight is reduced
3) Monowheel is cheaper than two wheeler.
4) Easy to man transport in industry.
5) Easy to park anywhere.

## 5. DISADVANTAGES

1) Turning problem.
2) Only one person can be seated.
3) During turning time handle so hard.

## 6. APPLICATION

1) For fun, entertainment and adventure purpose.
2) In bigger industry and company.
3) It is used in portland police department.

## 7. CONCLUSION

The driver must centralize his weight once the turn is complete. The balancing of vehicle is better at below 40km/hrs as compared to above 40km/hrs at the time of turning the driver feel the steering hard.

## 8. ACKNOWLEDGMENT

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