# Problems related to Design of Disc Brake

1) The distance between the pads center of pressure and the center of disc rotation is 0.12m and the coefficient of friction between the rubbing surfaces is 0.35. Determine the clamping force required to produce a braking torque of 82 Nm.

**Given**

$R = 0.12\ m$

$\mu = 0.35$

$T_B = 82\ N.m$

**To find:** $N$

**Solution:**

$$T_B = 2\mu N R$$

$$\text{clamping force, } N = \frac{T_B}{2\mu R} = \frac{82}{2 \times 0.35 \times 0.12}$$

$$\boxed{T_B = 976\ N}$$

**Result:**

$$T_B = 976\ N$$

2) A vehicle having a mass of 1275 Kg is brought to rest in a distance of 45m from a speed of 90 Km/h by its disc brake fitted to all four wheel. The effective diameter of the wheel is 0.7m. The disc units have two caliper fitted to each front wheel and one to each rear wheel. The caliper piston each have an area of 25.2 $cm^2$ (2 pistons per caliper) and the brake pad are situated at a radius of 105 mm from the disc axis (their coefficient of friction is 0.4). Determine the brake fluid pressure in the System during the braking period.

Given data:

$$m = 1275 \text{ kg}$$

$$S = 45 \text{ m}$$

$$V = 90 \text{ Km/h} = \frac{90}{3.6} = 25 \text{ m/s}$$

Wheel diameter = 0.7 m

Wheel radius = 0.35 m

$$n = 2+2+1+1 = 6$$

$$a = 25.2 \text{ cm}^2 = 25.2 \times 10^{-4} \text{ m}^2$$

$$R = 105 \text{ mm} = 0.105 \text{ m}$$

$$\mu = 0.4.$$

To find:

P

Solution:

formulas

$$P = \frac{T_B}{2 \times a \times \mu \times R \times n}$$

$T_B = f_B \times$ wheel radius $\Rightarrow F_B = m \times f$

$$f = \frac{V^2}{2S} = \frac{25^2}{2 \times 45}$$

$$\boxed{f = 6.94 \text{ m/s}^2}$$

$f_B = 1275 \times 6.94$

$$\boxed{f_B = 8854 \text{ N}}$$

$T_B = F_B \times$ wheel radius $= 8854 \times 0.35$

$$\boxed{T_B = 3099 \text{ N}}$$

$$P = \frac{T_B}{2a\mu Rn} = \frac{3099}{2 \times 25.2 \times 10^{-4} \times 0.4 \times 0.105 \times 6}$$

$$\boxed{P = 224 \times 10^4 \text{ N/m}^2}$$

Result: $P = 224 \times 10^4 \text{ N/m}^2$

3) The front wheels of a vehicle are fitted with two calipers per wheel. The disc operate at a radius of 150mm from the disc axis and they have a coefficient of friction of 0.45. The opposed piston in each unit are 36mm in diameter. The drivers pedal effort through the master cylinder raises the line pressure to 3560 $kN/m^2$ and this is raised to 5980 $kN/m^2$ by the action of the brake servo unit. The rear drum brake account for 36% of the front ~~axle~~ brake retarding torque. Determine the total braking torque during the retardation.

Given data:

$$P_s + P = 5980\ kN/m^2$$

$$R = 150mm = 0.15m$$

$$\mu = 0.45$$

$$d = 36mm = 0.036m$$

$$n = 2$$

To find:

Total Braking Torque during retardation

Solution:

Braking Torque produced by front brake $= 2(P_0 + P_s)a\mu R_n$

$= 2 \times 5980 \times \frac{\pi}{4} \times 0.036^2 \times 0.45 \times 0.15 \times 2$

$= 1.643 \text{ KN m}$

Braking Torque produced by front brake $= 1643 \text{ N m}$

Braking Torque produced by rear brake $= 0.36 \times 1643$

$= 591.5 \text{ Nm}$

Total Braking Torque $= 1643 + 591.5$

$= 2234.5 \text{ Nm}$

Result:

Total Braking Torque $= 2234.5 \text{ Nm}$

4) Two disc brakepad operate at a mean radius of 0.14m. The force applied to each pad is 4450N and the coefficient of friction between each pad and disc is 0.35. When the disc rotates at 500 rpm, calculate

(a) Frictional Torque

(b) The work done per minute by this torque

(c) The Heat energy generated per Second.

Given data:

Effective radius = 0.14 m

Force applied to pads = 4450 N

Coefficient of friction = 0.35.

No of pads = 2

To find:

(i) Frictional Torque

(ii) Work done per minute at the disc

(iii) Heat generated per second

Solution:

(i) Frictional Torque = Frictional force × Effective radius

Frictional force = Force applied to pads × No of Pads × Coefficient of friction

= ~~39~~ = 4450 × 2 × 0.35 = 3115

Frictional force = 3115 N

Frictional Torque = Frictional force × Effective radius of pad

= 3115 × 0.14 ⇒ 436

Frictional Torque = 436 N.m

(ii) Work done per minute at disc

= Frictional Torque × Angle turned through

= 436 × 2π N

= 436 × 2 × π × 500

= 1369040 J

= 1369 KJ

Work done per minute at disc = 1369 KJ

(iii) Heat generated per second = $\frac{\text{Work done/min}}{60} = \frac{1369}{60}$

Heat generated per second = 22.82 KJ

Result:

(i) Frictional Torque = 436 N.m

(ii) Work done per minute at disc = 1369 KJ

(iii) Heat generated per second = 22.82 KJ