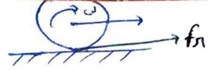

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Breaks

Breaks : It is a device by mean of each ~~anaky~~ artificial resistance is applied to a moving machine members to retard or completely stops its motion.

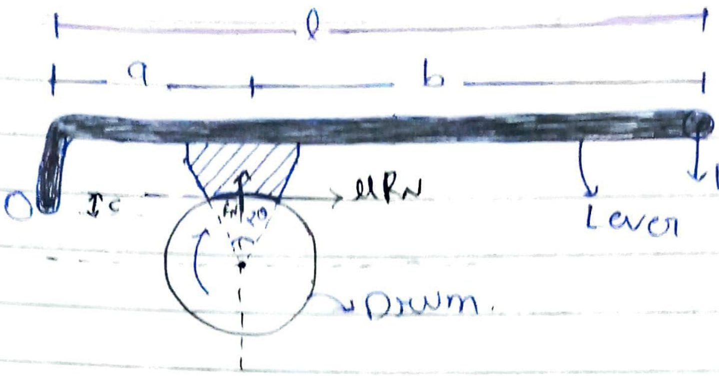
Types of Breaks :

- Block or Shoe brakes
- Band Brake
- Band and Block brake
- Internal Expanding Shoe brake
- Vaccume Brake.

Brake may also devided into two groups depending upon the dirn inwhich the force is applied.

- Radial Brakes : In this breakes the force act gradually On the drum.
  for example : Band, Block and internal expanding break.

- Axial Brake : In this breakes the force are applied axially on the drum.
  Eg : Disc and cone break.



Block or Shoe break

For clockwise direction of drum

Taking moment about O.

$$F \times l - R_N \times a + \mu R_N \times c = 0$$

$$F \times l = R_N a - \mu R_N \times c$$

$$F \times l = R_N(a - \mu c)$$

$$\left(\frac{Fl}{(a - \mu c)} = R_N \right) \quad \text{—— (I)}$$

Frictional Resistance

$$F_r = \mu R_N = \frac{\mu F l}{a - \mu c} \quad \text{—— (II)}$$

Braking torque

$$T_B = F_r \times r$$

$$\left[T_B = \frac{\mu F \times l \times r}{a - \mu c} \right]$$

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For anticlockwise direction of rotation of Drum :

Taking moment about O.

$$F \times l - R_N \times a - \mu R_N \times c = 0$$
$$F \times l = R_N a + \mu R_N \times c$$
$$F \times l = R_N (a + \mu c)$$
$$\left(\frac{F \times l}{(a + \mu c)} = R_N \right) \text{ --- (i)}$$

frictional ~~fo~~ Resistance

$$\left(F_r = \mu R_N = \frac{\mu F l}{(a + \mu c)} \right) \text{ --- (ii)}$$

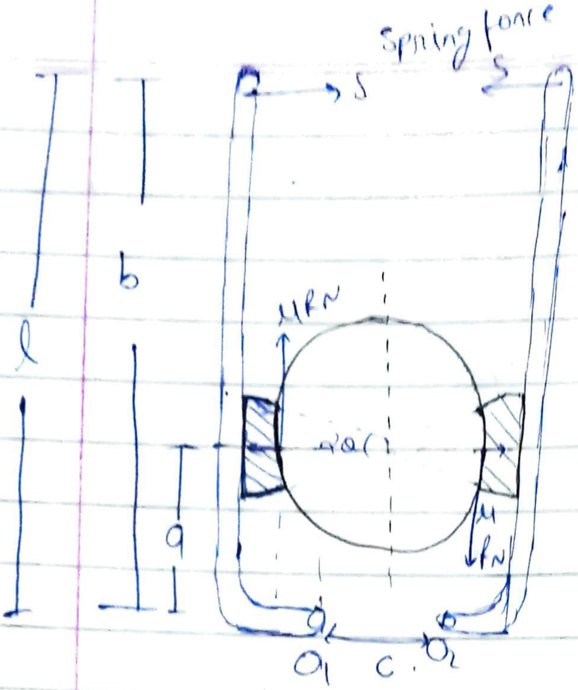
Braking torque.

$$T_B = F_r \times r$$
$$\left(T_B = \frac{\mu F l r}{(a + \mu c)} \right) \text{ --- (iii)}$$

It is assum that the normal reaction and the frictional force at the mid point of the block, generally a angle of contact 2θ is small but 2θ is more than 60° then equivalent Coefficient of friction is given by.

$$\boxed{\mu' = \frac{4 \mu \sin\theta}{2\theta + \sin 2\theta}}$$

*) angle > 60° then it use.



Taking moment about O_1

$$S_1 \times l - R_N \times a + \mu R_N \times c = 0$$

$$S_1 l = R_N a - \mu R_N \times c$$

$$\frac{S_1 l}{(a - \mu c)} = R_{N_1}$$

frictional resistance

$$F_{r_1} = \mu R_{N_1} = \frac{\mu F l}{(a - \mu c)}$$

Breaking Torque

$$T_{B_1} = F_r \times r$$

$$T_{B_1} = \frac{\mu F l r}{(a - \mu c)}$$

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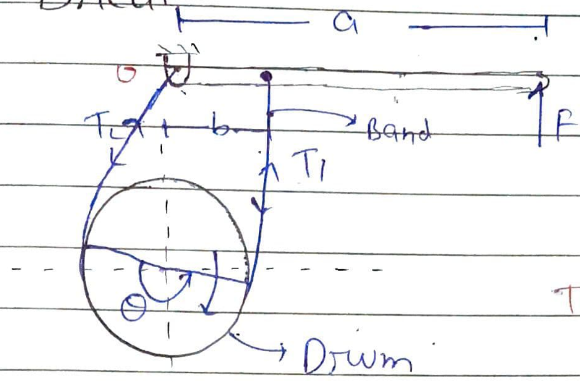
iii) Band Break:



Taking moment about O

$$-F \times a + T_1 \times b + 0 = 0$$

$$Fa = T_1 b \quad \text{--- (I)}$$

$$F = T_1 \times \frac{b}{a} \quad \text{--- (II)}$$

Or

$$T_1 = F \times \frac{a}{b} \quad \text{--- (III)}$$

$$\frac{T_1}{T_2} = e^{\mu\theta}$$

$$\frac{T_1}{T_2} = e^{\mu\theta}$$

$$T_B = (T_1 - T_2) r$$

$$\therefore T_2 = \frac{T_1}{e^{\mu\theta}}$$

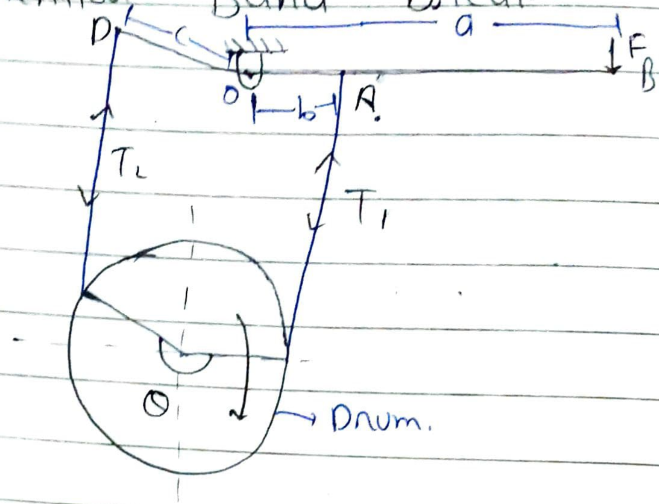
$$T_B = (T_1 - T_2) r$$

$$T_B = \left(T_1 - \frac{T_1}{e^{\mu\theta}} \right) r$$

$$T_B = T_1 \left(1 - \frac{1}{e^{\mu\theta}} \right) r$$

$$\boxed{T_B = F \times \frac{a}{b} \left(1 - \frac{1}{e^{\mu\theta}} \right) r}$$

iii) Differential Band break :



$$F \times a + T_1 \times b - T_2 \times c = 0$$

$$Fa = T_2 c - T_1 b \quad \text{--- (1)}$$

$$T_2 c > T_1 b$$

$$\cancel{c/b > T_1/T_2}$$

if $c > b$ the system ~~to~~ work satisfactory.

if $\dfrac{c}{b} = \dfrac{T_1}{T_2}$

$F = 0$ self locking condn of the break.

When, Drum rotates in anticlockwise dirn

$$\left(\frac{b}{c} = \frac{T_2}{T_1} \right)$$

iv) Band and block break : Band and block break arrangement is shown in fig. the band is lying with a no. of wooden blocks, each of which with in contact of a rim of drum.

(Balancing dynamometer)

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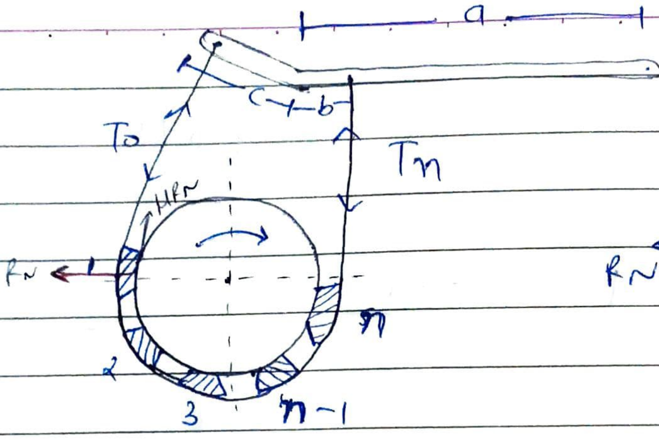
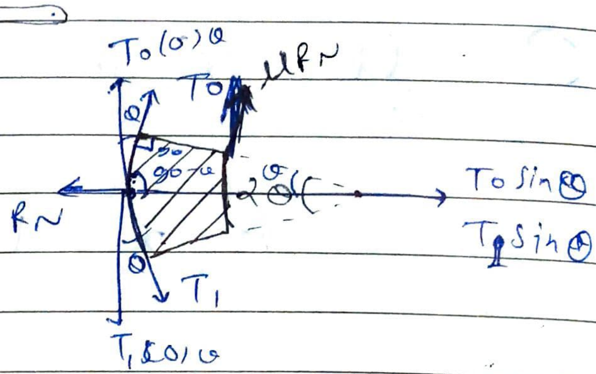
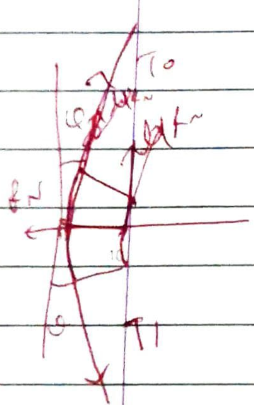






$$R_N = \sin\theta\,(T_1 + T_0) \quad \text{—— (1)}$$

$$\mu R_N = \cos\theta\,(T_1 - T_0) \quad \text{—— (2)}$$

on dividing eq^n (1) by (2)

$$\frac{1}{\mu} = \tan\theta \frac{(T_1 + T_0)}{(T_1 - T_0)}$$

$$\mu \tan\theta = \frac{(T_1 - T_0)}{(T_1 + T_0)} \quad \text{—— (3)}$$

on adding 1 on both side

$$1 + \mu \tan\theta = 1 + \frac{T_1 - T_0}{T_1 + T_0} \quad \text{—— (4)}$$

$$1 \mp \mu \tan\theta = 1 \mp \frac{(T_1 - T_0)}{T_1 + T_0} \quad \text{—— (5)}$$

$$1 + \mu \tan\theta = \frac{T_1 + \cancel{T_0} + T_1 - \cancel{T_0}}{T_1 + T_0} = \frac{2T_1}{T_1 + T_0}$$

$$1 - \mu \tan\theta = \frac{\cancel{T_1} + T_0 - \cancel{T_1} + T_0}{T_1 + T_0} = \frac{2T_0}{T_1 + T_0}$$

$$\frac{1 + \mu \tan\theta}{1 - \mu \tan\theta} = \frac{T_1}{T_0} \quad \text{—— (6)}$$

(Balancing to dynamometer)

for 2nd block

$$\frac{1+\mu\tan\theta}{1-\mu\tan\theta} = \frac{T_2}{T_1}$$

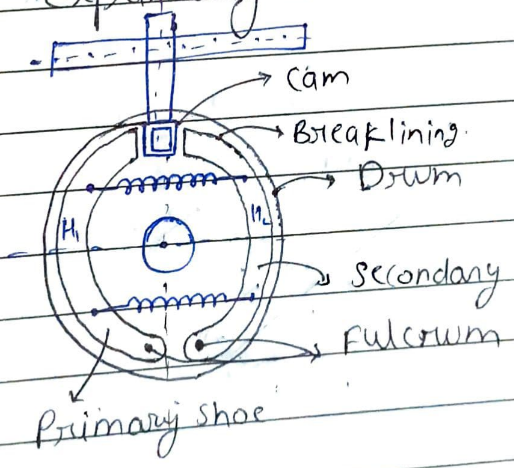
for n^{th} block

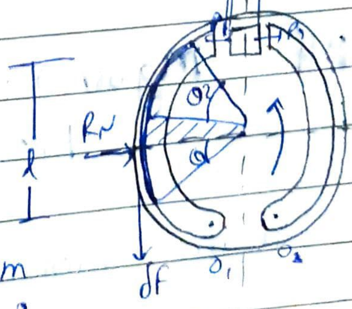
$$\frac{1+\mu\tan\theta}{1-\mu\tan\theta} = \frac{T_n}{T_{n-1}}$$

$$\frac{T_n}{T_0} = \frac{T_n}{T_{n-1}} \times \frac{T_{n-1}}{T_{n-2}} --- \frac{T_3}{T_2} \times \frac{T_2}{T_1} \times \frac{T_1}{T_0} = \left(\frac{1+\mu\tan\theta}{1-\mu\tan\theta}\right)^n$$

$$\boxed{\frac{T_n}{T_0} = \left(\frac{1+\mu\tan\theta}{1-\mu\tan\theta}\right)^n}$$

Internal Expanding Shoe breake :





P_1 = max^m intensity of pressure

P_n = normal pressure

r = Internal radius of drum

b = Breadth of break lining

T_b = Breaking torque

P_1 = force exerted by the Cam on the leading on primary Shoe., P_2 = force exerted by the Cam on the tralling or secondary shoe.

$M_N = \frac{1}{2} P_1 b r OO_1 \{ \theta$

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$P_1 l = M_n - M_F$

R_N = Normal reaction

F = frictional force

M_N = Moment of normal forces

M_F = Moment of frictional forces.

$$M_N = \frac{1}{2} p_1 b r OO_1 \left[(\theta_2-\theta_1) + \frac{1}{2}(\sin 2\theta_1 - \sin 2\theta_2)\right]$$

$$M_F = \mu p_1 b r \left[r(\cos\theta_1 - \cos\theta_2) + \frac{OO_1}{4}(\cos 2\theta_2 - \cos 2\theta_1)\right]$$

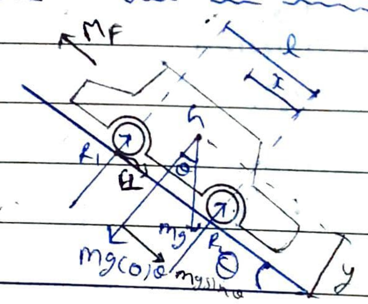
For leading shoe :

$$P_1 \cdot l = M_N - M_F$$

For Trailing shoe :

$$P_2 \cdot l = M_N + M_F$$

Breaking effect in a vehical : Breakes are applied on front wheels only.



$$MF = mg\sin\theta + F_1 \quad \text{—— (I)}$$

$$R_1 + R_2 = mg\cos\theta \quad \text{—— (II)}$$

Taking moment about G.

$$-F_1 \times y + R_1(l-x) - R_2 x = 0$$

$$F_1 y = R_1(l-x) - R_2 x \quad \text{—— (III)}$$

$\because F_1 = \mu R_1$ Put in eq^n (3)

$\therefore R_2 = mg\cos\theta - R_1$

$$\mu R_1 y = R_1(l-x) - xmg\cos\theta + R_1 x$$
$$\mu R_1 y = R_1 l - \cancel{R_1 x} - xmg\cos\theta + \cancel{R_1 x}$$
$$\mu R_1 y = R_1 l - xmg\cos\theta$$

$$xmg\cos\theta = R_1(l - \mu y)$$

$$\left(\frac{xmg\cos\theta}{(l-\mu y)} = R_1\right) \quad \text{———} \quad (\text{iv})$$

put R_1 in eq^n (1)

$$mf = mg\sin\theta + F_1$$
$$mf = mg\sin\theta + \mu R_1$$
$$\cancel{M}f = \cancel{m}g\sin\theta + \mu \frac{x\cancel{m}g\cos\theta}{l - \mu y}$$

$\cancel{Mf = mg}$

$$\left[f = g\sin\theta + \mu \frac{xg\cos\theta}{l - \mu y}\right]$$

Put $\theta = 0°$ for plane path

$$f = g\sin 0° + \mu \frac{xg\cos 0°}{l - \mu y}$$

$$\left[f = \frac{\mu x g}{l - \mu y}\right]$$