Breaks

Classification of break.

1. Mechanical break } used for low power absorption
2. Electrical break
3. Hydraulic break } High power absorption
4. Pneumatic break
   in train (Air break)

Mechanical break

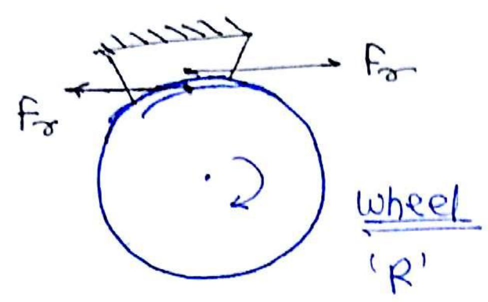
- Radial break
  - Block/shoe break
    - Short shoe break
    - long shoe break
  - Band break
    - Simple band
    - Differential break
  - Band-block break.
- Axial break.

Redial break ⇒ Force applied for breaking in Radial dirn.

Axial break → Force applied for breaking in axial dirn.

Break :- Break is defined as a machine element whose function is to retard a member, to bring the member into stationary condn, or to hold the body at rest.

Break perform above function by offering frictional resistance to a moving member by a stationary member like shoe.



$T_f = F_r \times R$

T_f = breaking torque.

Case(1) Drum is a Prime mover (Power P, N)

$$\text{Power} = \frac{2\pi N T_f}{60}$$

T_f = known (Breaking torque)

Case(II) Drum is not a prime mover [freely rotate]

$$\boxed{\omega_t = \omega_i + \alpha t}$$

α = known

$$\boxed{T_f = I.\alpha}$$

T_f = known

↳ breaking torque

$$\frac{\text{length}}{\pi D} = \text{no. of revo.} = n$$

$\theta = 2\pi n$

$\theta = \omega_t t + \frac{1}{2}\alpha t^2$

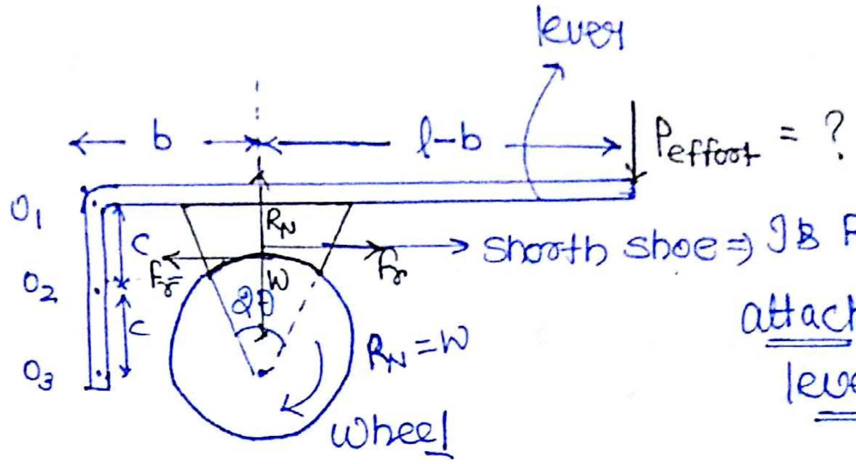
α = known

$T_f = I.\alpha$

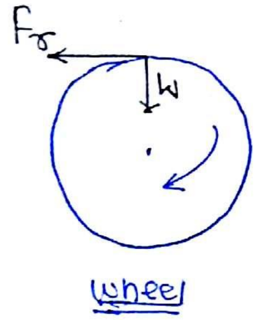
Shoe break

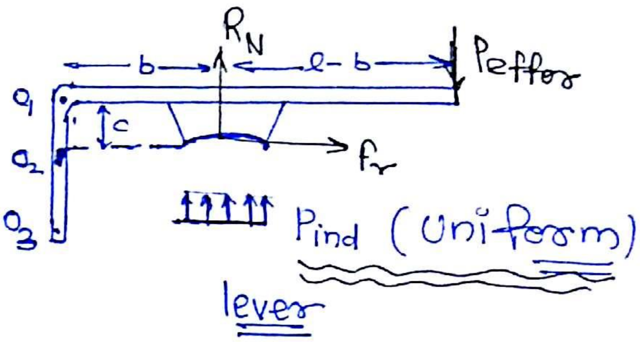
(short shoe)

$2\theta \leq 45^\circ$



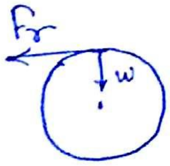
Shooth shoe ⇒ Is Rigidly attach with lever.





Case (I) Hinged at O_1:

wheel

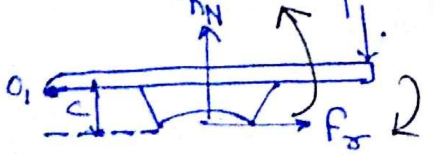


T_f = known $\{T_f = I \cdot \alpha\}$

$T_f = F_r \times R$, $F_r = \mu R_N$

R_N, W = known.

lever moment about O_1

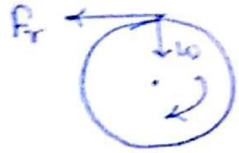


$R_N \cdot b + F_r C - P \cdot l = 0$, $F_r = \mu R_N$

$$\boxed{P_{effort} = \frac{R_N(b + \mu C)}{l}}$$

case-2 :- Hinged about O_2 :-

wheel

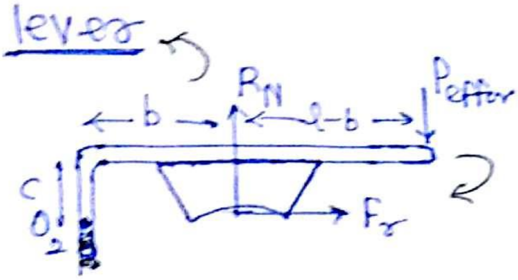


T_f = known

$T_f = F_r \times R$, $F_r = \mu R_N$

R_N, w = known.

lever



moment about 'O_2'

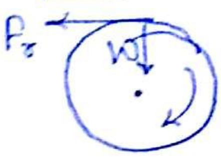
$$R_N \cdot b + F_r(0) - P.l = 0$$

$$\boxed{P = \frac{R_N . b}{l}}$$

P_{effort} = known

Case-3 Hinged about O_3 :-

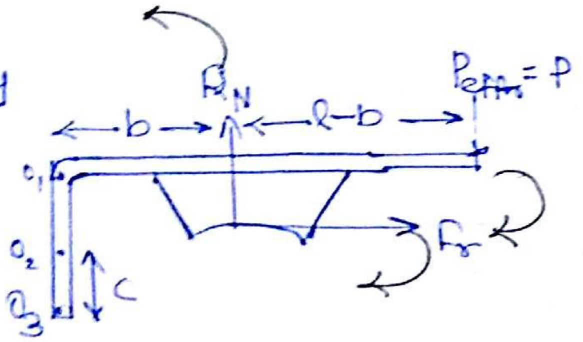
wheel



T_f = known

$T_f = F_r \times R$, $F_r = \mu R_N$

lever



$$R_N \cdot b - F_r(c) - P.l = 0$$

$$\boxed{P = \frac{R_N(b - \mu c)}{l}}$$

P_{effort} = known

* $P = \frac{R_N(b - \mu c)}{l}$

⇒ if $b = \mu c$ ⇒ $P_{effort} = 0$

- Self locking
or
- self breaking

} undesirable

⇒ if $b > \mu c$ ⇒ $P_{effort} = +ve$ ⇒ Controllable breaking

⇒ if $b < \mu c$ ⇒ $P_{eff} = -ve$ ⇒ Uncontrollable breaking.

Friction also supporting

In case-3 $R_N \cdot b - F_r(c) - P \cdot l = 0$

⇒ same direction.

⇒ self energising break.

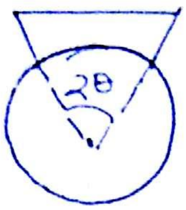
Conclusion:-

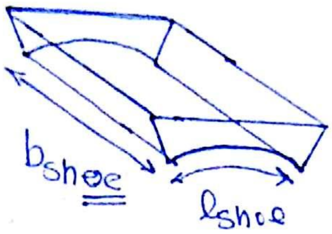
(i) Break is said to a self energising break when moment due to friction acting in same direction as moment due to effort.

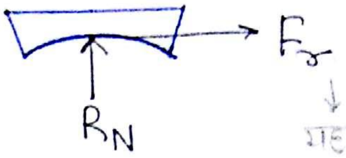
(ii) While ~~desing~~ designing the self energising break we does not permit self locking and uncontrollable breaking. (if ~~Ant~~ ACW O_1)

(iii) For the given Configration when drum rotate in clock wise dirn the fulcurm O_3 is the best fulcurm because it gives self energising break.

Design of shoe :-







यह तो होना ही चाहिए
Failure only RN से होगा

$$\boxed{l = R \cdot 2\theta}$$

$$P_{induced} = \frac{R_N}{l \cdot b}$$

Crushing (Compression)

Safe Condition

$$P_{ind} \leq P_{per.}$$

$$\frac{R_N}{l \cdot b} \leq P_{per.}$$

$$\frac{R_N}{(2\theta) R b} \leq P_{per.}$$

$$\boxed{(R_N)_{max} = (2\theta R)\, b .\, P_{per.}}$$

Q.6.7

R = 150 mm

$\mu = 0.25$

$T_f = F_r \times R$

$P_{eff} = 400\text{ N}$

$\cancel{l = 2\theta R}$

$\cancel{l = 2 \cdot \frac{\pi}{4} \cdot 0.150}$

$\cancel{l = 117.8\text{ mm}}$

$$R_N \times \cancel{200} = 400 \times \cancel{600}\ 3$$

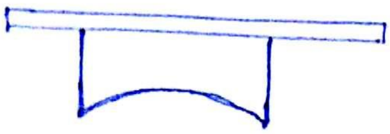
$$R_N = 1200\text{ N}$$

$$F_r = \mu R_N = 0.25 \times 1200$$

$$F_r = 300\text{ N}$$

$$T = 300 \times 0.150 = 45\text{ Nm}$$

Long shoe break :- ($2\theta > 45°$)



$P_{ind} \Rightarrow$ 

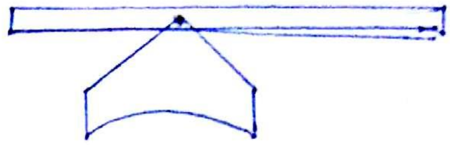
non uniform distribution

↳ Problem more wear.

$\Rightarrow$

~~long~~

Pivot



$P_{ind} \Rightarrow$ 

Uniform Pressure.

☆ $\Rightarrow$ long shoe is Pivoted on the lever to minimise wear.

$F_r = \mu R_N \Rightarrow$ ✗ not valid

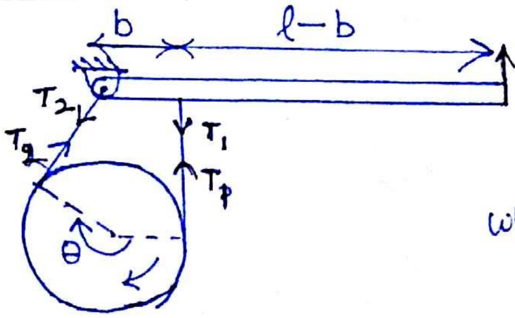
$\mu \longrightarrow \boxed{\mu_{eq} = \dfrac{4\mu \sin\theta}{2\theta + \sin 2\theta}}$ Replace μ by μ_{eq}

long shoe $\longrightarrow$ Short

↳ Convert in ↗

Band Break :-

Case-1 : simple band break



$P_{effort} = ?$

when we pull T_1, T_2 comes

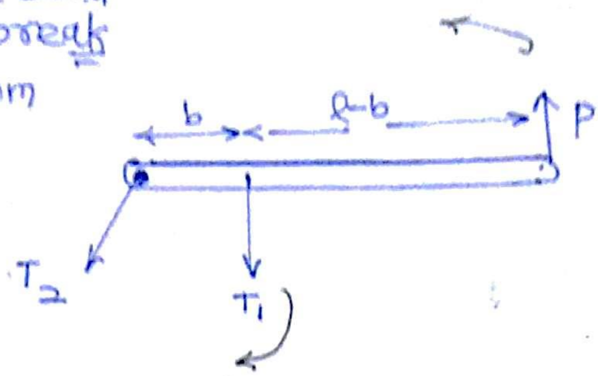
θ = Angle of wrap/overlay

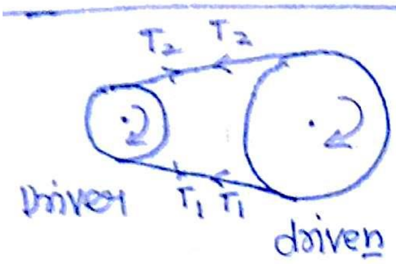
FBD

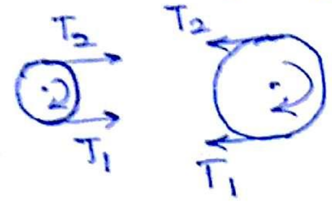
$T_1 > T_2$

simple band break

T_2 Pass from Hinge







$\boxed{T_1 > T_2}$

driven બાજુથી [illegible]

wheel → frictional torque

T_f = known

$$\boxed{T_f = (T_1 - T_2)R} \quad \text{—(I)}$$

$$\boxed{\frac{T_1}{T_2} = e^{\mu\theta}} \quad \text{—(II)}$$

$$\boxed{e^{\mu\theta} > 1}$$

Find T_1 & T_2

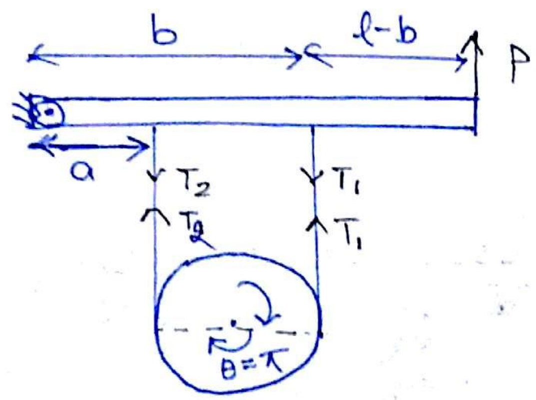
$T_1 \rightarrow$ large
$T_2 \rightarrow$ small
} Always assume

lever

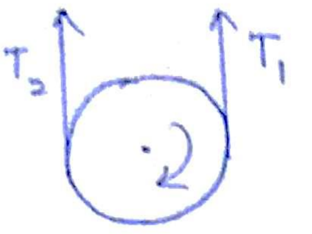
$$T_1 b - P.l = 0$$

$$\boxed{P = \frac{T_1 b}{l}}$$

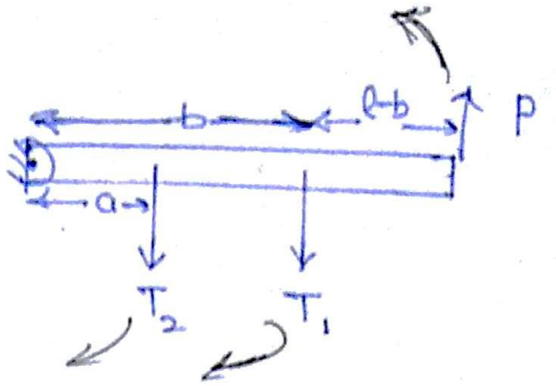
Case - 2 Differential band break



Wheel



$T_1 > T_2$



$$T_2 a + T_1 b - Pl = 0$$

$$P = \frac{T_1 b + T_2 a}{l}$$

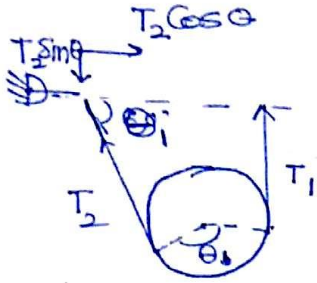
P = known

T_f = known

$T_f = (T_1 - T_2) \times R$ — ①

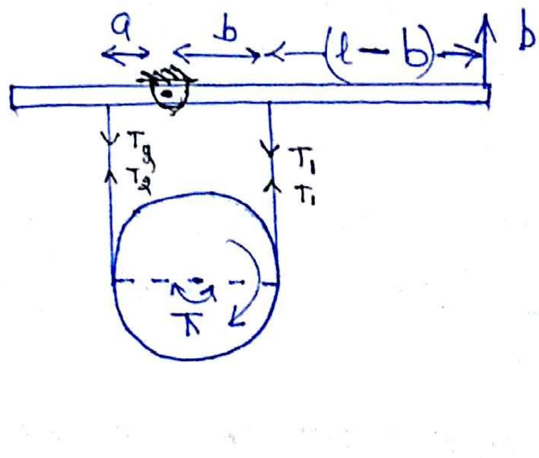
large → $\frac{T_1}{T_2} = e^{\mu\theta}$ — ②
small →

⇒ if



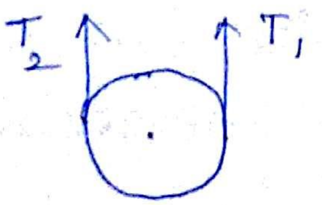
Case-3

Differential



FBD

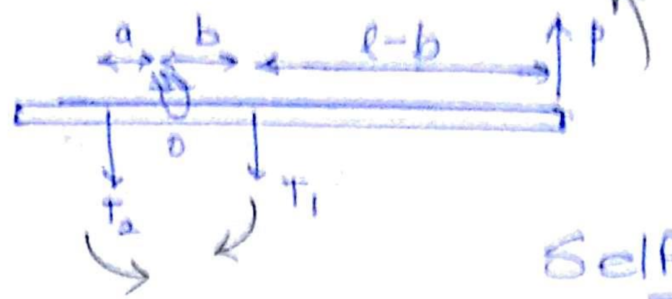
Wheel



$T_f = (T_1 - T_2) \times R$ — ①

$\frac{T_1}{T_2} = e^{\mu\theta}$ — ②

lever



Self energizing break

moment at '0'

$$T_1 b - \underline{T_2 a} - \underline{P l} = 0$$

$$P = \frac{T_1 b - T_2 a}{l}$$

if $T_1 b > T_2 a \Rightarrow P = +ve$ Controllable breaking

$T_1 b = T_2 a \Rightarrow P = 0$ self locking

$T_1 b < T_2 a \Rightarrow P = -ve$ Uncontrollable breaking

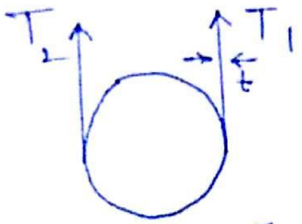
Conclusion

(i) break is said to be self energizing ~~bear~~ break when moment due to tension (T_2) is in same direction as moment due to effort

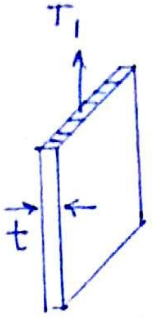
(ii) While designing the self energizing break we doesn't permit self locking & Uncontrollable breaking.

(iii) For the configration break no. 3 is the best break either the wheel rotate in cw/ACW dirn because it gives self energizing break.

Design of band :-



$T_1 > T_2$



$$(\sigma_{iAd})_{max} = \frac{T_1}{bt}$$

Safe Cond^n

$$\sigma_{max} \leq \sigma_{per.}$$

$$\frac{T_1}{bt} \leq \sigma_{per.}$$

$$\boxed{T_{max} = b.t.\ \sigma_{per.}}$$

$\Downarrow$

Strength of bend