6. BRAKES

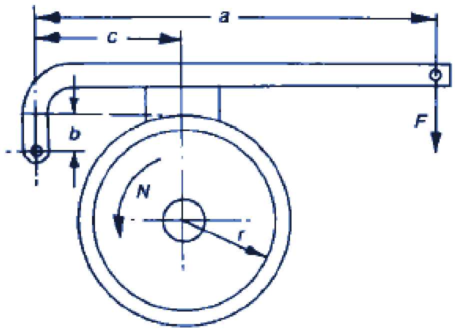
BRAKES: It's machine member used either to reduce the motion of machine or to bring the machine to rest.

Mechanical Energy Consumption	KE Consumption	Friction (Brakes) is applied and heat is generated.
	PE Consumption	E.g.…Case of Flat surface and inclined surface.

SHOE BRAKES:

P = Applied Load on operating lever, R = Reaction between friction lining and rotating wheel, l = Shortest distance between the Line of action of 'P' and fulcrum 'O', a = Shortest distance between the Line of action of 'R' and fulcrum 'O',	b = Shortest distance between the Line of action of 'F' and fulcrum 'O', 2θ = Angle subtended by shoe at centre, Applied moment = Pl (Clockwise) Reaction moment = Ra (Anti-Clockwise)

Non-Self Energising Shoe Brake:
Friction Force F = μR (Leftward on lever and Rightward on Wheel)
Additional moment = Fb (Anti-Clockwise)
If there is no additional moment in the direction of applied moment, the brake is said to be Non-Self Energising Shoe Brake.
At equilibrium Sum of moments at 'O' = 0
$R = Pl/(a + \mu b)$
Braking Torque = F r_d = μR r_d , Where r_d = Radius of wheel



Self-Energising Shoe Brake:
Friction Force F = μR (Rightward on lever and Leftward on Wheel)
Additional moment = Fb (Clockwise)
If there is additional moment in the direction of applied moment, the brake is said to be Self-Energising Shoe Brake.
At equilibrium Sum of moments at 'O' = 0
$R = Pl/(a - \mu b)$
Braking Torque = F r_d = μR r_d , Where r_d = Radius of wheel

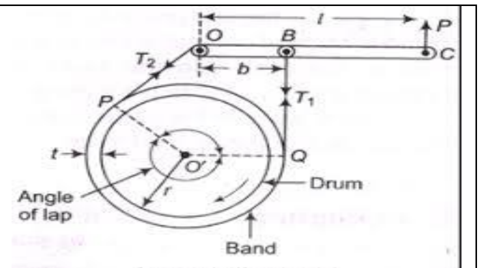
Self-Locking of Shoe Brake: It's extreme condition of self-energising brake.
At without Applied Load on operating lever (P = 0), Braking is present.
This effect encounters by extreme wear of brakes. Useful in Cranes.
Hence, limiting Condition for Self-Locking => **a = μb**

Equivalent Co-efficient of friction (μ'):
Uniform Pressure condition => 2θ ≤ 45° => Short Shoe => Braking Torque = F r_d = μR r_d
Uniform wear condition => 2θ > 45° => Long Shoe => Braking Torque = F r_d = μ'R r_d

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

SIMPLE BAND BRAKES: One end of band is connected to operating lever and another end to fulcrum.

$F = T_1 - T_2$ $\frac{T_1}{T_2} = \frac{P_{max}}{P_{min}} = e^{\mu\theta}$ $P_{max} = \frac{T_1}{r_d w}$, $P_{min} = \frac{T_2}{r_d w}$ Braking Torque, $T_b = (T_1 - T_2) r_d$ **Simple Band Brake is never self-energising brake.**	F = Total Friction Force, T1= Tension on Tight Side, T2 = Tension on Slack Side, θ = Angle of wrap, P_{max} = Maximum radial pressure due to normal reaction force on element P_{min} = Minimum radial pressure due to normal reaction force on element w = Width of band



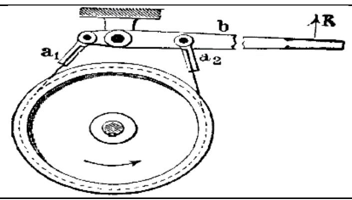
Simple band brake

DIFFERENTIAL BAND BRAKES: No end of band is passing through fulcrum.

$\frac{a}{b} \le \frac{T_1}{T_2} \le \frac{b}{a} < 1$

Both direction of rotation of brake It's self-energise but only in one direction of rotation it's self-locking.

Correct Sequence: b-O-a (b-L)



BAND-BLOCK BRAKES:

Braking Torque, $T_b = (T_1 - T_2)(r_d + t)$ $\frac{T_1}{T_2} = \left[\frac{1 + \mu \tan\theta}{1 - \mu \tan\theta}\right]^n$	2θ = Angle subtended by shoe at centre, P = Applied Load on operating lever, T = Reaction Force, n = No. of shoes,	r_d = Radius of wheel, t = Thickness of shoes,