A LECTURE NOTE
ON
TH.1 THEORY OF MACHINE
SEMESTER -4

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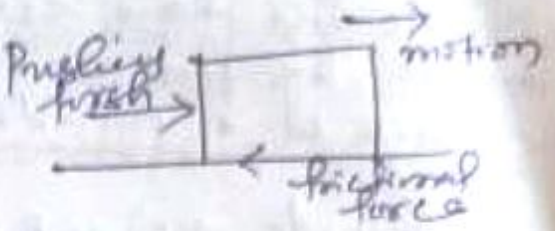
Sr. Lecture Mechanical Engineering

Mechanical Engineering

GOVT. POLYTECHNIC, MALKANGIRI

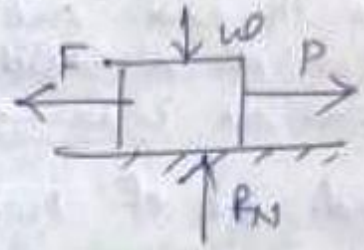
Friction:- It is the opposing forces, which act in the opposite direction of the movement of the upper body, is called "frictional force" or "friction".



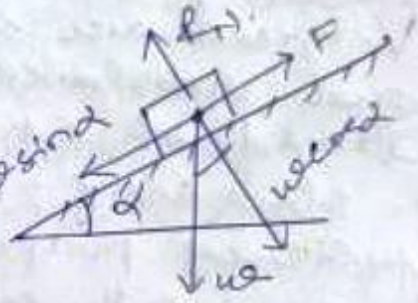
Co-efficient of friction:-

"The ratio of limiting friction to the normal reaction is known as co-efficient of friction (μ).

$$\mu = F/R_N$$



Angle of repose (α)



$W \sin\alpha = F$

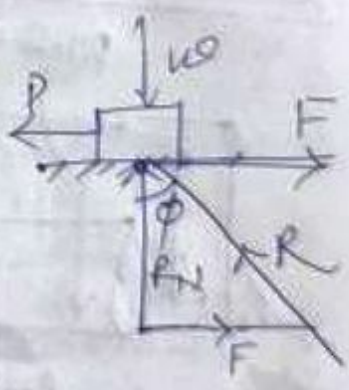
$W \cos\alpha = R_N$.

$$\frac{F}{R_N} = \mu = \frac{W \sin\alpha}{W \cos\alpha}$$

$$\boxed{\mu = \tan\alpha}$$

Angle of friction (ϕ)

It is the angle between resultant of frictional force and normal reaction and the normal reaction



$$\boxed{\tan\phi = \frac{F}{R_N} = \mu}$$

Screw friction :-

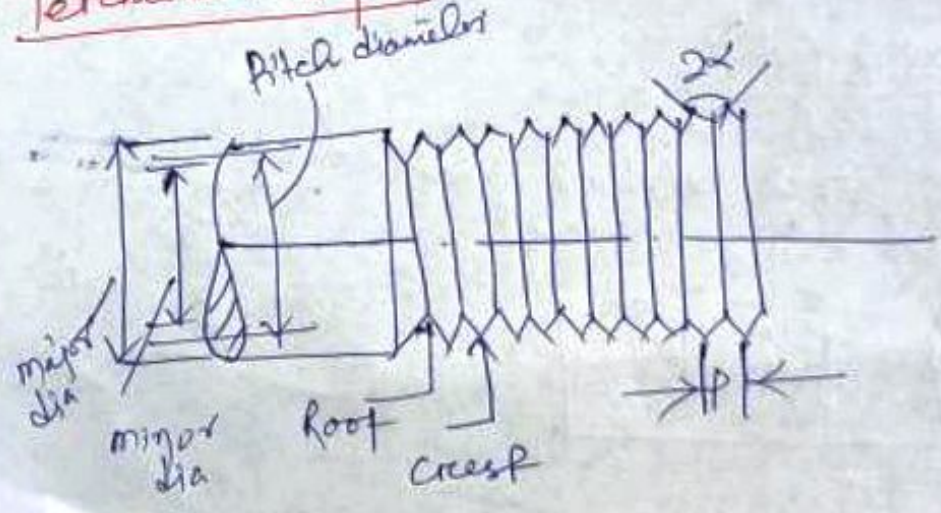
Friction Between nut & Bolt

fastening have screw thread which are made by cutting a contiguous helical groove on a cylindrical surface.

* If threads are cut on a outer surface of a solid rod, these are known as external thread.
* If the threads are cut on the internal surface of a ~~solid~~ hollow rod, these are known as internal thread.
* Threads are of two types → V-thread, Square thread.

V-threads are stronger and offer more frictional resistance to motion than square threads. Adv of v thread that its preventing from slackening. Hence V threads are used for fastening purpose i.e nut & bolts. where square threads are used in screw jack, vice screw etc.

Terminology



Helix:- It is the curve traced by a particle while moving along a screw thread.

Pitch:- It is the distance from a point of a screw to a corresponding point on the next thread, measured parallel to the axis of the screw.

Lead:- It is the distance, a screw thread advances axially in one turn.

Depth of thread:- It is the distance between top and bottom surface of a thread.

If Lead = Pitch (Single threaded screw)
Lead = n × Pitch (multi threaded screw)

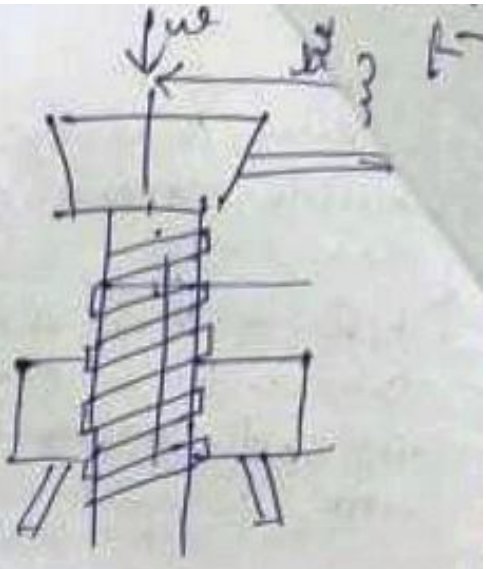
Helix angle:- It is the slope/inclination of the thread with the horizontal.

$$\tan\alpha = \frac{\text{lead of screw}}{\text{circumference of screw}}$$

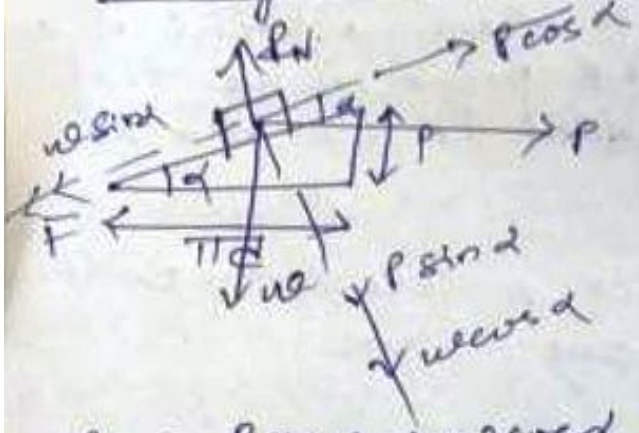
$$= P/\pi d \quad (\text{single})$$
$$= nP/\pi d \quad (\text{multi})$$

α = helix angle,
P = pitch
d = mean dia
n = no. of threads in one lead.

Screw Jack



Torque required to lift the load by screw jack.



$$R_N = P\sin\alpha + w\cos\alpha$$

$$F + w\sin\alpha = P\cos\alpha$$

$$\mu R_N + w\sin\alpha = P\cos\alpha$$

$$\mu(P\sin\alpha + w\cos\alpha) + w\sin\alpha = P\cos\alpha$$

$$\mu P\sin\alpha + w\mu\cos\alpha + w\sin\alpha = P\cos\alpha$$

$$w(\sin\alpha + \mu\cos\alpha) = P(\cos\alpha - \mu\sin\alpha)$$

$$w(\sin\alpha + \tan\phi\cos\alpha) = P(\cos\alpha - \tan\phi\sin\alpha)$$

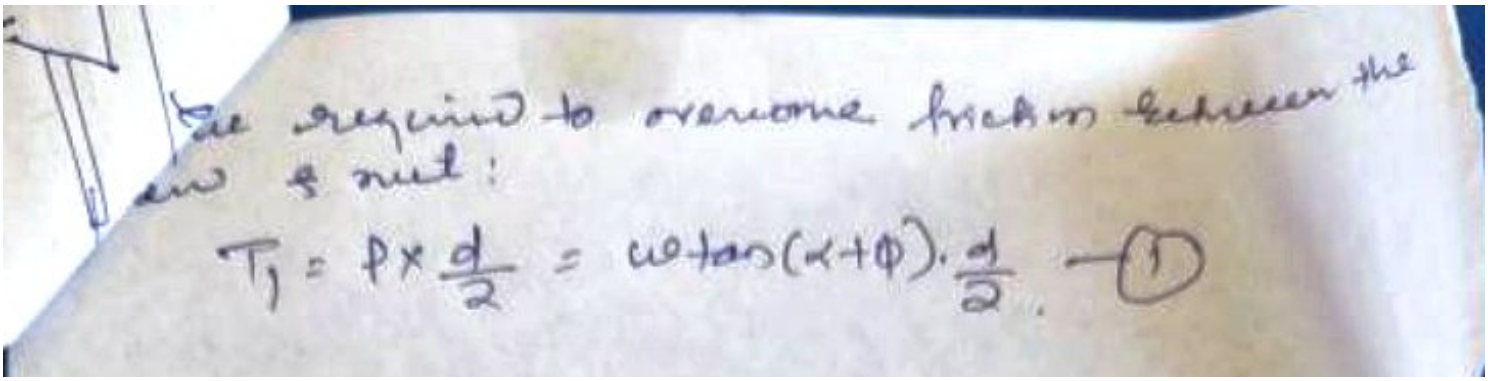
$$w\left(\sin\alpha + \frac{\sin\phi}{\cos\phi}\cdot\cos\alpha\right) = P\left(\cos\alpha - \frac{\sin\phi}{\cos\phi}\sin\alpha\right)$$

$$w\left(\frac{\sin\alpha\cdot\cos\phi + \sin\phi\cdot\cos\alpha}{\cos\phi}\right) = P\left(\frac{\cos\alpha\cdot\cos\phi - \sin\phi\cdot\sin\alpha}{\cos\phi}\right)$$

$$w(\sin(\alpha+\phi)) = P(\cos(\alpha+\phi))$$

$$P = w\cdot\frac{\sin(\alpha+\phi)}{\cos(\alpha+\phi)}$$

$$\boxed{P = w\cdot\tan(\alpha+\phi)}$$


be required to overcome friction between the
and nut:
$T_1 = P \times \frac{d}{2} = W \tan(\alpha + \phi) \cdot \frac{d}{2}$ — (1)