UNIVERSITY OF NAIROBI

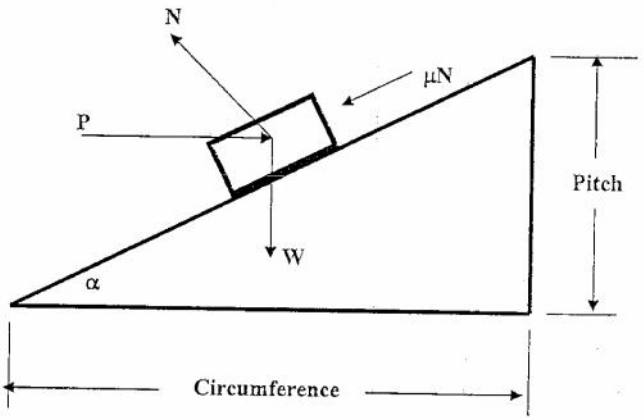
DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING

FME 211/212 – THEORY OF MACHINES

SCREW JACK

A screw thread can be regarded as an inclined plane rapped round a cylinder. The shape of the plane being found from

$$\text{Tan} = \frac{Pitch}{\pi \, x \, Mean \; diameter}$$

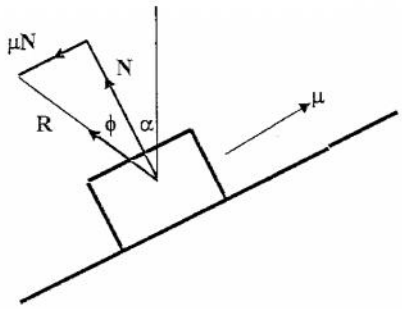


If a weight W is forced up the plane by a horizontal force P, it will be resisted by the force of friction μN where N is the normal reaction of the plane. When the weight starts to move up the plane, there will be a force μN down the plane and a reaction N normal to the plane. The resultant **R** will be inclined at the friction angle **α** to the normal. The friction angle is defined as $\tan \varphi = \mu$.

This reaction **R** will be the resultant of the horizontal force **P** and the weight **W**.

$\therefore$ P = W tan $(\varphi + \mu)$.....(i)

$$= W \frac{\tan\alpha + \tan\phi}{1 - \tan\alpha \tan\phi}$$



But $\tan\phi = \mu$

$$\therefore P = W \left(\frac{\tan\alpha + \mu}{1 - \mu\tan\alpha} \right) \quad \text{.....(ii)}$$

In the case of a screw jack the torque required to turn the nut is $T = P. \frac{d}{2}$

Where d is the mean diameter of the screw.
Substitution for P from equation (ii)

$$T = \frac{Wd}{2} \left(\frac{\tan\alpha + \mu}{1 - \mu\tan\alpha} \right) \quad \text{.....(iii)}$$

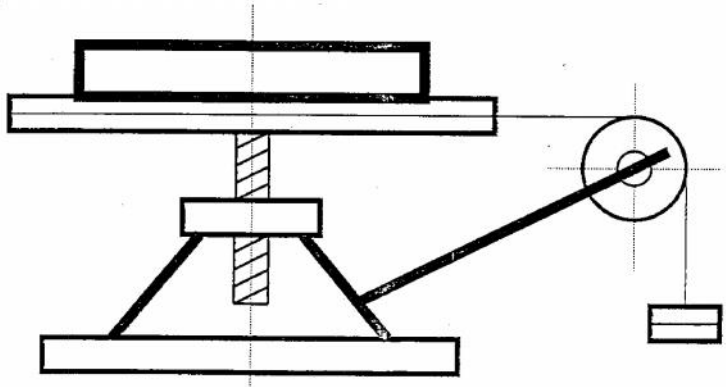
For lowering a load the expression will be altered by change of direction of the friction angle.

$$T = \frac{Wd}{2} \left(\frac{\tan\alpha - \mu}{1 + \mu\tan\alpha} \right) \quad \text{.....(iv)}$$

If μ is less than $\tan\alpha$, **T** will be positive, that is in the same direction as for lifting. This means that unless the screw is restrained, it will lower the load by itself.

OBJECT: To determine the Efficiency of a Screw Jack, and the Coefficient of Friction between the screw threads.

APPARATUS: Screw Jack fitted with a weight platform and a means of applying a known **torque** to the screw.



METHOD

Measure the **pitch and mean diameter** of the screw, and the **radius of the rope drum.** Place loads from **2 to 20 kg** on the platform and determine the **torque** required to turn pulley **A** in this experiment. Take the necessary measurements to determine this correction

RESULTS

The figures for load Vs torque should be plotted as a graph together with the efficiency η

$$\eta = \frac{work\ out}{work\ in} = \frac{Load\ x\ Pitch}{2\pi\ x\ Torque}$$

The coefficient of friction μ for both raising and lowering the load should be calculated from the equation:

$$\mu = \frac{\frac{2T}{W} - d\tan\alpha}{\frac{2T}{W}\tan\alpha + d}$$ **For raising**

And

$$\mu = \frac{d \tan \alpha - \frac{2T}{W}}{\frac{2T}{W} \tan \alpha + d}$$ **For lowering**

CONCLUSIONS

Discuss the results, and indicate possible sources of error.