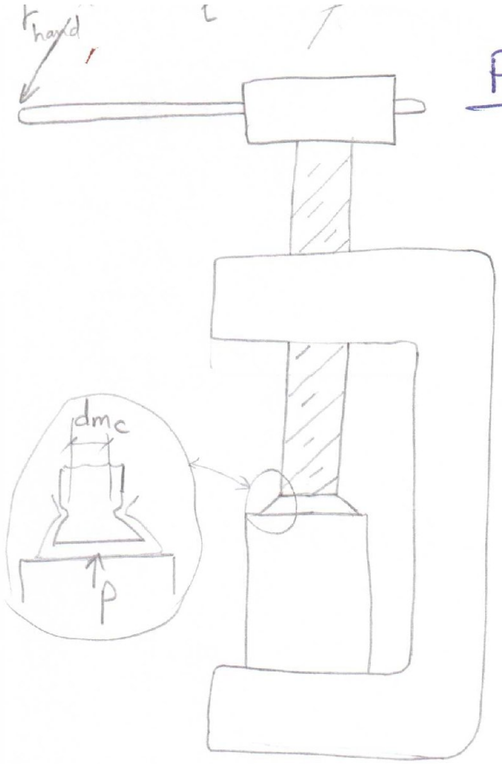
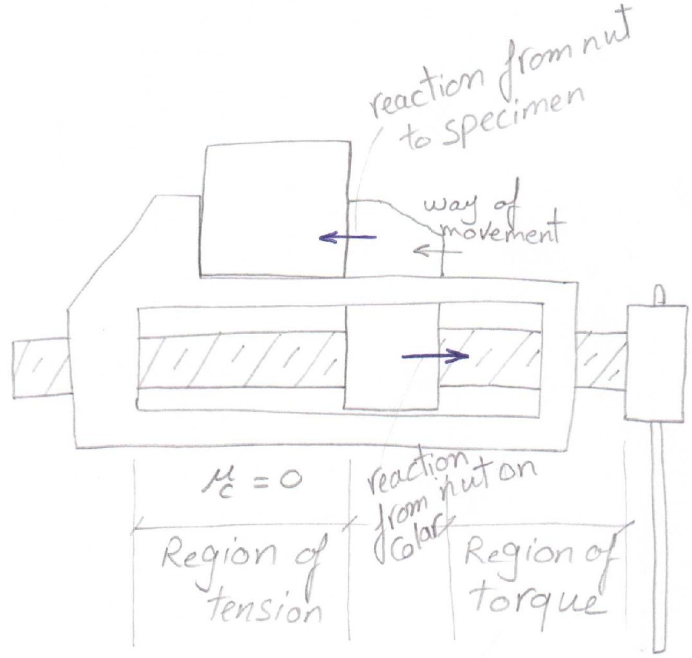
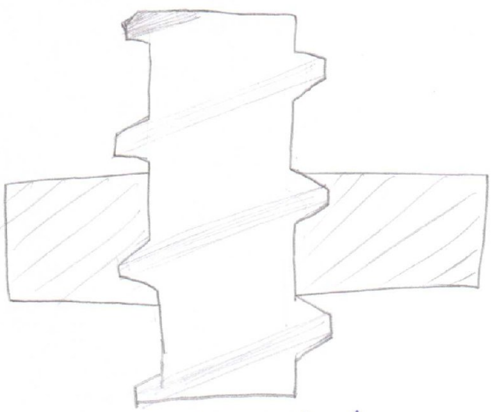
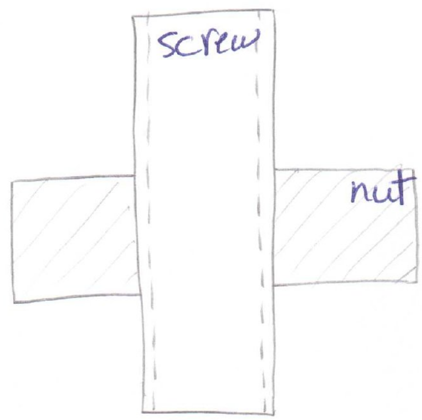
power screw

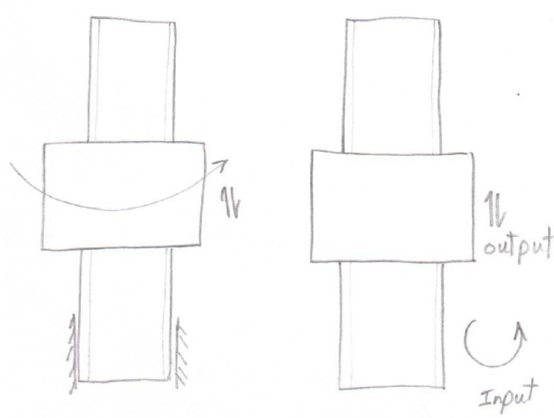


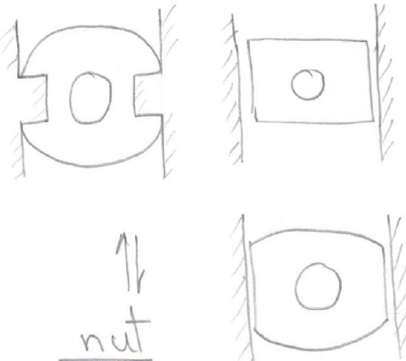


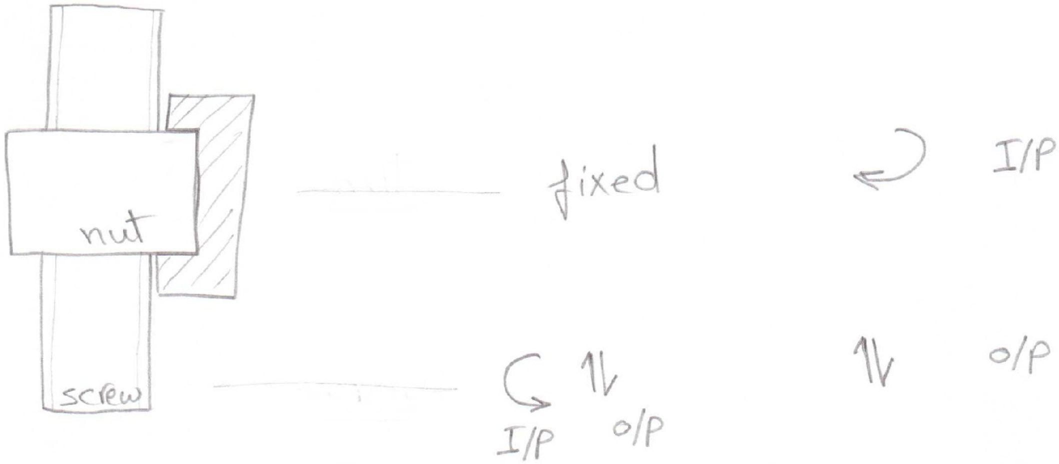


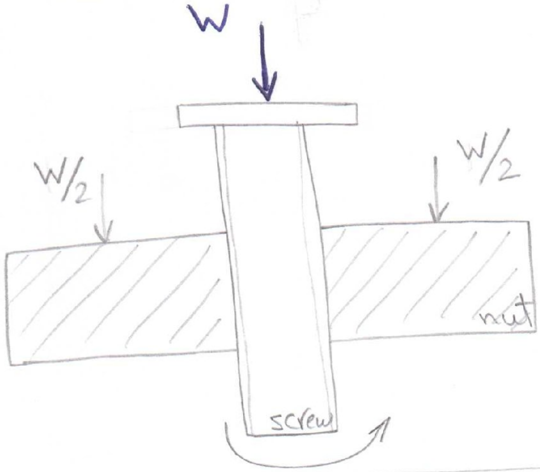


* relative motion between screw and nut









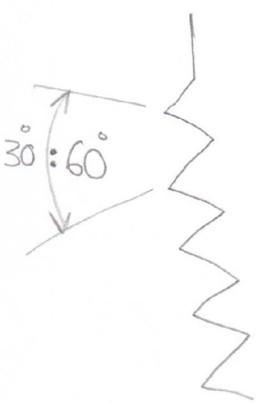
* force on nut
 and torque on screw

or

* force on screw
 and torque on screw too

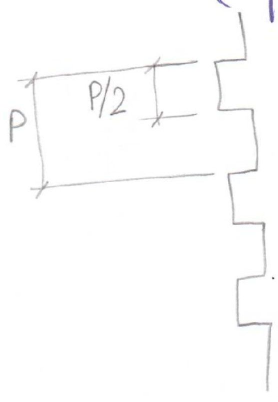
Threads

*Triangular



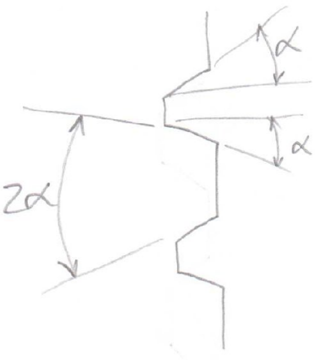
more frictional
less efficiency

*Rectangular (square)



$P = d_o - d_i$

*trapezoidal



* iso-trapezoidal
 $2\alpha = 30^\circ$

single thread $n=1$ | double & more $n=2$

$$L = nP$$

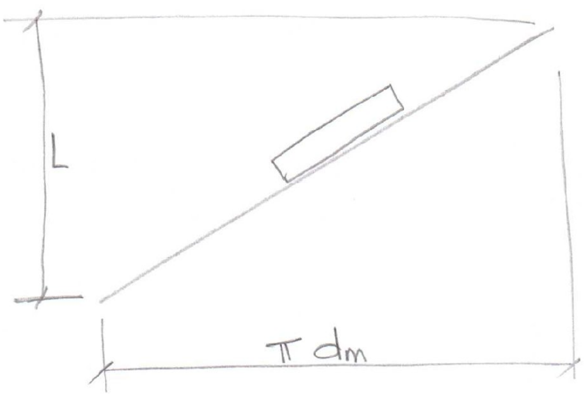
(L) depends on no. of threads

lead $(L) = P$ | $L = 2P$

* double thread has more efficiency in moving than single thread for same no. of teeth for one thread.

$$d_m = \frac{d_o + d_i}{2}$$

- if a point on a single thread of screw moves <u>one cycle</u> it moves a distance equal to a pitch



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* High friction between fastners and members used for high hold.
* low friction in power screw is needed to transmit motion (from rotational motion to linear motion).

Force Analysis   * for lifting & lowering

force
$$F = W\left[\frac{\pi \mu d_m + L}{\pi d_m - \mu L}\right]$$

torque
$$T = W * \frac{d_m}{2}\left[\frac{\pi \mu d_m \pm L}{\pi d_m \mp \mu L}\right]$$
lifting / lowering

* ↑ lifting → opposite direction to load ↓
  ↓ lowering → indirection ~ of ~ ↓
* d_m : mean diameter   L: lead μ: Coefficient of friction
  W : exerted force ⟹ (square thread)
* $L < \pi d_m \mu$ self locking
  $L > \pi d_m \mu$ not self locking
* IF $\mu = 0$ (no friction Case) $T_o = \frac{WL}{2\pi}$
* Efficiency $\eta = \frac{T_o}{T}$
* for (trapezoidal thread) with an axial load (Colar betn rotating and stationary members)

$$T = \frac{W d_m}{2}\left[\frac{\pi \mu d_m \sec\alpha + L}{\pi d_m - \mu L \sec\alpha}\right] + T_c$$

α: trapezoidal angle
T_c : Colar frictional torque $T_c = \frac{\mu_c W d_{mc}}{2}$

في حالة وجود أي bearing

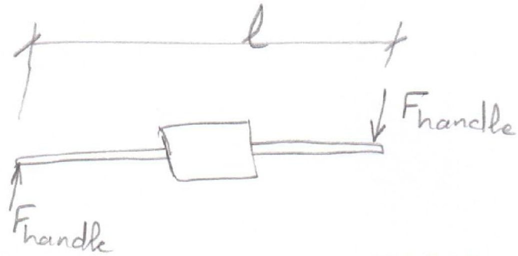
$\therefore T_c = 0$

* stresses in power screw

① screw

sec A – A

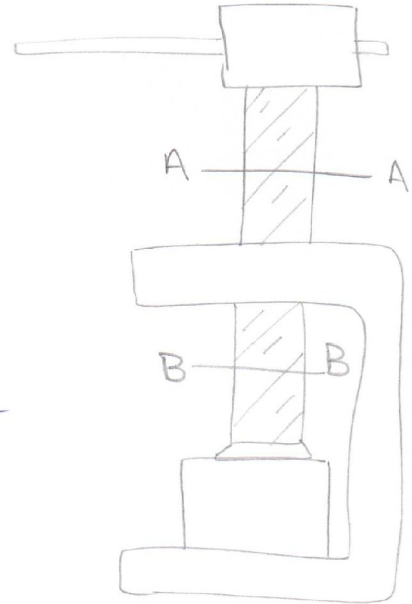
torsion $\tau = \frac{T * r}{J}$



bending $\sigma_b = \frac{My}{I}$

$M = F_{handle} * l$

$\tau_{max} = \sqrt{\left(\frac{\sigma_b}{2}\right)^2 + \tau^2} = \frac{0.5\, S_y}{f.s.}$



sec B – B

Compression

$\sigma_c = \frac{W}{A} = \frac{W}{\frac{\pi}{4} d_i^2}$

check for buckling $F_{cr} =$ —

torsion $\tau = \frac{T_c * r}{J}$

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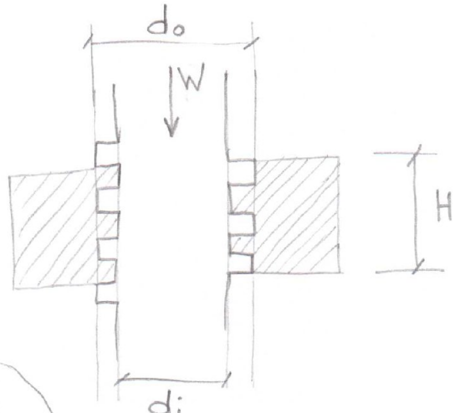
② thread

Load/tooth $= \frac{W}{\text{no. of teeth } (N)}$



H = height of nut = $N * P$

Area of shear stress $= \pi d_i * \frac{P}{2}$

$\tau_{\substack{screw\\steel}} = \frac{\text{Load/tooth}}{\text{Area}} = \frac{W/N}{\pi d_i * \frac{P}{2}}$

$= \frac{2W}{\pi d_i H}$

$\tau_{\substack{nut\\bronze}} = \frac{2W}{\pi d_o H}$ → screw

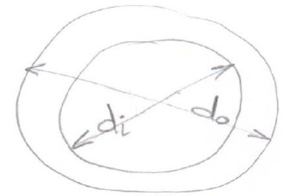
bearing

$$\sigma_{br} = \frac{\text{load / tooth}}{\text{projected area}} = \frac{W/N}{\frac{\pi}{4}\left(d_o^2 - d_i^2\right)}$$

$$= \frac{W/N}{\frac{\pi}{4}\left(d_o - d_i\right)\left(d_o + d_i\right)}$$

$$= \frac{W}{\frac{\pi}{4} * 2 d_m * P * N}$$

$$\sigma_{br} = \frac{2W}{\pi d_m H}$$



$d_o + d_i = 2 d_m$

$d_o - d_i = P$