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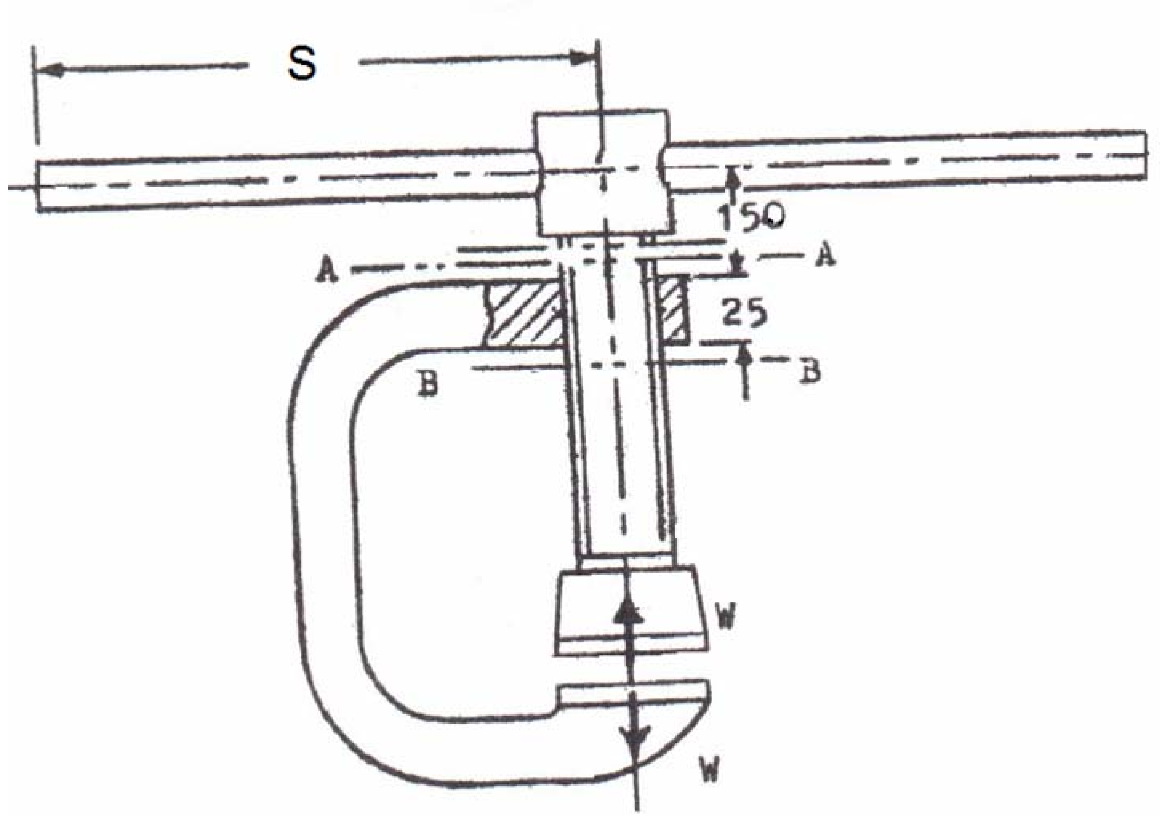
College of Engineering & Technology

Department: Mechanical Engineering   Marks: 20
Lecturer: Dr. Rola Afify   Time: 1.00 - 2.00
Course Code: ME356   Date: 16/12/2015

Name: **Model Answer**   R.N.:

Answer the following question:



The 70 mm screw of a 10 kN shop press, shown in Figure, has a trapezoidal thread with an angle of 28. The operator's force may be taken 180 N for each hand. The mean diameter of collar is 60 mm.

You may use this

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

Determine:

$d_o = 70\ mm$ trapezoidal $2\alpha = 28^\circ$

$W = 10\ KN = 10^4\ N$ $\therefore \alpha = 14^\circ$

$F_{handle} = 180 N$ $L_{handle} = 2S$

$d_{mc} = 60\ mm$ single thread $L = P = 12 mm$

a) The length S, assuming that the coefficient of friction is 0.12 in the threads and 0.125 at the collar. The inner diameter is 58 mm. The pitch is 12 mm.

Determine :-

a) $S = ??$ $\mu = 0.12$ $\mu_c = 0.125$

$d_i = 58$ mm $P = 12$ mm

Soln

$$d_m = \frac{d_i + d_o}{2} = \frac{58 + 70}{2} = 64 \text{ mm}$$

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

$$= 10^4 * \frac{64}{2} * \left[\frac{\pi * 0.12 * 64 * \sec 14 + 12}{\pi * 64 - 0.12 * 12 * \sec 14}\right] + \frac{0.125 * 10^4 * 60}{2}$$

$$T = 96610.4643 \text{ N.mm}$$

$$T = F_{handle} * L_{handle} = 180 * 2S$$

$$= 360\, S \quad \therefore S = 268.36 \text{ mm}$$

b) The efficiency of the press.

(b) $\eta = ??$

$$T_o = \frac{WL}{2\pi} = \frac{10^4 * 12}{2\pi} = 19098.59 \text{ N.mm}$$

$$\eta = \frac{T_o}{T} = \frac{19098.59}{96610.4643} = 0.198$$

c) Is the screw self-locking? Explain.

(c) Is the screw self-locking? Explain.

$$\mu \pi d_m \sec\alpha > L$$

$$\pi * 0.12 * 64 * \sec 14 > 12$$

$$24.866 > 12$$

self-locking

d) The maximum normal and shear Stresses in the screw.

(d) σ_{max} , $\tau_{max} = ??$

sec A-A $\sigma_b = 0$ $\tau = \frac{Tr}{J}$

$$\tau = \frac{T r}{J} = \frac{96610.4643 \times \frac{58}{2}}{\frac{\pi}{32}(58)^4} = 2.52\ MPa$$

$$\sigma_{max} = \frac{\sigma}{2} + \sqrt{\left(\frac{\sigma}{2}\right)^2 + \tau^2} = 0 + \sqrt{0^2 + (2.52)^2} = 2.52\ MPa$$

$$\tau_{max} = \sqrt{\left(\frac{\sigma}{2}\right)^2 + \tau^2} = \sqrt{0 + (2.52)^2} = 2.52\ MPa$$

Sec B-B

$$\sigma_c = \frac{F}{A} = \frac{W}{\frac{\pi}{4} d_i^2} = \frac{10^4 * 4}{\pi (58)^2} = 3.785\ MPa$$

$$T_c = \frac{\mu_c W d_{mc}}{2} = \frac{0.125 * 10^4 * 60}{2} = 37500\ N.mm$$

$$\tau = \frac{T_c r}{J} = \frac{37500 * \frac{58}{2}}{\frac{\pi}{32}(58)^4} = 0.979\ MPa$$

$$\sigma_{max} = \frac{\sigma}{2} + \sqrt{\left(\frac{\sigma}{2}\right)^2 + \tau^2} = \frac{3.785}{2} + \sqrt{\left(\frac{3.785}{2}\right)^2 + (0.979)^2} = 4.023\ MPa$$

$$\tau_{max} = \sqrt{\left(\frac{\sigma}{2}\right)^2 + \tau^2} = \sqrt{\left(\frac{3.785}{2}\right)^2 + (0.979)^2} = 2.13\ MPa$$

$\sigma_{max.} = 4.023$ MPa Sec B-B & $\tau_{max} = 2.52$ MPa Sec A-A

e) The shear stress on the screw and nut threads.

(e) τ_{screw} & τ_{nut} = ?? shear stress on threads.

$$\tau_{screw} = \frac{2W}{\pi d_i H} = \frac{2 * 10^4}{\pi * 58 * 25} = 4.39\ MPa$$

H = 25 mm from drawing

$$\tau_{nut} = \frac{2W}{\pi d_o H} = \frac{2 * 10^4}{\pi * 70 * 25} = 3.64\ MPa$$

f) The bearing stress in the threads.

f) σ_{br} = ??

$$\sigma_{br} = \frac{2W}{\pi d_m H} = \frac{2 * 10^4}{\pi * 64 * 25} = 3.98\ MPa$$