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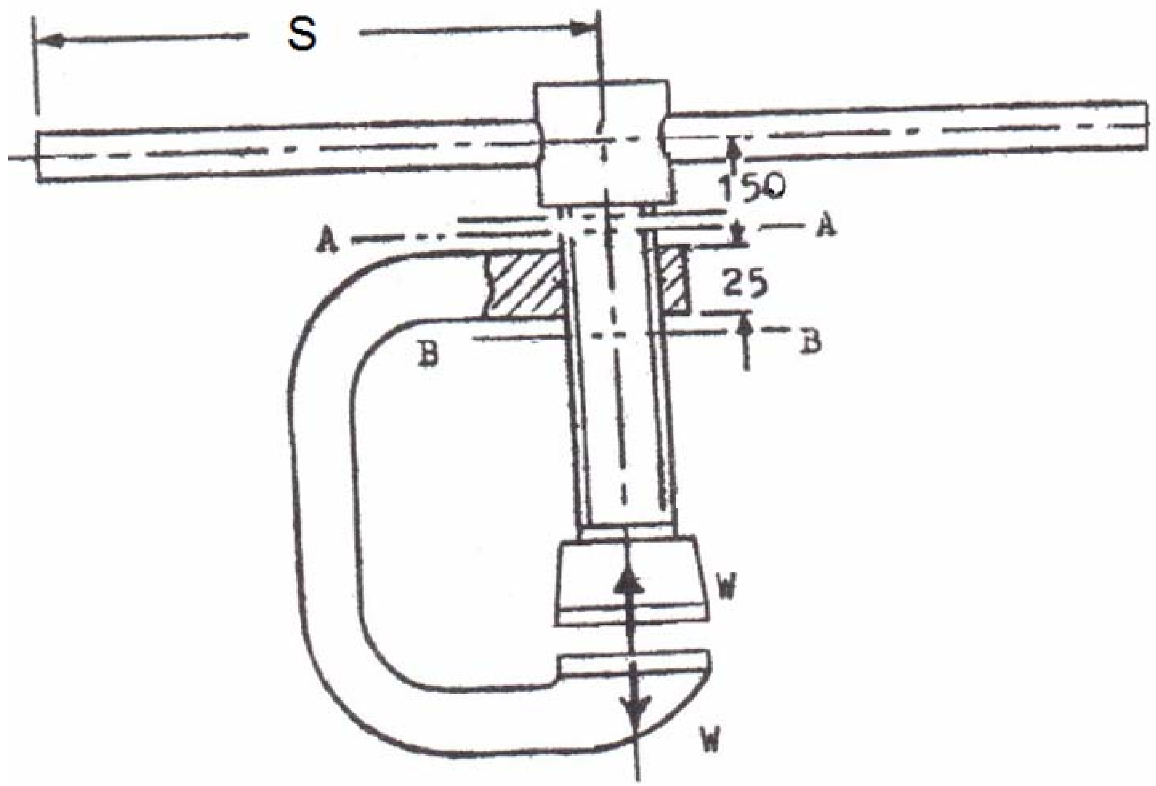
College of Engineering & Technology

Department: Mechanical Engineering   Marks: 20
Lecturer: Dr. Rola Afify   Time: 11.00 - 12.00
Course Code: ME356   Date: 16/12/2015

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

Answer the following question:



The 70 mm double thread screw of a 10 kN shop press, shown in Figure, has an iso-trapezoidal thread. 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:

$d_o = 70\,mm$ double thread $L = 2P$

$W = 10\,KN = 10^4$ Newton

iso-trapezoidal $2\alpha = 30^\circ$ $\therefore \alpha = 15^\circ$

$F_{handle} = 180$ Newton $dmc = 60\,mm$

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

$L = 2P = 2 * 12 = 24\,mm$

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

$$= 10^4 * \frac{64}{2} * \left[\frac{\pi * 0.12 * 64 \sec 15 + 24}{\pi * 64 - 0.12 * 24 \sec 15}\right] + \frac{0.125 * 10^4 * 60}{2}$$

$T = 116625.1575\ N.mm$

$T = F_{handle} * 2S = 360\,S$

$\therefore S = 323.96\,mm \simeq 324\,mm$

b) The efficiency of the press.

b) $\eta = ??$

Soln $T_o = \frac{WL}{2\pi} = \frac{10^4 * 24}{2\pi} = 38197.2\ N.mm$

$\eta = \frac{T_o}{T} = \frac{38197.2}{116625.16} = 0.3275 \simeq 0.33$

c) Is the screw self-locking? Explain.

Soln

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

$\pi * 0.12 * 64 \sec 15 > 24$

$24.97855 > 24$

self-locking

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

d) σ_{max} , $\tau_{max} = ??$

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

$$\tau = \frac{T r}{J} = \frac{116625.16 * \frac{58}{2}}{\frac{\pi}{32}(58)^4} = 3 \text{ MPa}$$

$$\sigma_{max} = \frac{\sigma}{2} + \sqrt{\left(\frac{\sigma}{2}\right)^2 + \tau^2} = 0 + \sqrt{0^2 + 3^2} = 3 \text{ MPa}$$

$$\tau_{max} = \sqrt{\left(\frac{\sigma}{2}\right)^2 + \tau^2} = \sqrt{0^2 + 3^2} = 3 \text{ MPa}$$

<u>sec B–B</u>

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

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

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

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

$$= \frac{3.785}{2} + \sqrt{\left(\frac{3.785}{2}\right)^2 + (0.979)^2} = 4.023 \text{ MPa}$$

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

$$= \sqrt{\left(\frac{3.785}{2}\right)^2 + (0.979)^2} = 2.13 \text{ MPa}$$

$\sigma_{max} = 4.023$ MPa sec B–B & $\tau_{max} = 3$ MPa sec A–A

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

e) $\tau_{screw} = ??$ & $\tau_{nut} = ??$ shear stress on threads

soln $\tau_{screw} = \frac{2W}{\pi d_i H}$ from drawing $H = 25$ mm

$$= \frac{2 * 10^4}{\pi * 58 * 25} = 4.39 \text{ MPa}$$

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

f) The bearing stress in the threads.

f) $\sigma_{br} = ??$

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