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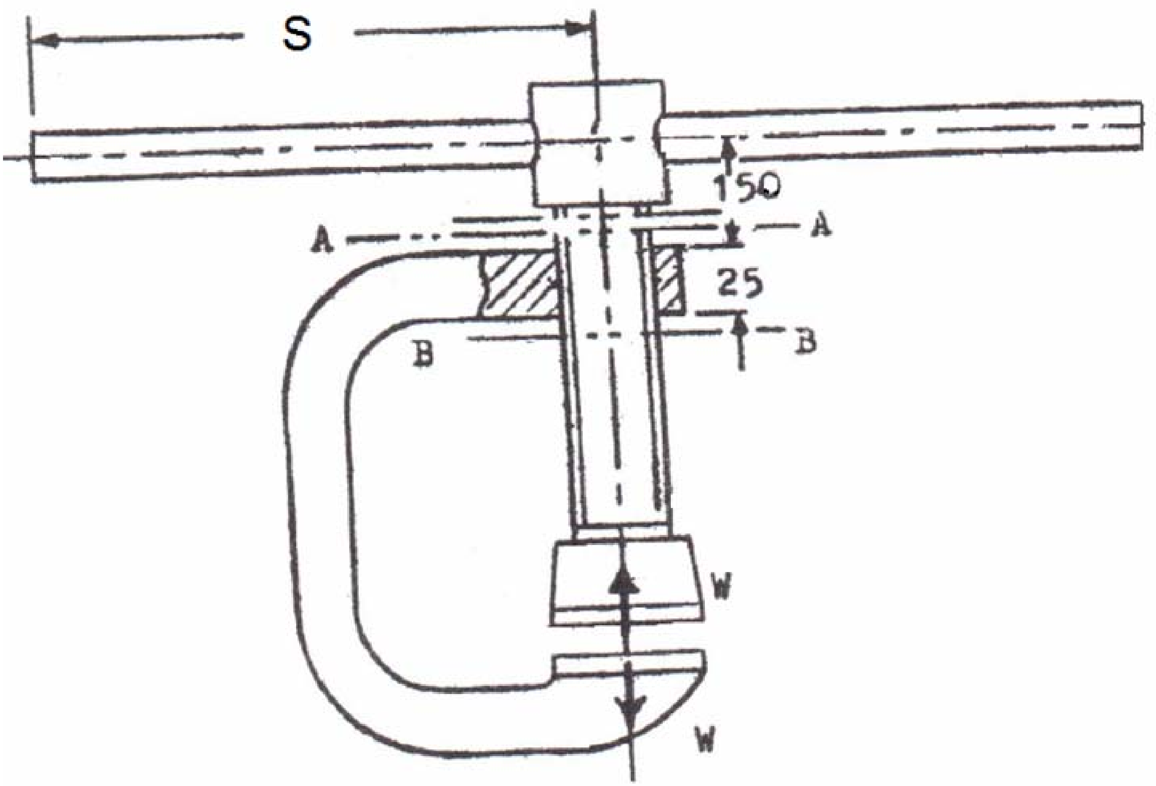
College of Engineering & Technology

Department: Mechanical Engineering — Marks: 20
Lecturer: Dr. Rola Afify — Time: 3.00 - 4.00
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 square thread. The operator's force may be taken 180 N for each hand but he is using only one 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:

$d_o = 70mm$ $W = 10\ KN = 10^4\ N$

square thread $\sec\alpha = 1$ $P = d_o - d_i$

$F_{handle} = 180\ N$ $L_{handle} = S$ $dm_c = 60\ mm$

single length $L = P = 12\ mm$

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

Determine :-

ⓐ $S = ??$ $\qquad \mu = 0.12 \qquad \mu_c = 0 \qquad d_i = 58\ mm$

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

$P = d_o - d_i = 70 - 58 = 12\ mm$

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

$$= 10^4 * \frac{64}{2} \left[\frac{\pi * 0.12 * 64 * 1 + 12}{\pi * 64 - 0.12 * 12 * 1} \right] + 0 = 57913.4\ N.mm$$

$T = F_{handle} * L_{handle} = 180 * S \qquad \therefore S = 321.74\ mm$

b) The efficiency of the press.

ⓑ $\eta = ??$

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

$$\eta = \frac{T_o}{T} = \frac{19098.59}{57913.4} = 0.3298$$

c) Is the screw self-locking? Explain.

ⓒ Is the screw self-locking? Explain.

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

$\pi * 0.12 * 64 * 1 > 12$

$24.127 > 12 \qquad$ self-locking

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

ⓓ $\sigma_{max}, \tau_{max} = ??$

sec A-A

$$\sigma_b = \frac{My}{I} = \frac{(180 * 150) * \frac{58}{2}}{\frac{\pi}{64}(58)^4} = 1.4\ MPa$$

$$\tau = \frac{Tr}{J} = \frac{57913.4 * \frac{58}{2}}{\frac{\pi}{32}(58)^4} = 1.512\ MPa$$

$$\sigma_{max} = \frac{\sigma}{2} + \sqrt{\left(\frac{\sigma}{2}\right)^2 + \tau^2} = \frac{1.4}{2} + \sqrt{\left(\frac{1.4}{2}\right)^2 + (1.5)^2} = 2.366\ MPa$$

$$\tau_{max} = \sqrt{\left(\frac{\sigma}{2}\right)^2 + \tau^2} = \sqrt{\left(\frac{1.4}{2}\right)^2 + (1.5)^2} = 1.666 \text{ MPa}$$

sec B-B

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

$T_c = 0 \quad \therefore \tau = 0$

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

$$\tau_{max} = \sqrt{\left(\frac{\sigma}{2}\right)^2 + \tau^2} = \frac{3.785}{2} = 1.893 \text{ MPa}$$

$\sigma_{max} = 3.785$ MPa & $\tau_{max} = 1.893$ MPa at sec B-B

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

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

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

H = 25 mm from drawing

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

f) The bearing stress in the threads.

(f) σ_{br} = ??

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