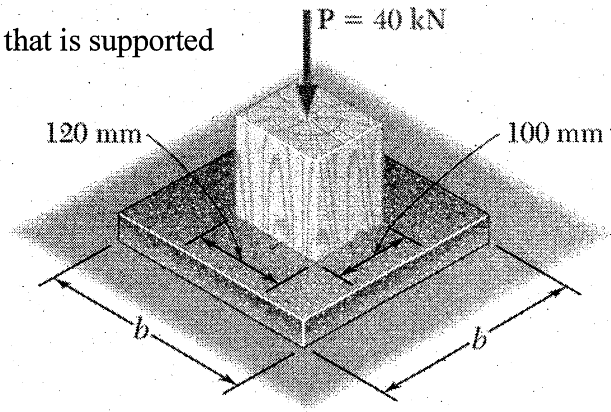
ENGR 3131 SI Session Worksheet 2/4/16 R Name:

1) GIVEN: A 40-kN axial load is applied to a short wooden post that is supported by a concrete footing resting on undisturbed soil.
REQ'D: (a) Maximum bearing stress on concrete footing, (b) Size of footing for average bearing stress in soil of 145 kPa.



a) $\sigma_B = \frac{P}{A_B}$

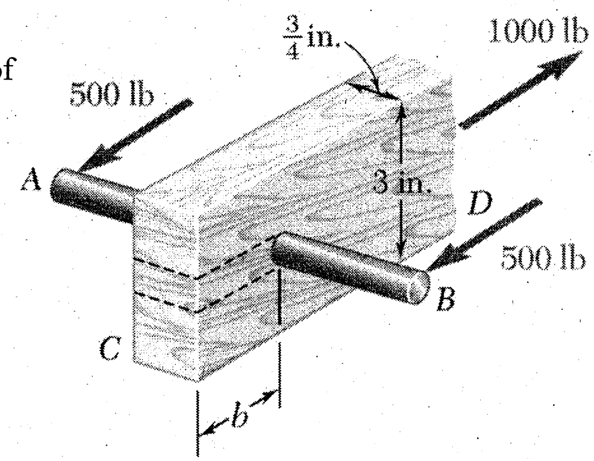
$= \frac{40{,}000\,N}{(120\,mm)^2} = \underline{\underline{2.778\ MPa}}$

b) $\sigma_B = \frac{P}{A_B} \Rightarrow A_B = \frac{P}{\sigma_B}$

$A_B = \frac{40{,}000\,N}{.145\,MPa} = 275.9 \times 10^3\ mm^2$

$b = \sqrt{A_B} = \sqrt{275.9 \times 10^3\ mm^2} = \underline{\underline{525.2\ mm}}$

2) GIVEN: A ∅ 1/2" steel rod is fitted to a round hole near end of the wooden member.
REQ'D: (a) Maximum average normal stress in the wood
(b) Distance b for shearing stress of 90 psi
(c) Average bearing stress on the wood



a) $\sigma = \frac{P}{A} = \frac{1000\,lb}{(3" - .5")(.75")}$

$= \underline{\underline{533.3\ psi}}$

b) $\tau = \frac{P}{A_s} \Rightarrow A_s = \frac{P}{\tau}$

$A_s = \frac{1000\,lb}{90\,psi} = 11.111\ in^2$

$A_s = b(.75") \times 2$

$b = \frac{11.11\,in^2}{.75"(2)} = \underline{\underline{7.41\ in}}$

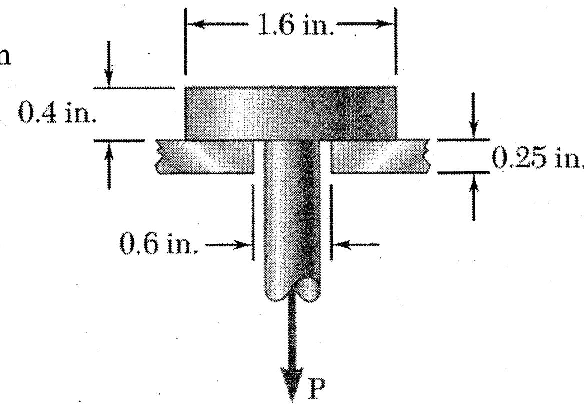
c) $\sigma_B = \frac{P}{A_B}$

$= \frac{1000\,lb}{.5"(.75")}$

$= \underline{\underline{2666.7\ psi}}$

3) GIVEN: Load P is applied to a steel rod supported by an aluminum plate in which a ∅0.6" hole has been drilled. Shearing stress must not exceed 18 ksi in the steel rod and 10 ksi in the aluminum plate.

REQ'D: Largest load P that can be applied to the rod.



FOR AL:

$\tau = \frac{P}{A_s} \Rightarrow P = \tau A_s$

$P_{AL} = (10 \text{ ksi})(1.6\text{in})(\pi)(.25\text{in}) = 12.57 \text{ kips}$ BASED ON AL

FOR STEEL:

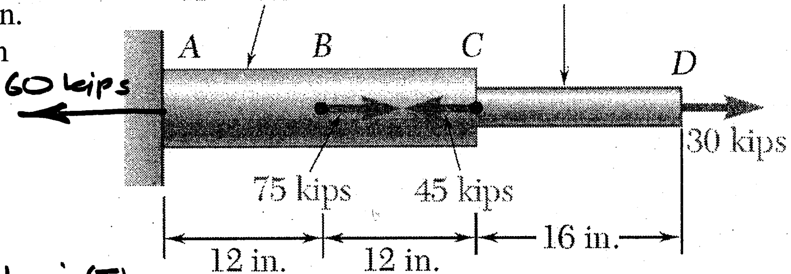
$P_s = (18 \text{ ksi})(.6\text{in})(\pi)(.4\text{in}) = 13.57 \text{ kips}$ BASED ON STEEL

LEAST DETERMINES:

$P_{allow} = \underline{\underline{12.57 \text{ ksi}}}$

4) GIVEN: Steel bar caries a series of loads as shown.

REQ'D: Axial load, axial stress and axial strain in each of the segments.



SECTION AB:

$P_{AB} = \underline{60 \text{ kips}}$ (T)

$\sigma = \frac{P_{AB}}{A_{AB}} = \frac{60 \text{ kips}}{.9 \text{ in}^2} = \underline{\underline{66.67 \text{ ksi}}}$ (T)

$\varepsilon_{AB} = \frac{\sigma_{AB}}{E_{ST}} = \frac{66.67 \text{ ksi}}{30 \times 10^3 \text{ ksi}} = \underline{\underline{.00222}}$ in/in LONGER

SECTION BC:

$P_{BC} = \underline{\underline{15 \text{ kips (C)}}}$

$\sigma_{BC} = \frac{15 \text{ kips (C)}}{.9 \text{ in}^2} = \underline{\underline{16.66 \text{ ksi}}}$ (C)

$\varepsilon_{BC} = \frac{16.66 \text{ ksi}}{30 \times 10^3 \text{ ksi}} = \underline{\underline{.000556}}$ in/in SHORTER

SECTION CD:

$P_{CD} = \underline{\underline{30 \text{ kips (T)}}}$

$\sigma_{CD} = \frac{30 \text{ kips (T)}}{.3 \text{ in}^2} = \underline{\underline{100 \text{ ksi}}}$ (T)

$\varepsilon_{CD} = \frac{100 \text{ ksi}}{30 \times 10^3 \text{ ksi}} = \underline{.00333}$ in/in LONGER