ENGR 3131 SI Session Worksheet 9/16/15 W Name: SOLUTIONS

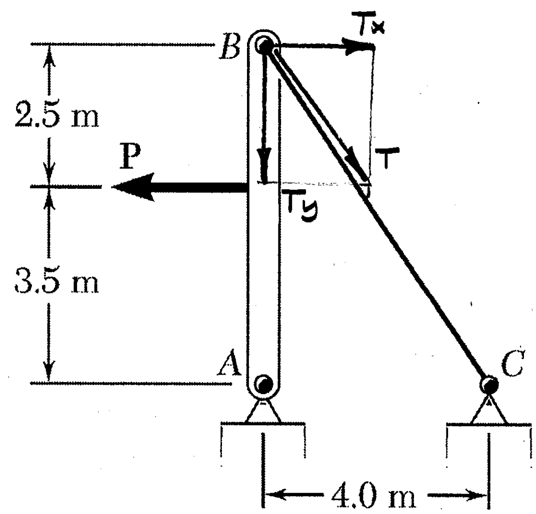
1) GIVEN: A 4.8ft long steel wire with ∅0.25in is subjected to a 750-lb tensile load. ($E_s = 29\text{x}10^6$ psi)
REQ'D: (a) Elongation of the wire.
(b) Corresponding normal stress. (B9.1)

a) $\Delta L = \frac{PL}{AE} = \frac{750\text{lb}(4.8\text{ft})(12\text{ in/ft})}{\frac{\pi}{4}(.25\text{in})^2\, 29\times10^6\text{psi}}$

$= \underline{\underline{0.03035 \text{ in}}}$ LONGER

b) $\sigma = \frac{P}{A} = \frac{750\text{lb}}{\frac{\pi}{4}(.25\text{in})^2} = 15279 \text{ psi} \Rightarrow \underline{\underline{15.279 \text{ ksi (T)}}}$

2) GIVEN: ∅4mm steel guy wire *BC* as shown. $E_s = 200$ GPa
REQ'D: Maximum load, P, if max stress and elongation in the wire must not exceed 190 MPa and 6 mm.



MAX T BASED ON ΔL:

$\Delta L = \frac{PL}{AE} \Rightarrow P = \frac{\Delta L A E}{L}$

$T = \frac{0.006\text{m}(\frac{\pi}{4}(.004\text{m})^2)200\times10^9\text{ Pa}}{L = \sqrt{4^2+6^2}}$

$= \underline{2091.2 \text{ N}}$ MAX BASED ON ΔL

$T_x = 2091.2\text{N}\frac{4}{\sqrt{4^2+6^2}}$

$= \underline{1160.0 \text{ N}} \rightarrow$

MAX T BASED ON σ:

$\sigma = \frac{P}{A} \Rightarrow P = \sigma A$

$T = 190\times10^6 \text{ N/m}^2(\frac{\pi}{4}(.004\text{m})^2)$

$= 2387.6 \text{ N}$ MAX BASED ON σ

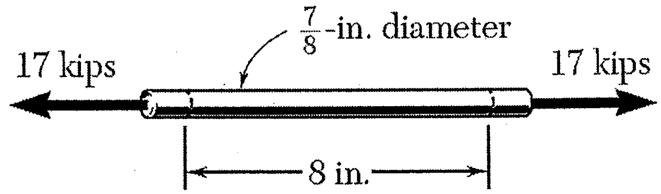
LOWEST CONTROLS SO $T_{max} = \underline{2091.2 \text{ N}}$

$\Sigma M_A = 0$

$-1160\text{N}(2.5+3.5\text{m}) + P(3.5\text{m}) = 0$

$P = \underline{\underline{1989 \text{ N}}} \leftarrow$ MAX LOAD P

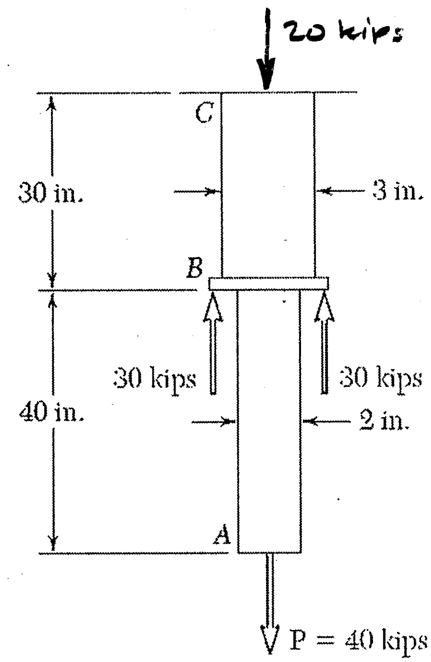
3) GIVEN: A steel rod with Ø7/8in is tensile tested as shown.
($\nu = 0.3$ and $E = 29\text{x}10^6$ psi for steel)
REQ'D: (a) Elongation in the 8in. gage length.
(b) Change in diameter of the rod. (B9.49)



a) $\Delta L = \frac{PL}{AE} = \frac{17\times10^3\,lb\,(8\,in)}{\frac{\pi}{4}(\frac{7}{8}'')^2(29\times10^6\,psi)} = \underline{\underline{0.00780\ in}}$ LONGER

b) $\Delta\phi = \frac{\nu PL}{AE} = \frac{-0.3(17\times10^3\,lb)(7/8\,in)}{\frac{\pi}{4}(\frac{7}{8}'')^2\,29\times10^6\,psi} = \underline{\underline{0.000256\ in}}$ SMALLER

4) GIVEN: Two solid cylindrical rods are joined at B and loaded as shown.
Rod AB is steel ($E = 29\text{x}10^6$ psi). Rod BC is brass ($15\text{x}10^6$ psi).
REQ'D: (*a*) Total deformation of the composite rod *ABC*.
(*b*) Deflection of point *B*. (B9.16)



$\Delta L_{AC} = \Delta L_{BC} + \Delta L_{AB}$

$\Delta L_{AB} = \frac{P_{AB} L_{AB}}{A_{AB} E_{AB}}$

$= \frac{40\,kips\,(40\,in)}{\frac{\pi}{4}(2\,in)^2\,29\times10^6\,psi}$

$= \underline{0.01756\ in}$ LONGER

$\Delta L_{BC} = \frac{P_{BC} L_{BC}}{A_{BC} E_{BC}}$

$= \frac{-20\,kips\,(30\,in)}{\frac{\pi}{4}(3\,in)^2\,15.\times10^6\,psi}$

$= \underline{-0.005659\ in}$ SHORTER

a) $\Delta L_{AC} = \Delta L_{BC} + \Delta L_{AB}$

$= -0.005659\ in + 0.01756\ in$

$= \underline{\underline{0.0119\ in}}$ LONGER

b) $\Delta L_{BC} = \underline{\underline{-0.00566\ in}}$ SHORTER