Solutions to problem set 1B

(1) 9.81 N/kg 2.2046 lb/kg 25.4 × 10⁻³ m/in.

$$Pa = N/m^2 \Rightarrow psi = lb/in^2 \Rightarrow \frac{9.81\ N/kg}{2.2046\ lb/kg \times 25.4\times10^{-3}\ m/in.}$$

$$= 6896\ \frac{N/m^2}{lb/in}$$

2-8

$$\tau = \frac{P}{A_s} \Rightarrow 950\times10^3 = \frac{50\times10^3}{2(.3)(\frac{L}{2})} \Rightarrow L = \frac{50}{950(.3)}$$

$$L = .1754\ m = 175.4\ mm\ (\text{neglect gap})$$

2.10 ~~2.15~~ 3-10 3-11

2.10-

(a) $P_T = (350\times10^6)(\text{Net Area of Top Plates}) = (350\times10^6)(2)(.03-.012)(.01) = 126\ KN$

or $P_T = (350\times10^6)(\text{Net Area of Middle Plate}) = 350\times10^6(.025-.012)(.025) = 113.8\ KN$ ← smaller ans.

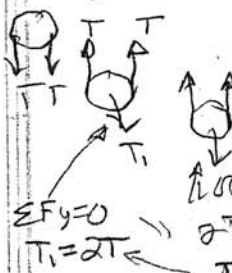
(b) $P_B/2 = (650\times10^6)(.012)(.010) \Rightarrow P_B = 156\ KN$ ← smaller ans

or $P_B = 650\times10^6(.012)(.025) \Rightarrow P_B = 195\ KN$

(c) $P_S/2 = (240\times10^6)\frac{\pi}{4}(.012)^2 \Rightarrow P_S = 543\ KN$ ← ans.

(d) $\frac{P_S}{2}_{Top} = 2(300\times10^6)(.018)(.01) \Rightarrow P_{S\,Top} = 216\ KN$ ans.

2-15



$\Sigma F_y = 0 \Rightarrow 2T_1 = 1000$

$T_1 = 2T$ ← $T_1 = 500\ lb$

$T = 250\ lb$

(a) $\sigma_c = \frac{T_1}{A_1} = \frac{500}{\frac{\pi}{4}(.25)^2} = 10{,}186\ psi = 10.2\ ksi$

(b) $\sigma_B = \frac{T}{A_1} = \frac{250}{\frac{\pi}{4}(.126)^2} = 20{,}372\ psi = 20.4\ ksi$

(c) $\tau = \frac{2T_1}{(2)A_P} = \frac{(2)(500)}{(2)\frac{\pi}{4}(\frac{3}{8})^2} = 9{,}054\ psi = 9.05\ ksi$

1-13 (Continued)

2-3] Normal stress allowable = 13.5 KSI

$P_N = (13.5\times10^3)(1)(1)(1/2) = 6,750$ lbs (governs)

allowable Bearing stress = 18 KSI

$P_B = (18\times10^3)(2)(1)(3/8) = 13,500$ lbs

allowable Shear stress = 6.5 KSI

$P_S = (6.5\times10^3)(2)(3/8\times1) = \underline{4875}$ lbs ← ans.

3-5]

$\epsilon_C = \frac{\Delta l_C}{l_C} = 900\times10^{-6} = \frac{\Delta l_C}{72} \Rightarrow \Delta l_C = 0.0648$ in

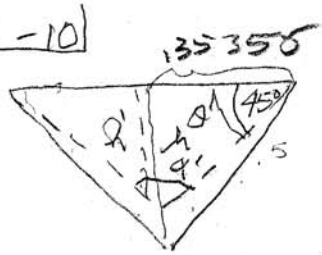
Bar A is rigid $\Delta l_C = \Delta l_B$

(a) $\epsilon_B = \frac{.0648}{42} = 1.543\times10^{-3} = \underline{1543\,\mu}$

(b) $\Delta l'_B = (.0648 - .006) = 0.0588$

$\epsilon'_B = \frac{0.0588}{42} = 1.40\times10^{-3} = 1400\,\mu$

3-10]



$h = .5\sin 45° = .$

$h' = .35355 - .010 = 0.34355$

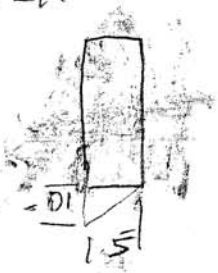
$\tan\theta' = \frac{0.34355}{.35355} = 0.9717 \Rightarrow \theta' = 44.178°$

$\alpha' = 180 - (2)(44.178) = 91.64370°$ or

Change in original right angle = $1.6437° = 0.02868$ rad

So Shear strain = $-\underline{0.0287}$ m/m $\Rightarrow |\gamma| = \underline{0.0287}$

3-11



$\gamma = \frac{.01}{.5} = \underline{.02}$ ← ans