No. 5505 Engineer's Computation Pad

Problem 1

Spherical PV $\Rightarrow \sigma_1 = \sigma_2 = \frac{pr}{2t}$

Given $d = 2m \Rightarrow r = 1m$ $\quad E = 200\ GPa$

$t = 10mm = 0.01m$ $\quad \nu = 0.3$

Strain gauge $L_0 = 20\ mm$

$\Delta L = 0.012\ mm$

$$\Rightarrow \epsilon_1 = \frac{\Delta L}{L_0} = \frac{0.012\ mm}{20\ mm} = 6 \times 10^{-4}$$

Using Hooke's law

$$\epsilon_1 = \frac{\sigma_1}{E} - \nu\frac{\sigma_2}{E} = \frac{\sigma_1}{E}(1-\nu)$$

$$\therefore \sigma_1 = \frac{E\epsilon_1}{1-\nu} = \frac{200 \times 10^9\ Pa \times 6 \times 10^{-4}}{1-0.3}$$

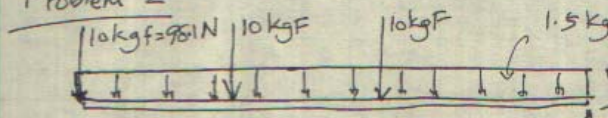
$$= 171.4 \times 10^6\ Pa = 171.4\ MPa$$

$$= \frac{pr}{2t}$$

$$\Rightarrow p = \frac{\sigma_1 \cdot 2t}{r} = \frac{171.4\ MPa \times 2 \times 0.01m}{1m}$$

$$= 3.429\ MPa$$

Problem 2

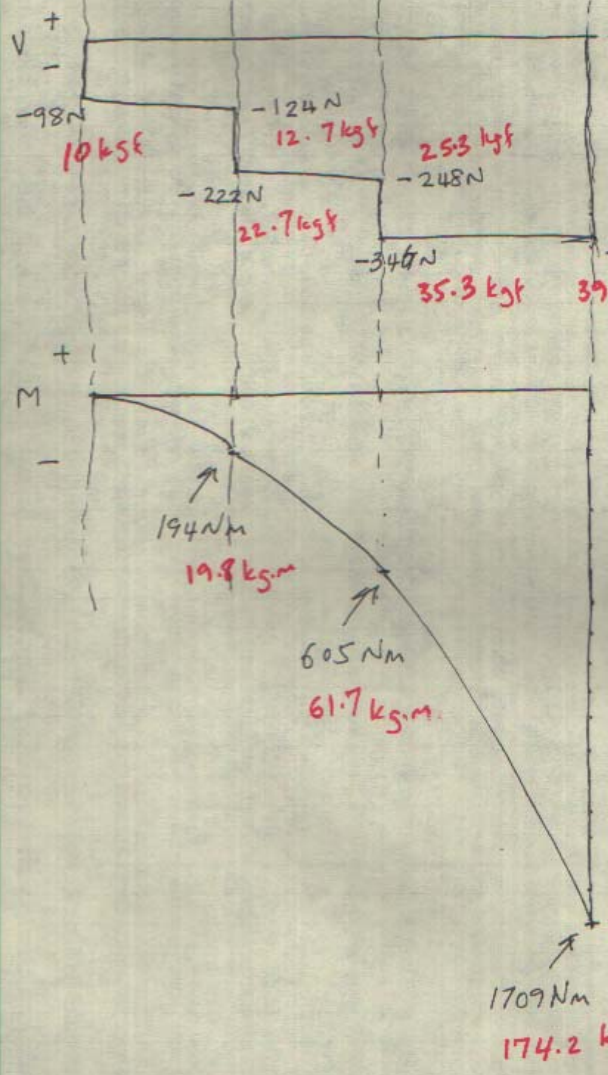


$+\uparrow \Sigma F_y = 0 = F_B - 3\times 98.1\,N - 14.7\frac{N}{m}\times 6.5\,m$

$\Rightarrow F_B = 390.0\,N$

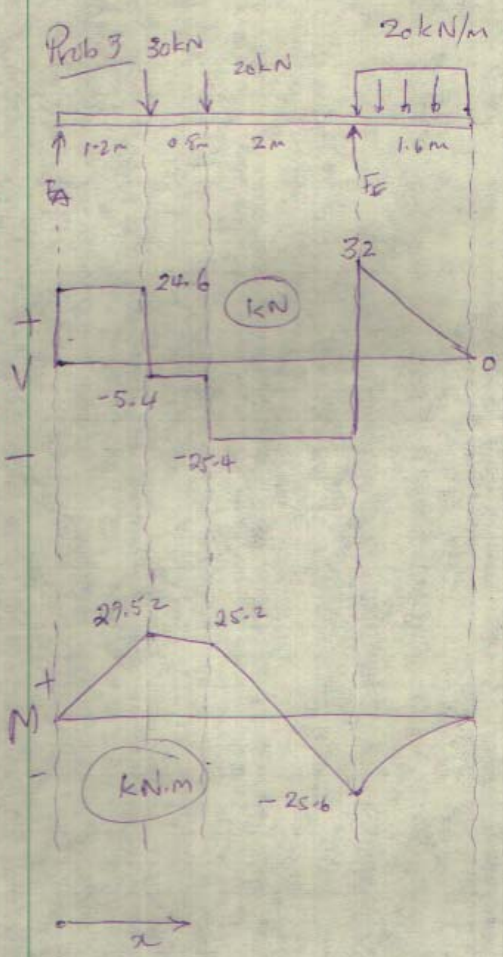
$\circlearrowleft \Sigma M_B = 0 = -98.1N\times 6.5m - 98.1N\times 4.75m - 98.1N\times 3m - 14.7\frac{N}{m}\times 6.5m\times\frac{6.5m}{2} - M_R$

$\Rightarrow M_R = -1709\,N.m$



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Prob 3



$+\uparrow \Sigma F_y = 0 = -30kN - 20kN - 20\frac{kN}{m} \times 1.6m + F_A + F_E$

$F_A + F_E = 82kN$

$\circlearrowleft \Sigma M_A = 0 = 30kN\,(1.2m) + 2kN\,(2m) - F_E\,(4m) + 20\frac{kN}{m} \times 1.6m \times 4.8m$

$F_E = 57.4\ kN$

$F_A = 24.6\ kN$

$|M_{max}| = 29.52\ kN.m$

W 410 x 38.8 beam

$S = 628 \times 10^3\ mm^3$

$= 628 \times 10^{-6}\ m^3$

$\sigma_{max} = \frac{29.52 \times 10^3\ Nm}{628 \times 10^{-6}\ m^3}$

$= 47 \times 10^6\ \frac{N}{m^2} = 47 MPa$

For $2 \le x \le 4$

$M_{(2)} = 25.2\ kNm$ $\quad M_{(4)} = -25.6\ kNm$

$V = -25.4\ kN = \frac{dM}{dx}$

$\therefore M = -25.4x + C_1$

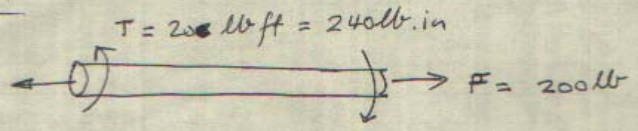
@ $x = 2$ $\quad M = 25.2\ kNm = -25.4\,(2)\ kNm + C_1$

$\therefore C_1 = 76\ kNm$

$\therefore \boxed{M = -25.4x + 76}\ kNm$

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Problem 4



Hollow cylinder $d_i = 0.5\,in$

$r_i = 0.25\,in$

$t = 0.025\,in$

$r_o = 0.275\,in$

$A = \pi (r_o^2 - r_i^2) = 4.123 \times 10^{-2}\,in^2$

$J = \frac{\pi}{2} (r_o^4 - r_i^4) = 2.848 \times 10^{-3}\,in^4$

$P = 500\,psi$

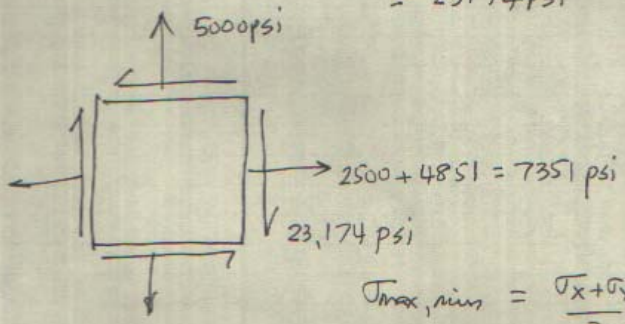
Pressure loading: $\sigma_{hoop} = \frac{Pr}{t}$ (use r_i) $= \frac{500\,psi \times 0.25\,in}{0.025\,in} = 5000\,psi$

$\sigma_{axial} = \frac{\sigma_{hoop}}{2} = 2500\,psi$

Axial loading $\sigma = \frac{F}{A} = \frac{200\,lb}{4.123 \times 10^{-2}\,in^2} = 4851\,psi$

Torsional loading $\tau = \frac{Tr_o}{J} = \frac{240\,lb.in \times 0.275\,in}{2.848 \times 10^{-3}\,in^4}$

$= 23174\,psi$



$\sigma_{max,min} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$