Homework #2

Due Thu 9/10/09

Team Number: 6

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Hand in this sheet (cover sheet) with your solution

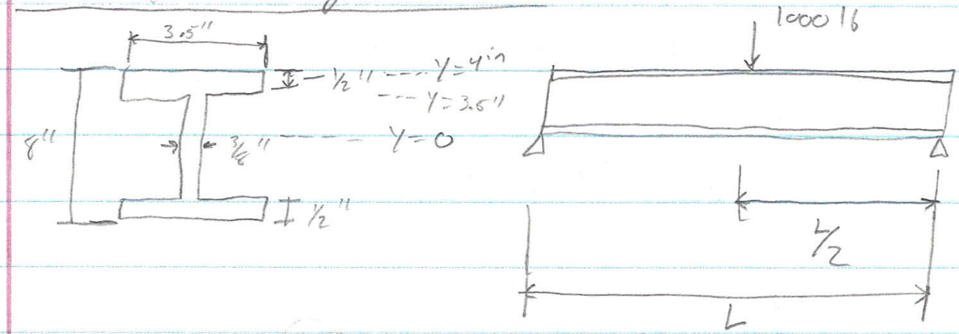
1. Textbook Problem 4.32 (Review on Static Body Stresses)
2. Textbook Problem 4.37 (Review on Static Body Stresses)
3. Textbook Problem 4.58 (Review on Static Body Stresses)
4. Textbook Problem 4.66 (Review on Static Body Stresses)
5. Textbook Problem 4.72 (Review on Static Body Stresses)

32/40

8.32 **Known:** $P = 1000\,lb$

Find: σ_{max}

Schematic & given data:



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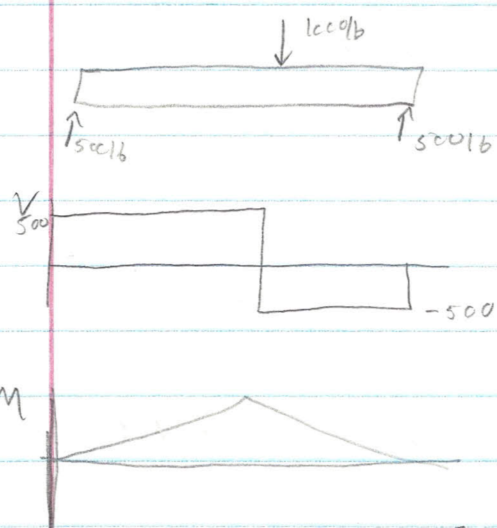
Assumption: Static Loading

Analysis: $A = 6.125\,in^2$; $I_x = \frac{b_1 h_1^3}{12} - \frac{b_2 h_2^3}{12} = \frac{(3\frac{1}{2})(8)^3}{12} - \frac{(3\frac{1}{8})(7\,in)^3}{12}$

$\sigma = \frac{My}{I} \Rightarrow M =$ $\qquad = 60.01\,in^4$



$\tau = \frac{V}{Ib}\int_{y=y_0}^{y=c} y\,dA = \frac{500\,lb}{(60.01\,in^4)(3.5)}\int_{y=3.5''}^{y=4in} y(3.5)\,dy$

$\tau = 2.38\,(3.5)\,\frac{y^2}{2}\Big|_{3.5''}^{4''} = 15.62\,\frac{lb}{in^2}$

$\tau = \frac{V}{Ib}\int_{y=y_0}^{y=c} y\,dA = \frac{500\,lb}{(60.01\,in^4)(0.375\,in)}$

$\left[\int_{y=0}^{3.5''} y\,(\tfrac{3}{8}'')\,dy + \int_{3.5}^{4} y\,(3.5'')\,dy\right]$

$\Rightarrow \tau = 22.22\left[0.375\,\frac{y^2}{2}\Big|_0^{3.5} + 3.5\,\frac{y^2}{2}\Big|_{3.5}^{4}\right] = 196.8\,\frac{lb}{in^2}$

$\boxed{\sigma_{max} = 196.8\,\frac{lb}{in^2}}$ ✓

Approx.

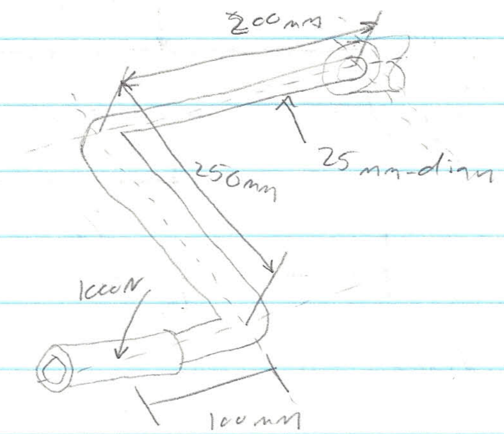
$\frac{500\,lb}{(0.375'')(8\,in)} = 166.7\,\frac{lb}{in^2}$ ✓

actual is greater than approximation.

4.37 Known:

Find: $\sigma_{max\,bending}$, $(\sigma+\tau)_{max}$

Schematics:



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Assumptions:

Analysis: a) bending stress $\sigma_{max} = \frac{32M}{\pi d^3}$

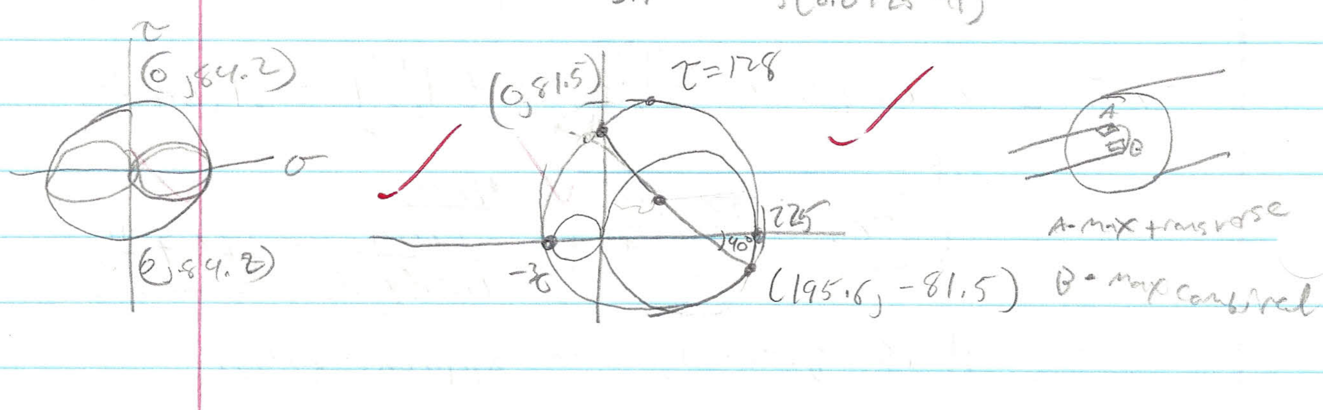
$M = (1000N)(300mm) = 300{,}000\ Nmm = 300\ Nm$

$\boxed{\sigma_{max} = 1.956 \times 10^8 Pa}$

b) torsional + transverse shear

Torsional: $\tau = \frac{16T}{\pi d^3} = \frac{16(1000)(0.25)}{\pi(0.025^3)} = 8.149 \times 10^7 Pa$

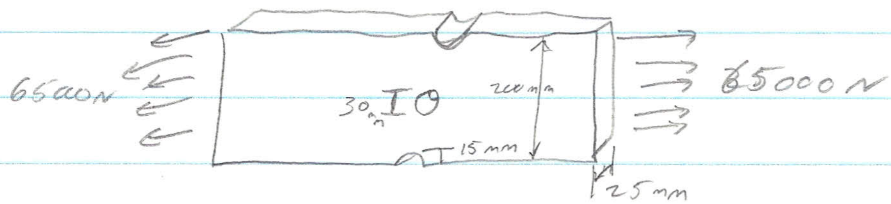
Transverse: $\tau_{max} = \frac{4V}{3A} = \frac{4(1000N)}{3(0.0125^2 \pi)} = 2.716 \times 10^6 Pa$



4.58 Known:

Find: $\sigma_{max_{hole}}$, $\sigma_{max_{notch}}$

Schematic:



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Assumptions:

Analysis: $\sigma_{max_{hole}} = \frac{P}{A} = \frac{P}{(b-d)h} = \frac{65{,}000N}{(200-30)25mm^2} = 15.29MPa$

-15-15

$d/b = \frac{30}{200} = 0.15 \Rightarrow K_t = 2.5$ $\quad \sigma = K_t\,\sigma_{nom} = 2.5(15.29MPa) =$

$\boxed{\sigma_{max_{hole}} = 38.23MPa}$ × -1

$\sigma_{max_{notch}} = \frac{P}{A} = \frac{P}{bh} = \frac{65{,}000N}{25(170)mm} = 15.2\ MPa$

$\frac{H}{h} = \frac{200}{170} = 1.1765$

$K_t = 2.4 \Rightarrow \sigma_{max_{notch}} = Kt(\sigma_{nom}) =$

$\frac{r}{h} = \frac{15}{170} = 0.0882$

36.7MPa

-1

4.66 Known: 10x40 mm (h x b) $\sigma_{x,y}$ yeild = 300 MPa

6 mm ϕ hole

Find: σ distrobution,

Schematic:

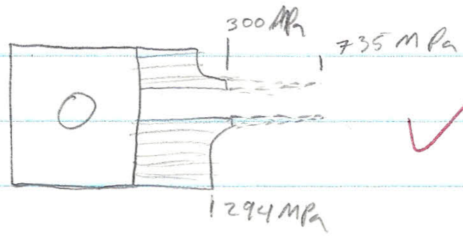
Assumptions: bar initially stress free, Material has idealized stress-strain curve.

Analysis: $\sigma_{max} = K_t \sigma_{nom}$

$\sigma_{nom} = \frac{P}{A} = \frac{P}{(b-d)h}$

a) $100\,kN = P$; $\sigma_{nom} = \frac{100\,kN}{(40mm-6mm)\,10mm} = 294\,MPa = \sigma_{nom}$

$K_t = 2.5$ $\sigma_{max} = 2.5(294\,MPa) = \boxed{735\,MPa = \sigma_{max}}$



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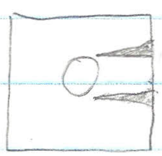
b)



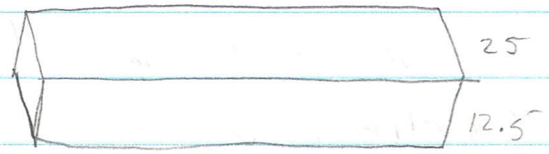
X +1

4.72 Known: $\sigma_{yeild} = 550\,MPa$, $K = 2.5$, $Z = I/c = bh^2/6 = \frac{12.5(25)^2}{6} = 1302\ mm^3$

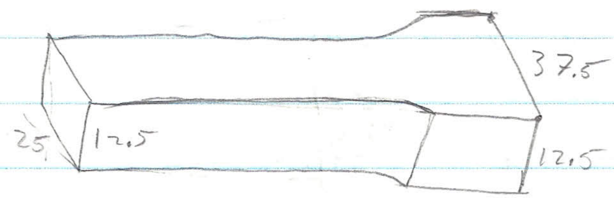
Find: M: Yeilding, Yeilding complete

Schematic:

A



B



Assumptions: Idealized stress-strain curve.

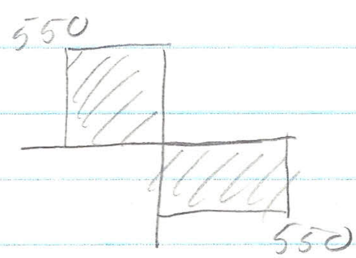
Analysis: $\sigma_{nom} = \frac{P}{A} = \frac{P}{bh} = \frac{P}{12.5mm(25mm)}$

a) $Z = I/c = \frac{bh^2}{6} = \frac{12.5(25)^2}{6} = 1.3\ m^3$

$\sigma_y = \frac{My}{I} = \frac{M}{Z} \Rightarrow M_A = \sigma_y Z = (550\,MPa)(1302\ mm^3) = \boxed{716\ Nm}$ ✓

$M_B = \frac{\sigma_y Z}{K} = \boxed{286\ Nm}$ ✓

Complete Yeilding



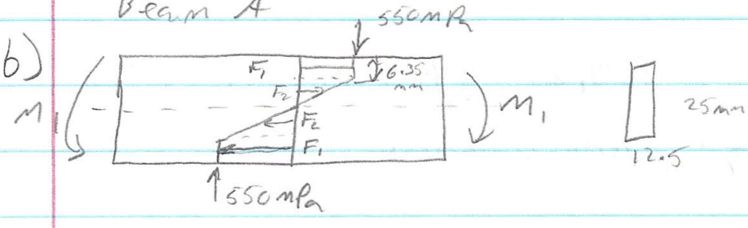
$M_A = F\left(\frac{h}{2}\right) = \sigma_y\left(\frac{h}{2}\right)^2(b)$

$= \boxed{268,555\ N}$ ✓ (divided by 2.5)

$MB = \frac{M_A}{K} = \boxed{107,442\ N}$ -1 1074

Beam A

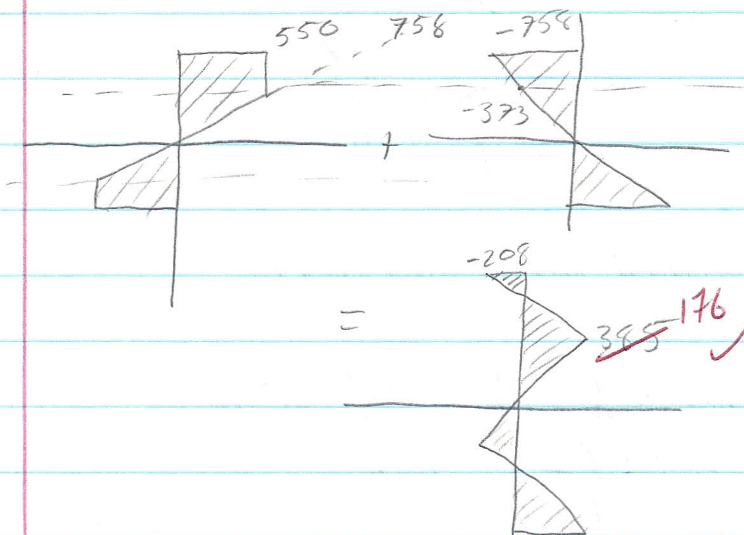
b)



$Z = 1302 \, mm^3$

$M_1 = (550\,MPa)(6.35\,mm)(12.5\,mm)(18.65\,mm)$
$+ (275\,MPa)(6.15\,mm)(12.5\,mm)(18.2\,mm) = 987{,}542\ Nmm$

$$\boxed{\sigma = \frac{M}{Z} = 758\ MPa}$$ ✓



✓ -1

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