6/10

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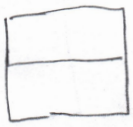
CIV102F Quiz #10: 1300h-1500h Thursday, November 21, 2019

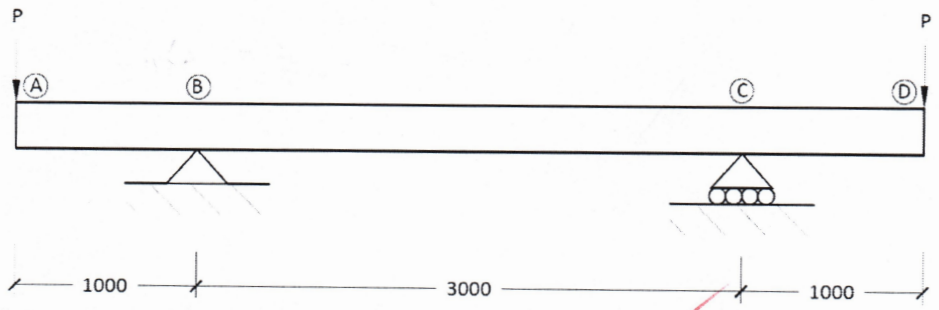
Shear Stresses and Beam Deflections

The beam shown below is made from Jack Pine no. 1 grade. It has a square cross section with dimensions 254 mm × 254 mm.

1. Calculate location of the centroidal axis and moment of inertia I.
2. Draw the shear force and bending moment diagrams caused by the applied point load P.
3. Using the bottom table in Appendix 6, calculate the value of P which causes a shear failure, P_{shear}, and the value of P which causes a flexural failure, $P_{flexure}$. What value of P will cause failure?
4. Using your predicted failure load P from part 3, calculate the downwards deflection at points A and D.

All dimensions are in mm.

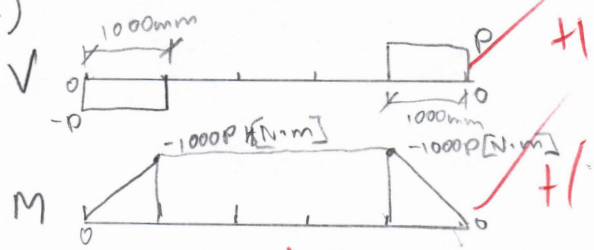




1.) $\bar{y} = \frac{\sum A_i d_i}{A_i} = \frac{254 \times 254 \times 127}{254^2} = 127\text{cm} = \bar{y}$ +1

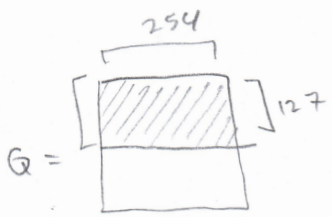
$I = \sum A_i d_i + I_0 = 0 + \frac{bh^3}{12} = \frac{254^4}{12} = 0.346859 \times 10^9\ mm^4 = I$

2.)



+1

+1



Tension $_{max}$ < Compression $_{max}$

= 9.0 < 10.5

3.) $\tau_{max} = 0.8MPa = \frac{VQ}{Ib}$ ~~1.0~~

$\frac{0.8MPa\ Ib}{Q} = V$ ~~+1~~

$V_{max} = \frac{0.8MPa \cdot 0.346859 \times 10^9 \times 254}{254 \times 127 \times (\frac{127}{2})} =$

$V_{max} = 17204N = 17.20kN$

∴ 17.20kN will cause failure ~~+0.5~~

$\sigma_{max} = \frac{My}{I}$

$\frac{\sigma_{max} I}{y} = M$ ~~13.0~~

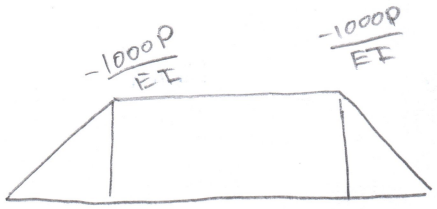
$\frac{90.0.346859 \times 10^9}{127cm} = 1000P$ ~~+0.5~~

$24580N = P$

∴ 24.6kN = P

4 on Back

4.)

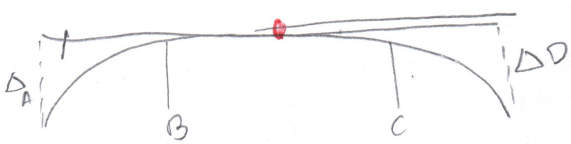


$P = 17.2\,kN = 17200\,N$

$E_{SO} = 6000\,MPa$

$\phi_{max} = \frac{M}{EI} = \frac{1000 \cdot 17200}{6000 \cdot 0.34C8595 \times 10^9}$

$\phi_{max} = 8.2646 \times 10^{-6}$

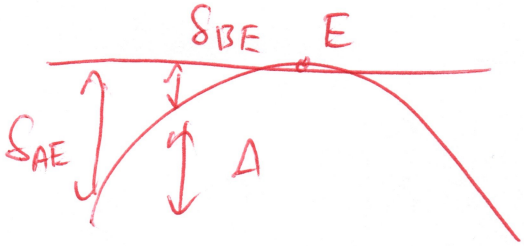


$\Delta_A = \Delta_D$

$\Delta_A = \delta_{AB} = A_1 d_1 = [8.2646 \times 10^{-6} \cdot 1000mm] \frac{1}{2} \cdot \frac{1}{3} \cdot 1000m$

$= 8.2646 \times 10^{-6} \cdot 1000^2 \cdot \frac{1}{6}$

$\therefore \boxed{\Delta_A = \Delta_D = 1.377mm}$



$\Delta = \delta_{AE} - \delta_{BE}$