FINAL ASSESSMENT COVER PAGE - 2022/23

Module Code: FEEG2005

Module Title: Materials and structures

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Number of pages: 2
(*This submission contains xxx number of pages plus this cover page)*

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Date: 22/05/2023

3 SQ1

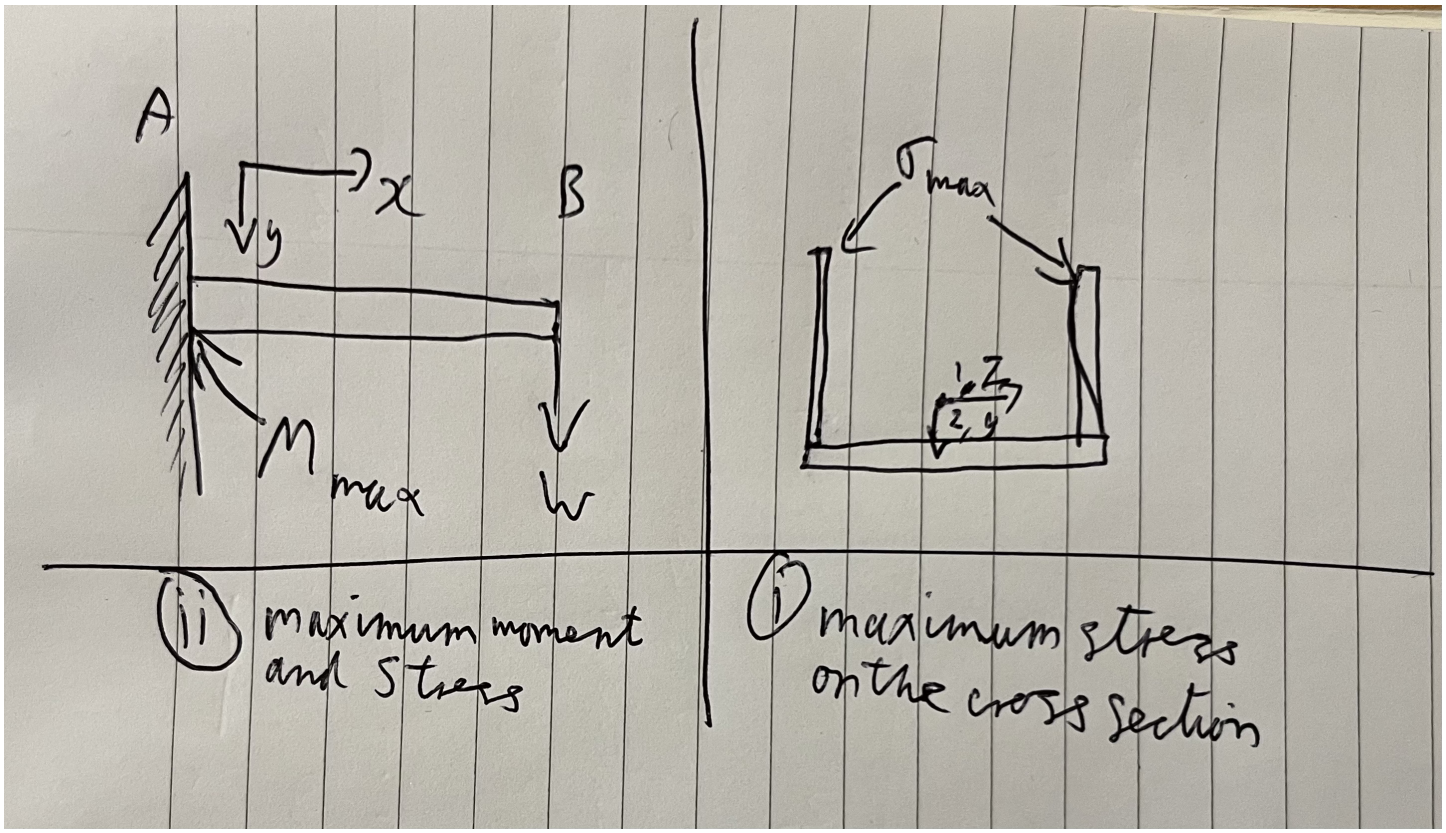
3.1 i

Chooisng option (ii) will result in less deflection in the y-direction, because $\frac{d^2v}{dx^2} = -\frac{M_2 I_1}{E I_2 I_1}$. The moment is fixed, it is the dead load of the beam and the load applied at the tip. E is a property of the material, so can't be changed. Using the larger of the second moments of area gives a smaller fraction, meaning less deflection. Intuitively, the further the material is from the bending axis, the more it resists bending, so by having a C shape rather than a U shape, the material is as far away as possible.

3.2 ii

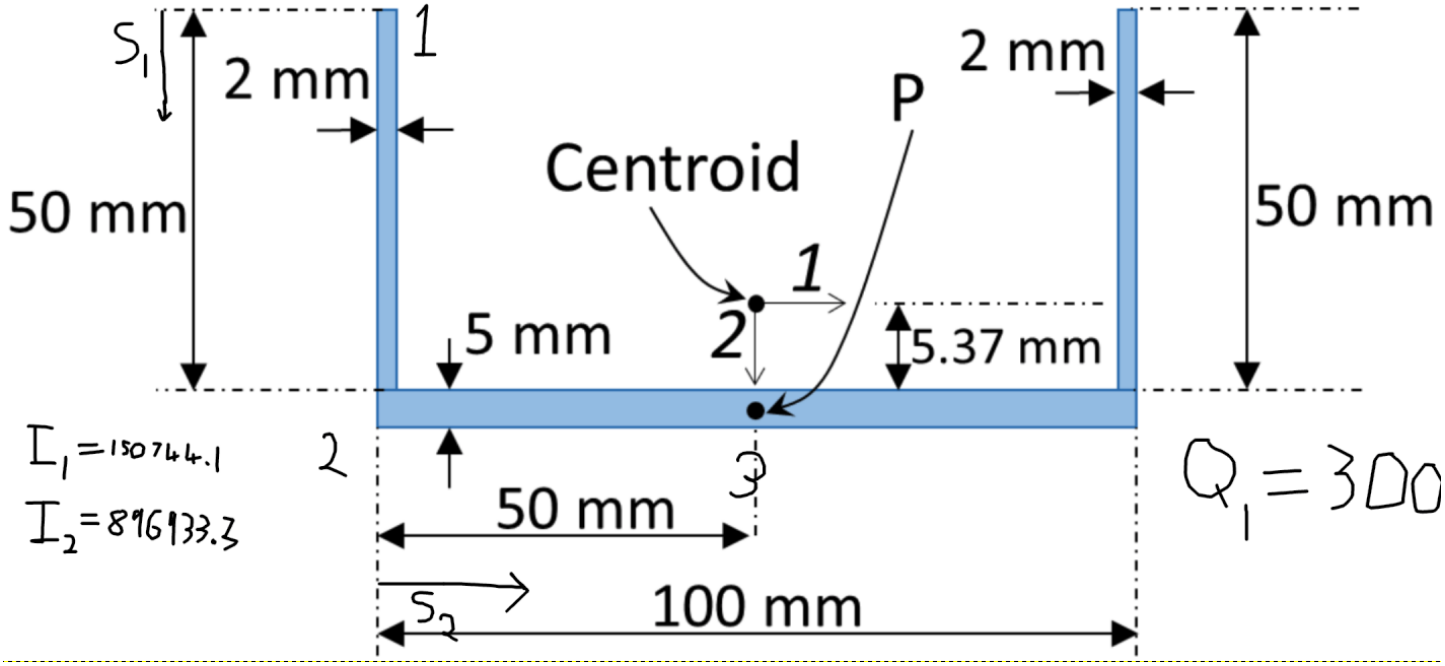
$y = 50 - 5.37 = 44.63$ $M_A = 1.5W$

Engineer's bending theory: $\sigma_x x = \frac{yM_{yz}}{I_{zz}}$ $\frac{\sigma_x x \times I_{zz}}{y} = M$ $\frac{240\times10^6\times150744.1\times10^{-12}}{44.63\times10^-3\times1.5} = W = 540.4N$ Safety factor of 3 means $W = 180N$



3.3 iii

$I_{yz} = 0$, so $q = \frac{Q_y}{I_{zz}} \bar{y} A + q_{out}$



$$q_{12}(s_1) = \frac{Q_1}{I_2} \bar{y} A = \frac{300}{896933.3}(50 - 1)(2s_1) = 0.0323 s_1$$

$q_{12,max} = 1.82$

$$q_{23}(s_2) = \frac{Q_1}{I_2} \bar{y} A + q_{out} = \frac{300}{896933.3}(50 - \frac{s_2}{2})(5s_2) + 1.82 = \frac{300}{896933.3}(250 s_2 - \frac{5}{2} s_2^2)$$

$q_{23,max} = \frac{300}{896933.3}\left(250 \times 50 - \frac{5}{2} 50^2\right) + 1.82 = 3.910 MPa$

This is point 3 on the cross section of the beam. Because there is a point load, the point on the cross section becomes a line down the beam.