The cantilevered beam shown below is loaded in pure bending. The beam has a cross section at location C on the beam as shown below right. The origin O is located on the neutral axis of the beam.

a) Determine the second area moment I_{Oz} corresponding to the neutral axis of the beam.

b) Determine the distribution of normal stress on the cross section of the beam as a function of y.

c) Determine the maximum (magnitude) normal stress occurring on the cross-sectional face at C.

Use the following dimensions: $M = 2000 \ N \cdot m$, $t = 20 \ mm$, $b = 80 \ mm$ and $h = 80 \ mm$.

cross section at C

$$I_o = \left(I_1\right)_o + \left(I_2\right)_o + \left(I_3\right)_o$$

w/ $\left(I_2\right)_o = \frac{1}{12} h^3 t$

$\left(I_1\right)_o = \left(I_1\right)_E + A_1 \, d_{oE}^2$; $\left(I_1\right)_E = \frac{1}{12} t^3 (2b)$

$A_1 = 2bt$

$d_{oE} = \frac{h}{2} + \frac{t}{2}$

$= \frac{1}{6} bt^3 + (2bt)\left(\frac{1}{2}\right)^2(h+t)^2$

$= \left[\frac{1}{6} t^3 + \frac{1}{2} t(h+t)^2\right]b = \left(I_3\right)_o$

$\sigma = \frac{My}{I_o} \Rightarrow \sigma_{max} = \frac{M}{I_o}\left(\frac{h}{2} + t\right)$