Problem 1[18-5]

A steel bar with the dimensions (L = 0.450 m, t = 0.020 m, w = 0.100 m) is subjected to an axial compressive load of 265 kN.

The modulus of elasticity of the steel is 2.10 GPa and Poisson's ratio is 0.3.

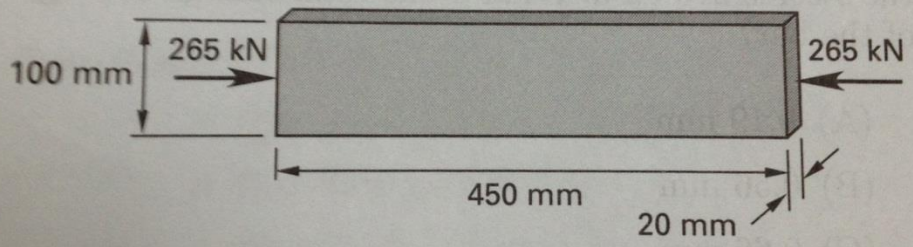
What is the final thickness of the bar? Neglect buckling.

$$S_{ys} = \tau_{\max,\text{failure}} = \frac{S_{yt}}{\sqrt{3}} = 0.577 S_{yt} \qquad 18.49$$

SAMPLE PROBLEMS

Problem 1

A steel bar with the dimensions shown is subjected to an axial compressive load of 265 kN. The modulus of elasticity of the steel is 210 GPa, and Poisson's ratio is 0.3. What is the final thickness of the bar? Neglect buckling.



(A) 19.003 mm

(B) 19.006 mm

(C) 20.000 mm

(D) 20.004 mm

Contd.

Area, $A = w \cdot t = 2.00 \times 10^{-3}\ m^2$

$P = -2.65 \times 10^5$ N, $E = 2.1 \times 10^9$ Pa

Normal Stress, $\sigma = P/A = -1.32 \times 10^8$ Pa

Axial Strain, $\varepsilon_x = \sigma/E = -6.31 \times 10^{-4}$

Deformation, $\delta_{axial} = \varepsilon_x \cdot L \quad -2.84 \times 10^{-4}$

Contd.

Lateral Strain, $\varepsilon_{lateral} = -\nu \cdot \varepsilon_x = 1.89 \times 10^{-4}$

Energy, $U = 1/2 \cdot P \cdot \delta_{axial} = 3.76 \times 10^{1}$ N.m

Strain energy per unit volume, $u = \sigma^2/(2 \cdot E)$

$= 4.18 \times 10^{4}$ Pa

Contd.

- Change in thickness, $\Delta t = \varepsilon_{lateral} \cdot t = 3.79 \times 10^{-6}$ m

- Shear Modulus, $G = E/[2 \cdot (1 + \nu)] = 8.08 \times 10^{10}$ Pa