TOBB EKONOMİ VE TEKNOLOJİ ÜNİVERSİTESİ

MAK 206 Strength of Materials – 2015 Spring

QUIZ 7

6 March 2015 Ad, Soyad: **SOLUTION**

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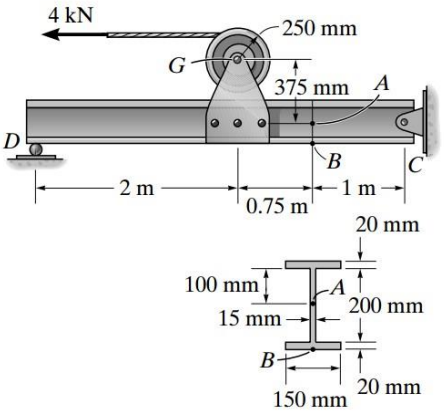
Problem:

Determine the state of stress at point A and B when the beam is subjected to the cable force of 4 kN. Indicate the result as a differential volume element.

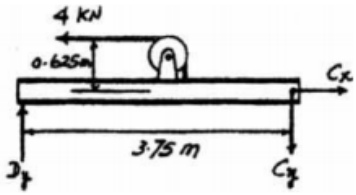


Support Reactions:

$\zeta + \Sigma M_D = 0; \quad 4(0.625) - C_y(3.75) = 0$

$C_y = 0.6667 \text{ kN}$

$\overset{+}{\rightarrow} \Sigma F_x = 0; \quad C_x - 4 = 0 \quad C_x = 4.00 \text{ kN}$

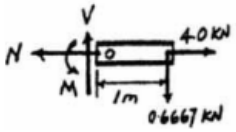


Internal Forces and Moment:

$\overset{+}{\rightarrow} \Sigma F_x = 0; \quad 4.00 - N = 0 \quad N = 4.00 \text{ kN}$

$+\uparrow \Sigma F_y = 0; \quad V - 0.6667 = 0 \quad V = 0.6667 \text{ kN}$

$\zeta + \Sigma M_o = 0; \quad M - 0.6667(1) = 0 \quad M = 0.6667 \text{ kN} \cdot \text{m}$



The State of stress at point A

Section Properties:

$A = 0.24(0.15) - 0.2(0.135) = 9.00(10^{-3}) \text{ m}^2$

$I = \frac{1}{12}(0.15)(0.24^3) - \frac{1}{12}(0.135)(0.2^3) = 82.8(10^{-6}) \text{ m}^4$

$Q_A = \Sigma \bar{y}' A' = 0.11(0.15)(0.02) + 0.05(0.1)(0.015)$

$= 0.405(10^{-3}) \text{ m}^3$

Normal Stress:

$$\sigma = \frac{N}{A} \pm \frac{My}{I}$$

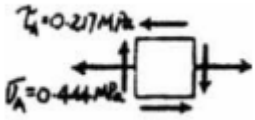
$$\sigma_A = \frac{4.00(10^3)}{9.00(10^{-3})} + \frac{0.6667(10^3)(0)}{82.8(10^{-6})}$$

$= 0.444 \text{ MPa (T)}$ **Ans.**

Shear Stress: Applying shear formula.

$$\tau_A = \frac{VQ_A}{It}$$

$$= \frac{0.6667(10^3)[0.405(10^{-3})]}{82.8(10^{-6})(0.015)} = 0.217 \text{ MPa}$$ **Ans.**



The State of stress at point B

Section Properties:

$A = 0.24(0.15) - 0.2(0.135) = 9.00(10^{-3}) \text{ m}^2$

$I = \frac{1}{12}(0.15)(0.24^3) - \frac{1}{12}(0.135)(0.2^3) = 82.8(10^{-6}) \text{m}$

$Q_B = 0$

Normal Stress:

$$\sigma = \frac{N}{A} \pm \frac{My}{I}$$

$$\sigma_B = \frac{4.00(10^3)}{9.00(10^{-3})} - \frac{0.6667(10^3)(0.12)}{82.8(10^{-6})}$$

$= -0.522 \text{ MPa} = 0.522 \text{ MPa (C)}$ **Ans.**

Shear Stress: Since $Q_B = 0$, then

$\tau_B = 0$ **Ans.**