TOBB EKONOMİ VE TEKNOLOJİ ÜNİVERSİTESİ

MAK 206 Strength of Materials – 2015 Spring

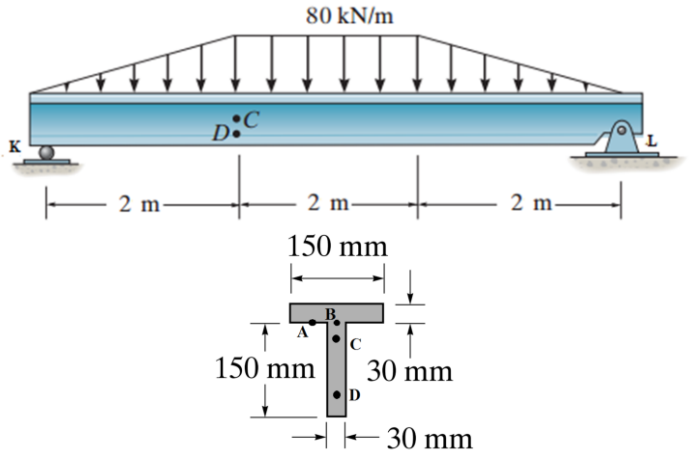
QUIZ 6

27 February 2015 Ad, Soyad: **SOLUTION**

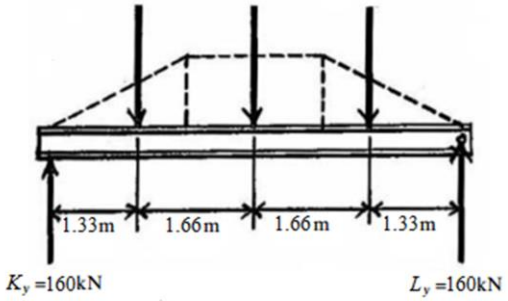
Doç. Dr. M. Ali Güler No: _____

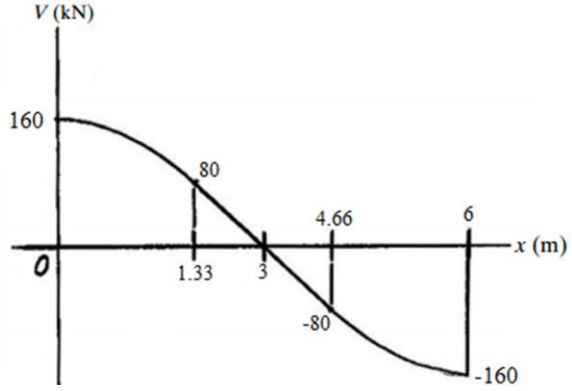
Problem: The dimensions are shown for beam KL.

a) Draw the shear diagram for the beam.
b) Determine the shear stress at points C (centroid) and D located on the web of the beam. (the distance between D point and the lower edge of the cross section is 30 mm)
c) Determine the shear stress at points A and B.
d) Determine the maximum shear stress acting in the beam at the critical section.



a)





b)

The neutral axis passes through centroid C of the cross-section,

$$\bar{y} = \frac{\Sigma \bar{y} A}{\Sigma A} = \frac{0.075\,(0.15)(0.03) + 0.165(0.03)(0.15)}{0.15(0.03) + 0.03(0.15)}$$

$$= 0.12 \text{ m}$$

$$I = \frac{1}{12}(0.03)(0.15^3) + 0.03(0.15)(0.12 - 0.075)^2$$

$$+ \frac{1}{12}(0.15)(0.03^3) + 0.15(0.03)(0.165 - 0.12)^2$$

$$= 27.0\,(10^{-6})\text{ m}^4$$

$$Q_{max} = \bar{y}' A' = 0.06\,(0.12)(0.03)$$

$$= 0.216\,(10^{-3})\text{ m}^3$$

$$Q_D = 0.105(0.03)(0.03)$$

$$= 0.945\,(10^{-4})\text{ m}^3$$

$$\tau_C = \frac{V_C Q_{max}}{It} = \frac{80\,(10^3)\left[0.216(10^{-3})\right]}{27.0(10^{-6})\,(0.03)}$$

$$= 21.33\text{ MPa}$$

$$\tau_D = \frac{V_D Q_D}{It} = \frac{80\,(10^3)\left[0.945\,(10^{-4})\right]}{27.0(10^{-6})\,(0.03)}$$

$$= 9.33\text{ MPa}$$

c)

$$Q_{A,B} = 0.045(0.15)(0.03)$$

$$= 2.025(10^{-4})\text{ m}^3$$

$$\tau_A = \frac{V_A Q_A}{It} = \frac{80\,(10^3)\left[2.025(10^{-4})\right]}{27.0(10^{-6})\,(0.15)}$$

$$= 4\text{ MPa}$$

$$\tau_B = \frac{V_B Q_B}{It} = \frac{80\,(10^3)\left[2.025(10^{-4})\right]}{27.0(10^{-6})\,(0.03)}$$

$$= 20\text{ MPa}$$

d) V_{max}=160 kN

$$\tau_{max} = \frac{V_{max} Q_{max}}{It} = \frac{160(10^3)\left[0.216(10^{-3})\right]}{27.0(10^{-6})\,(0.03)}$$

$$= 42.66\text{ MPa}$$