TOBB EKONOMİ VE TEKNOLOJİ ÜNİVERSİTESİ

MAK 206 Strength of Materials – 2013 Spring

QUIZ 1

21 January 2013 Ad, Soyad: _____

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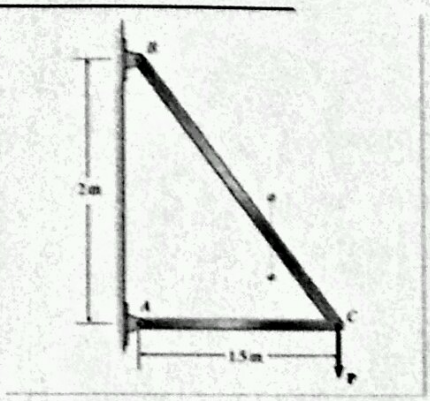
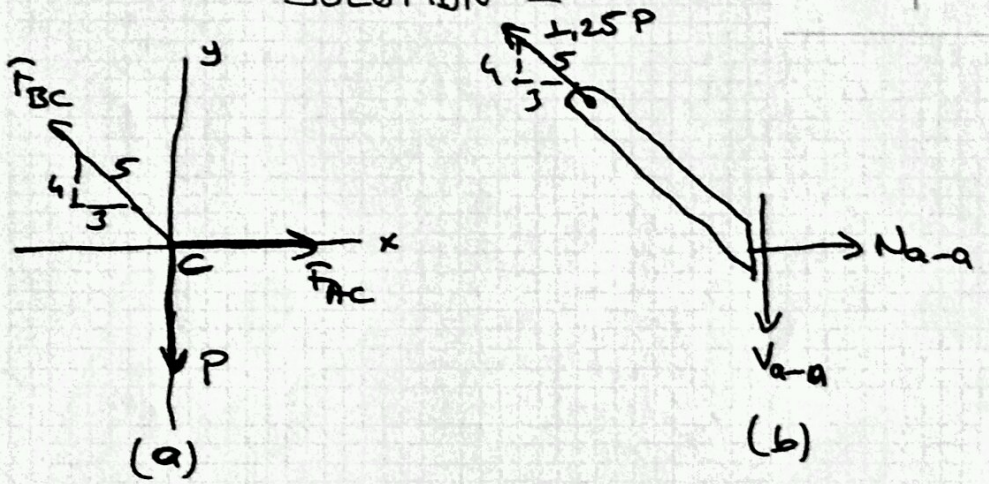
Problem: Determine the largest load P that can be a applied to the frame without causing either the average normal stress or the average shear stress at section a–a to exceed $\sigma = 150$ MPa and $\tau = 60$ MPa, respectively. Member CB has a square cross section of 25 mm on each side.



– SOLUTION –



Analyse the equilibrium of Joint C using FBD in figure a

$+\uparrow \Sigma F_y = 0$; $\frac{4}{5} F_{BC} - P = 0 \Rightarrow F_{BC} = 1.25P$

Substituting F_{BC} in Figure (b).

$\rightarrow \Sigma F_x = 0 \Rightarrow N_{a-a} - 1.25P \cdot \frac{3}{5} = 0 \Rightarrow N_{a-a} = 0.75P$

$+\uparrow \Sigma F_y = 0 \Rightarrow \frac{4}{5} \cdot 1.25P - V_{a-a} = 0 \Rightarrow V_{a-a} = P$

** The cross-sectional area of a-a $\Rightarrow A_{a-a} = \frac{0.025 \cdot 0.025}{3/5} = 1.0417 \times 10^{-3}\ m^2$

$\Rightarrow$ Normal stress: $\sigma_{allow} = \frac{N_{a-a}}{A_{a-a}} \Rightarrow 150 \times 10^6 = \frac{0.75P}{1.0417(10^{-3})} \Rightarrow P = 208.33(10^3)\ N = 208.33\ kN$

$\Rightarrow$ Shear Stress: $\tau_{allow} = \frac{V_{a-a}}{A_{a-a}} \Rightarrow 60 \times 10^6 = \frac{P}{1.0471(10^{-3})}$

$P = 62.5 \times (10^3)\ N = 62.5\ kN$

Answer