University of Maryland, College Park
Department of Civil & Environmental Engineering

Homework Set # 19
Due May 19, 2003

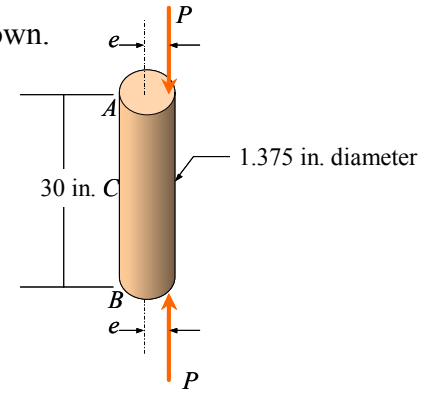
ENES 220 – Mechanics of Materials – Spring 2003

Problem 1

An axial load P is applied to the 1.375-in. diameter steel rod AB as shown. When $P = 21$ kips, it is observed that the horizontal deflection of the midpoint C is 0.03 in. Using $E = 29 \times 10^6$ psi, determine

(a) The eccentricity e of the load.

(b) The maximum stress in the rod.

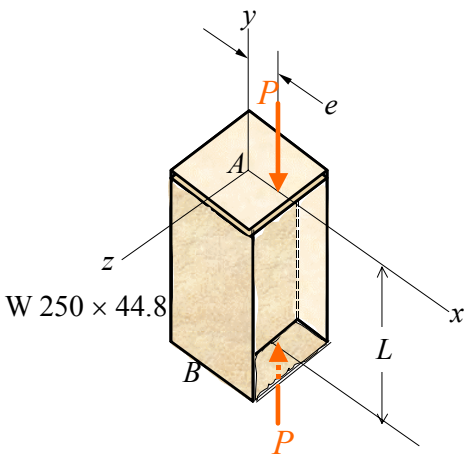


Problem 2

Axial loads of magnitude of P are applied parallel to the geometric axis of the column AB and intersect the x-axis at a distance $e = 12$ mm from the geometric axis. For the grade of steel used, $\sigma_Y = 250$ MPa and $E = 200$ GPa. Knowing that a factor of safety (FS) of 2.5 with respect to permanent deformation is required, determine

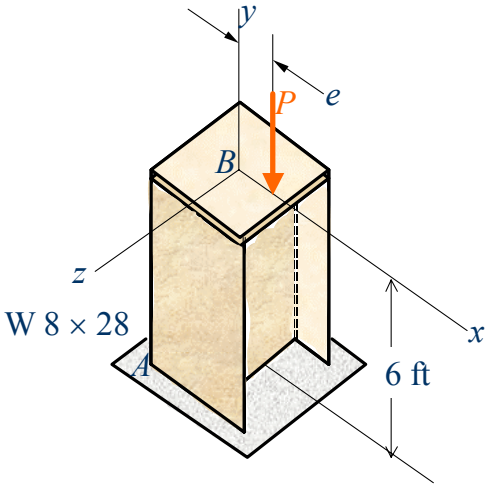
(a) The magnitude P of the allowable load when the length L is 4.25 m.

(b) The ratio of the load found in part a to the magnitude of the allowable centric load for the column.



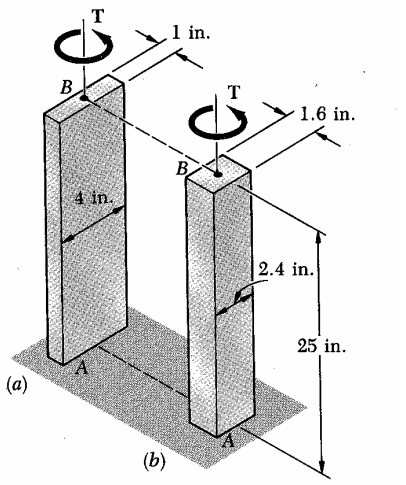
Problem 3

An axial load P is applied at a point located on the x-axis at a distance $e = 0.60$ in. from the geometric axis of the W8 × 28 rolled-steel column AC. Knowing that the column is free at its top B and fixed at its base A and that $\sigma_Y = 50$ ksi and E = 30 × 10^6 psi, determine the allowable load P if a factor of safety of 3 with respect to yield is required.



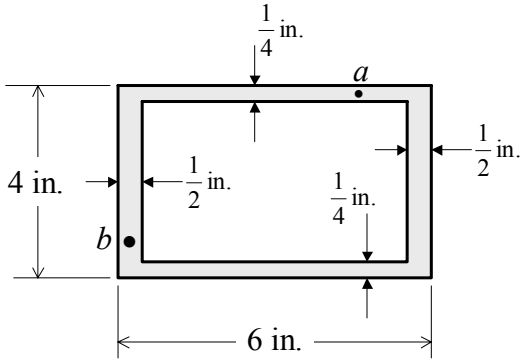
Problem 4

Each of the two brass bars shown is subjected to a torque of magnitude $T = 12.5$ kip· in. Knowing that $G = 5.6 \times 10^6$ psi, determine for each bar the maximum shearing stress and the angle of twist at B.



Problem 5

A 5-kip · ft torque is applied to a hollow aluminum shaft having the cross section shown. Neglecting the effect of stress concentration, determine the shearing stress at points a and b.



Problem 6

Determine the elastic moment M_y and the plastic (nominal) moment M_p (or M_n) for the steel beam shown in the figure. Also calculate the shape factor and the nominal uniform load w_n, which can be placed on the beam for a 12-ft simple span. Use $\sigma_Y = 36$ ksi.