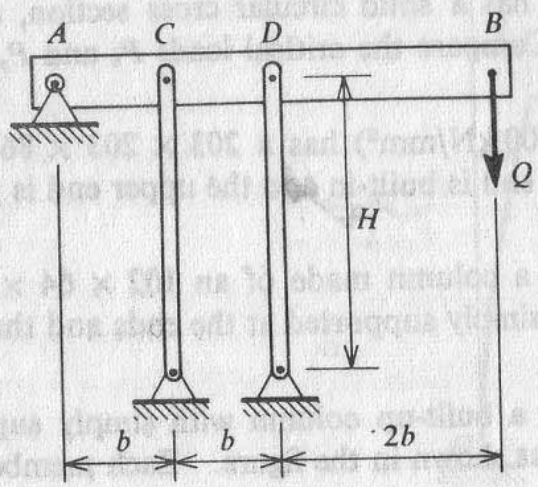
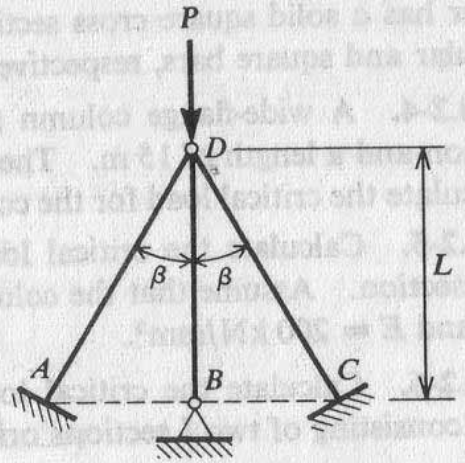
PROBLEM SET# 4 -COLUMNS

10.2-11. A heavy, relatively rigid bar AB is pin-supported at end A and supported at C and D by two identical pin-ended slender columns as shown in the figure. Each column has flexural rigidity EI. At what load Q does the system collapse?



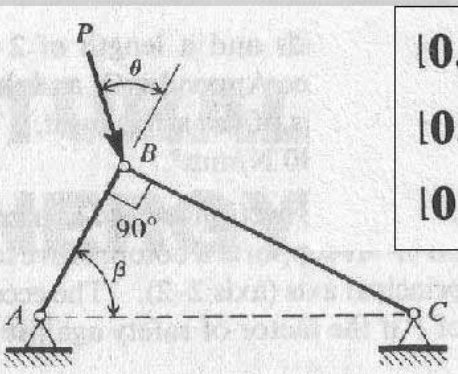
Prob. 10.2-11



Prob. 10.2-12

10.2-12. A structure $ABCD$ is composed of three slender bars (see figure) having the same flexural rigidity EI. Joints B and D are pin connections and supports A and C are fixed. The angle $\beta = 30°$. Assuming that collapse occurs by buckling of the members, determine the critical value of the vertical load P acting at joint D.

10.2-13. A pin-connected truss ABC is composed of two slender bars (see figure) having identical cross sections and the same material. Assuming that collapse occurs by buckling of the members, determine the angle θ so that the load P will be a maximum. (Assume $0 < \theta < \pi/2$.)



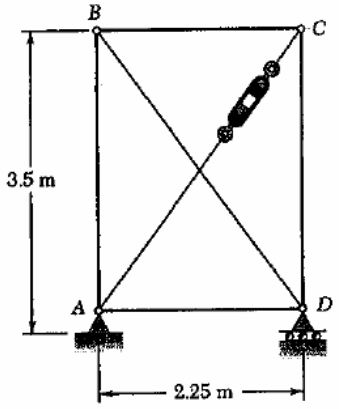
Prob. 10.2-13

10.2-11 $Q = 3\pi^2 EI/4H^2$

10.2-12 $P_{cr} = 36.1EI/L^2$

10.2-13 $\theta = \arctan \cot^2 \beta$

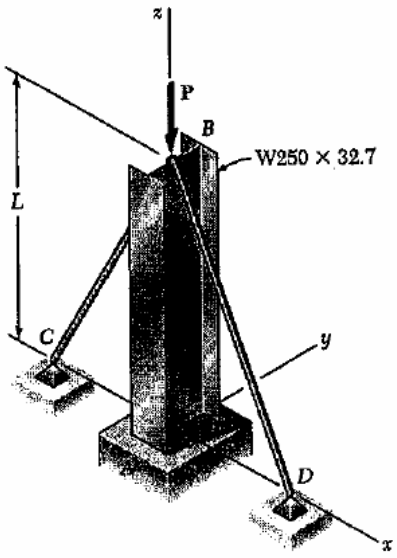
PROBLEM 10.20



10.20 Members *AB* and *CD* are 30-mm-diameter steel rods, and members *BC* and *AD* are 22-mm-diameter steel rods. When the turnbuckle is tightened, the diagonal member *AC* is put in tension. Knowing that a factor of safety with respect to buckling of 2.75 is required, determine the largest allowable tension in *AC*. Use $E = 200$ GPa and consider only buckling in the plane of the structure.

ANS: 2.77 KN

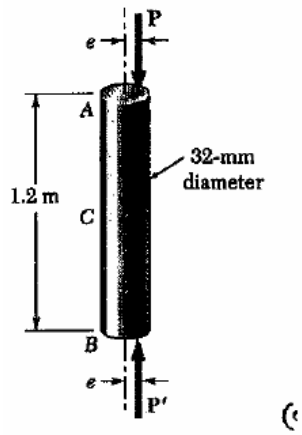
PROBLEM 10.28



10.28 Column *AB* carries a centric load **P** of magnitude 72 kN. Cables *BC* and *BD* are taut and prevent motion of point *B* in the *xz* plane. Using Euler's formula and a factor of safety of 2.3, and neglecting the tension in the cables, determine the maximum allowable length *L*. Use $E = 200$ GPa.

ANS: 12.08 m

PROBLEM 10.32



10.32 An axial load **P** is applied to the 32-mm-diameter steel rod *AB* as shown. For $P = 37$ kN and $e = 1.2$ mm, determine (*a*) the deflection at the midpoint *C* of the rod, (*b*) the maximum stress in the rod. Use $E = 200$ GPa.

ANS: 78.9 Mpa