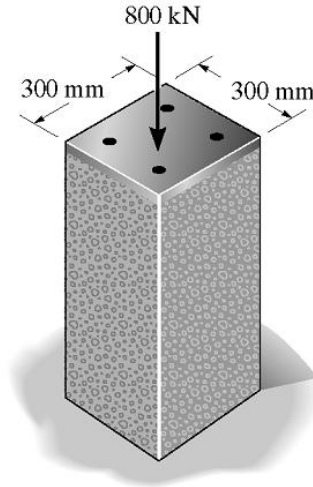


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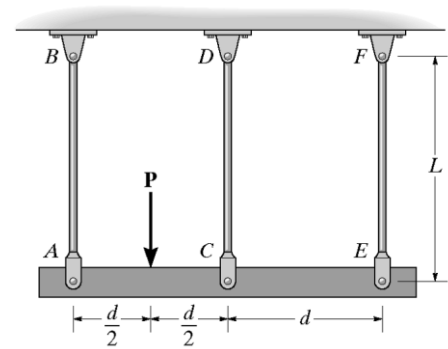
Student ID:

AM22: Statically Indeterminate Problems - Axially Loaded Members

1. The concrete column is reinforced using four steel reinforcing rods, each having a diameter of 18 mm. Determine the stress in the concrete and the steel if the column is subjected to an axial load of 800 kN. $E_{st} = 200 \text{ GPa}$, $E_c = 25 \text{ GPa}$.



2. The three suspender bars are made of the same material with Young's modulus E and have equal cross-sectional areas A . Determine the average normal stress in each bar if the rigid beam ACE is subjected to the force P .

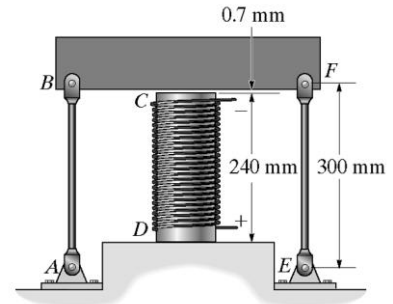


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AM22: Statically Indeterminate Problems - Axially Loaded Members

3. The center rod CD of the assembly is heated from $T_1 = 30^\circ\text{C}$ to $T_2 = 180^\circ\text{C}$ using electrical resistance heating. Also, the two end rods AB and EF are heated from $T_1 = 30^\circ\text{C}$ to $T_2 = 50^\circ\text{C}$. At the lower temperature T_1 the gap between C and the rigid bar BF is 0.7 mm. Determine the force in rods AB , CD and EF caused by the increase in temperature. Rods AB and EF are made of steel, and each has a cross-sectional area of 125 mm^2 . CD is made of aluminum and has a cross-sectional area of 375 mm^2 . $E_{\text{st}} = 200\text{ GPa}$, $E_{\text{al}} = 70\text{ GPa}$, $\alpha_{\text{st}} = 12(10^{-6})/^\circ\text{C}$, and $\alpha_{\text{al}} = 23(10^{-6})/^\circ\text{C}$.



4. The bar has a cross-sectional area A , length L , modulus of elasticity E , and coefficient of thermal expansion α . The temperature of the bar changes uniformly along its length from T_A at A to T_B at B so that at any point x along the bar $T = T_A + x(T_B - T_A)/L$. Determine the force the bar exerts on the rigid walls. Initially no axial force is in the bar.

