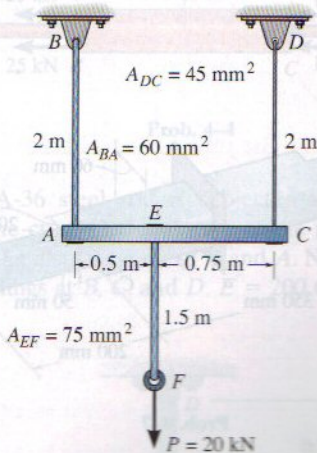**4-15.** The assembly consists of three titanium rods and a rigid bar AC. The cross-sectional area of each rod is given in the figure. If a vertical force $P = 20$ kN is applied to the ring F, determine the vertical displacement of point F. $E_{ti} = 350$ GPa.


$A_{DC} = 45$ mm^2

$A_{BA} = 60$ mm^2

2 m

2 m

E

A C

|—0.5 m—|— 0.75 m —|

1.5 m

$A_{EF} = 75$ mm^2

F

$P = 20$ kN

Prob. 4–15

4-46. The beam is pinned at A and supported by two aluminum rods, each having a diameter of 25 mm and a modulus of elasticity $E_{al} = 70(10^3)$ MPa. If the beam is assumed to be rigid and initially horizontal, determine the displacement of the end B when the force of 25 kN is applied.
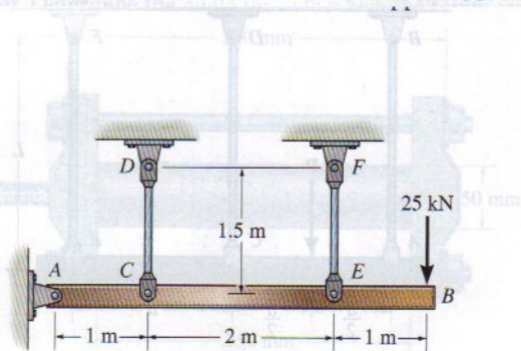

Probs. 4–46/47

4-75. A thermo gate consists of a 6061-T6-aluminum plate AB and an Am-1004-T61-magnesium plate CD, each having a width of 15 mm and fixed supported at their ends. If the gap between them is 1.5 mm when the temperature is $T_1 = 25°C$, determine the temperature required to just close the gap. Also, what is the axial force in each plate if the temperature becomes $T_2 = 100°C$? Assume bending or buckling will not occur. $E_{al} = 68.9$ GPa, $E_{am} = 44.7$ GPa, $\alpha_{al} = 24(10^{-6})/°C$, $\alpha_{am} = 26(10^{-6})/°C$.
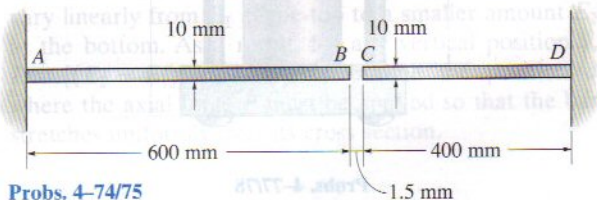
Probs. 4–74/75

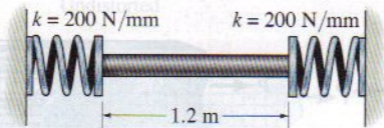
*4-76. The C83400-red-brass rod AB and 2014-T6-aluminum rod BC are joined at the collar B and fixed connected at their ends. If there is no load in the members when $T_1 = 10°C$, determine the average normal stress in each member when $T_2 = 50°C$. Also, how far will the collar be displaced? The cross-sectional area of each member is 1000 mm². $E_{br} = 100$ GPa, $\alpha_{br} = 18(10^{-6})/°C$, $E_{al} = 70$ GPa, $\alpha_{al} = 23(10^{-6})/°C$.
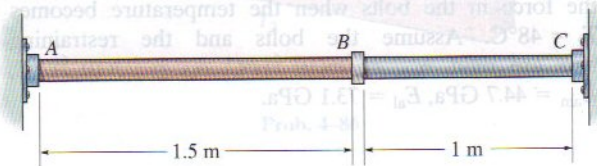
Prob. 4–76

*4-84. The rod is made of A-36 steel and has a diameter of 6 mm. If the springs are compressed 12 mm. when the temperature of the rod is $T = 10°C$, determine the force in the rod when its temperature is $T = 75°C$. $E = 200$ GPa, $\alpha = 12(10^{-6})/°C$.

$k = 200$ N/mm $k = 200$ N/mm

← 1.2 m →

Prob. 4–84