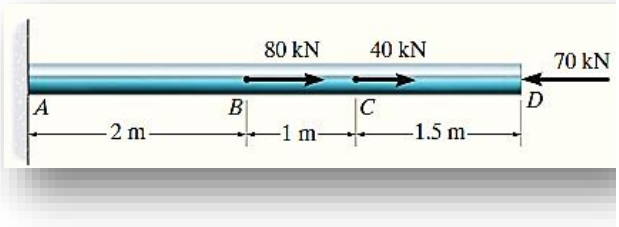
ME212 Strength of Materials

Chapter 4- Examples

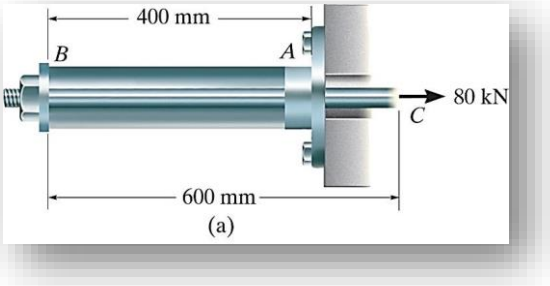
Exp. 1

The uniform A-36 steel bar in the Figure has a diameter of 50 mm and is subjected to the loading shown. Determine the displacement at D, and the displacement of point B relative to C. Take $E_{A-36} = 200$ GPa.



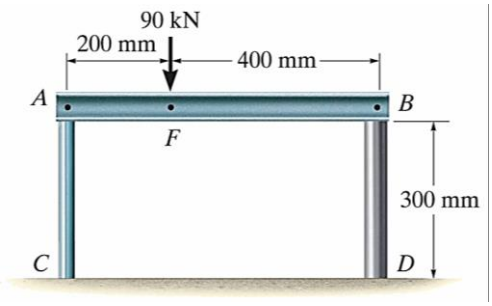
Exp. 2

The assembly shown in Figure(a) consists of an aluminum tube AB having a cross-sectional area of 400 mm^2. A steel rod having a diameter of 10 mm is attached to a rigid collar and passes through the tube. If a tensile load of 80 kN is applied to the rod, determine the displacement of end C of the rod. Take $E_{st} = 200$ GPa, $E_{al} = 70$ GPa



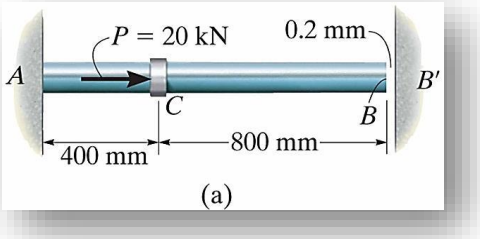
Exp.3

Rigid beam AB rests on the two short posts shown in the figure. AC is made of steel and has a diameter of 20 mm, and BD is made of aluminum and has a diameter of 40 mm. Determine the displacement of point F on AB if a vertical load of 90 kN is applied over this point. Take $E_{st} = 200$ GPa, $E_{al} = 70$ GPa



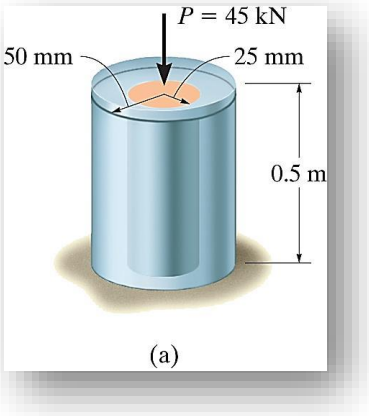
Exp.4

The steel rod shown in figure has a diameter of 10 mm. It is fixed to the wall at A, and before it is loaded, there is a gap of 0.2 mm between the wall at B' and the rod. Determine the reactions at A and B' if the rod is subjected to an axial force of $P = 20$ kN as shown. Neglect the size of the collar at C. Take $E_{st} = 200$ GPa.



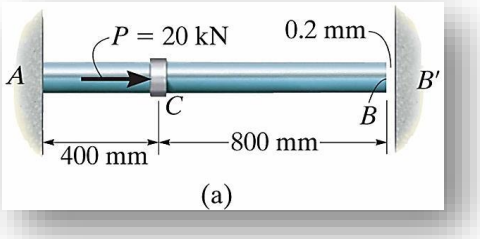
Exp.5

The aluminum post shown in Figure(a) is reinforced with a brass core. If this assembly supports an axial compressive load of $P = 45$ kN, applied to the rigid cap, determine the average normal stress in the aluminum and the brass. Take $E_{al} = 70(10^3)$ MPa and $E_{br} = 105(10^3)$ MPa.



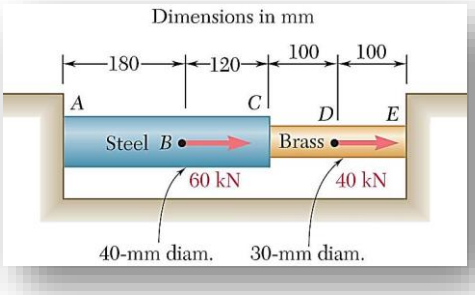
Exp.6 (Exp 4-The Force Method)

The steel rod shown in figure has a diameter of 10 mm. It is fixed to the wall at A, and before it is loaded, there is a gap of 0.2 mm between the wall at B' and the rod. Determine the reactions at A and B' if the rod is subjected to an axial force of $P = 20$ kN as shown. Neglect the size of the collar at C. Take $E_{st} = 200$ GPa.



Exp.7

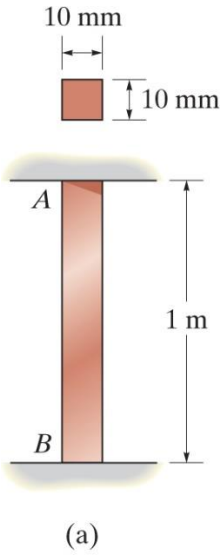
Two cylindrical rods, one of steel and the other of brass, are joined at C and restrained by rigid supports at A and E. For the loading shown and knowing that $E_{st} = 200$ GPa and $E_{br} = 105$ GPa, determine (a) the reactions at A and E, (b) the deflection of point C.



Exp. 8

The A-36 steel bar shown in Fig.(a) is constrained to just fit between two fixed supports when $T_1 = 30°C$. If the temperature is raised to $T_2 = 60°C$, determine the average normal thermal stress developed in the bar.

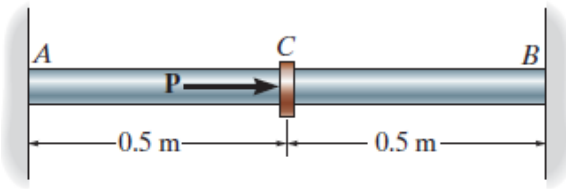
$\alpha = 12(10^{-6})/°C$



(a)

Exp. 9

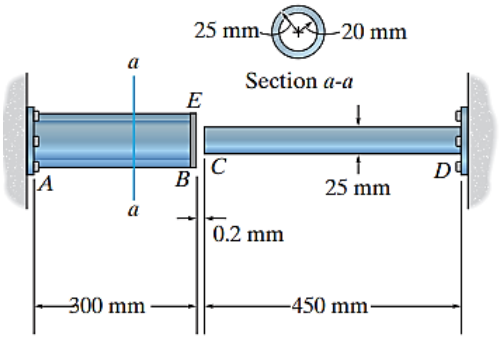
The A-36 steel rod has a diameter of 50 mm and is lightly attached to the rigid supports at A and B when $T_1 = 80°C$. If the temperature becomes $T_2 = 20°C$ and an axial force of $P = 200$ kN is applied to its center, determine the reactions at A and B.



$E_{st} = 200$ GPa, $\alpha = 12(10^{-6})/°C$

Exp.10

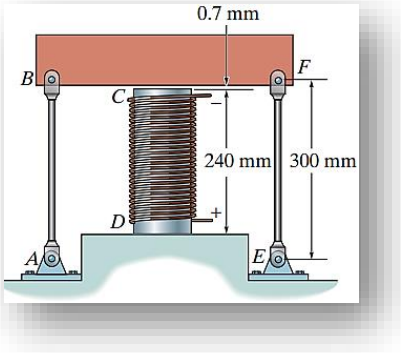
The AM1004-T61 magnesium alloy tube AB is capped with a rigid plate E. The gap between E and end C of the 6061-T6 aluminum alloy solid circular rod CD is 0.2 mm when the temperature is at 30° C. Determine the normal stress developed in the tube and the rod if the temperature rises to 80° C. Neglect the thickness of the rigid cap.



$\alpha_{mg} = 26(10^{-6})/°\text{C}$, $\alpha_{al} = 24(10^{-6})/°\text{C}$,
$E_{mg} = 44.7$ GPa, $E_{al} = 68.9$ GPa,

Exp.11

The center rod CD of the assembly is heated from $T_1 = 30°C$ to $T_2 = 180°C$ using electrical resistance heating. At the lower temperature T_1 the gap between C and the rigid bar is 0.7 mm. Determine the force in rods AB and EF caused by the increase in temperature. Rods AB and EF are made of steel, and each has cross-sectional area of 125 mm^2. CD is made of aluminum, and has cross-sectional area of 375 mm^2.



$E_{st} = 200$ GPa, $E_{al} = 70$ GPa and $\delta_{al} = 23(10^{-6})/°C$

Exp.12

The rigid link is supported by a pin at A, a steel wire BC having an unstretched length of 200 mm and cross-sectional area of 22.5 mm^2 and a short aluminum block having an unloaded length of 50 mm and cross-sectional area of 40 mm^2 If the link is subjected to the vertical load shown, determine the average normal stress in the wire and the block. $E_{st} = 200$ GPa, $E_{al} = 70$ GPa.