Arab Academy for Science, Technology & Maritime Transport.
College of Engineering & Technology,
Mechanical Engineering Department.

# Stress analysis (ME 276)
# Sheet No. 1.

(1) A metal wire is 2.5 mm diameter and 2 m long. A force of 120 N is applied to it and it stretches 0.3 mm. Assume the material is elastic. Determine the following:
(a) The stress in the wire,
(b) The strain in the wire.

(2) A steel tensile test specimen has a cross sectional area of 100 $mm^2$ and a gauge length of 50 mm, the gradient of the elastic section is 410 X $10^3$ N/mm. Determine the modulus of elasticity.

(3) A steel column is 3 m long and 0.4 m diameter. It carries a load of 50 MN. Given that the modulus of elasticity is 200 GPa, calculate the compressive stress and strain and determine how much the column is compressed.

(4) Determine the average normal stress developed at points ***A***, ***B***, and ***C***. The diameter of each segment is indicated in Figure 1.

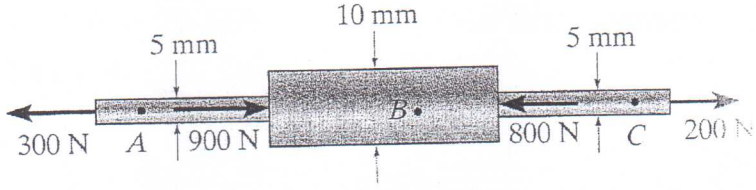



Figure 1.

(5) The bar shown in Figure 2 has a constant width of 35 mm and a thickness of 10 mm. Determine the maximum average normal stress in the bar when it is subjected to the loading shown.

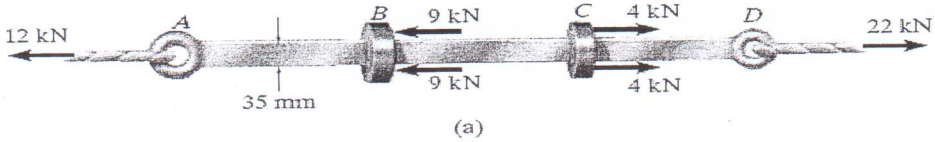



Figure 2.

(6) The steel bar shown in Figure 3 is made from two segments having cross-sectional areas of $A_{AB} = 600$ mm$^2$ and $A_{BD} = 1200$ mm$^2$. Determine the vertical displacement of end $A$ and the displacement of $B$ relative to $C$. ($E$ = 200 GPa.)

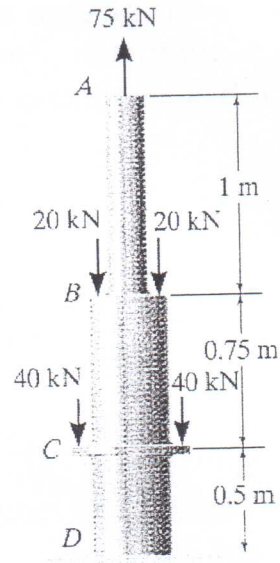



Figure 3.

(7) The 20 mm-diameter steel rod, shown in Figure 4, is subjected to the axial forces shown. Determine the displacement of end $C$ with respect to the fixed support at $A$. ($E$ = 200 GPa.)

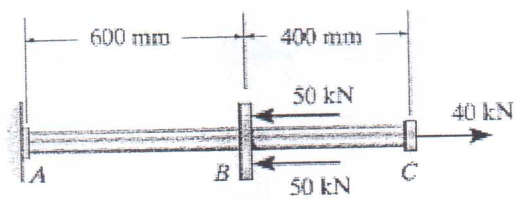



Figure 4.

(8) Segments $AB$ and $CD$ of the assembly shown in Figure 5 are solid circular rods and segment $BC$ is a tube. If the assembly is made of aluminum of $E$ = 70 GPa, determine the displacement of end $D$ with respect to end $A$.

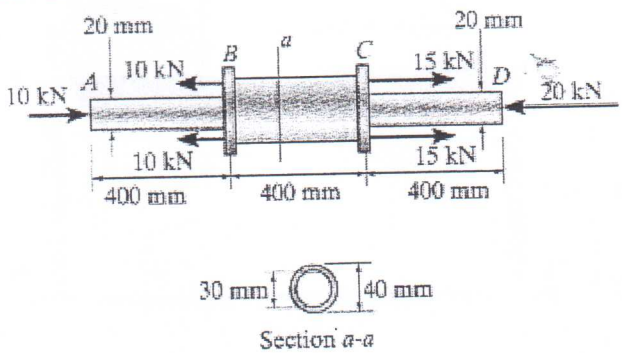



Figure 5.

(9) The steel rod shown in Figure 6 is subjected to the loading shown. If the cross-sectional area of the rod is 50 $mm^2$, determine the displacement of its end ***D***. Neglect the size of the couplings at ***B***, ***C***, and ***D***. (***E*** = 200 GPa.)

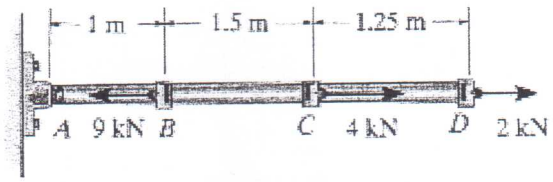



Figure 6.

(10) The assembly shown in Figure 7 consists of a steel rod ***CB*** and an aluminum rod ***BA***, each having a diameter of 12 mm. If the rod is subjected to the axial loadings at ***A*** and at the coupling ***B***, determine the displacement of the coupling ***B*** and the end ***A***. Neglect the size of the connections at ***B*** and C assuming that they are rigid. $E_{st}$ = 200 GPa and $E_{al}$ = 70 GPa.

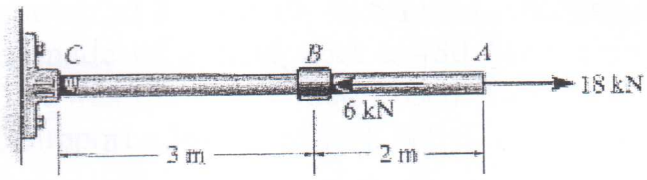
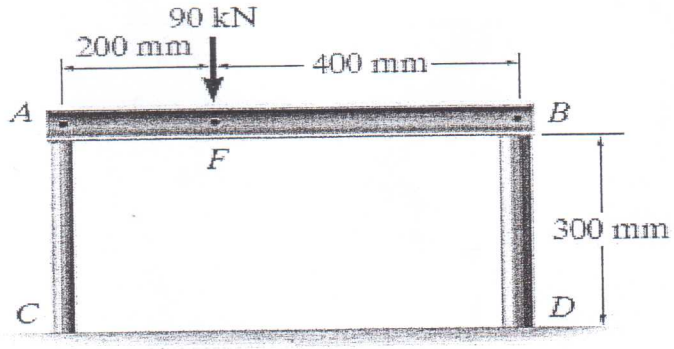



Figure 7.

(11) A rigid beam ***AB*** rests on the two short posts shown in Figure 8. ***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 and $E_{al}$ = 70 GPa.




(a)

Figure 8.

(12) Members ***ABC*** and ***DEF***, shown in Figure 9, are joined with steel links (***E*** = 200 GPa). Each of the links is made of a pair of 25 X 35 mm plates. Determine the change in length of:
(a) Member ***BE***,
(b) Member ***CF***.

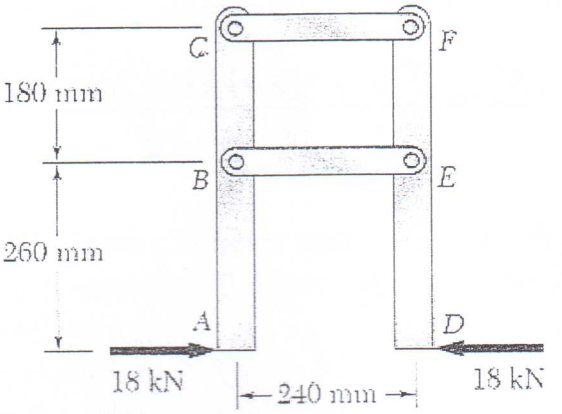



Figure 9.

(13) Link ***BC***, shown in Figure 10, is 6 mm thick, has a width ***w*** = 25 mm, and is made of a steel with a 480 MPa ultimate strength in tension. What was the safety factor used if the structure shown was designed to support a load **P** of 16 KN?

(14) Link ***BC***, shown in Figure 10, is 6 mm thick and is made of a steel with a 450 MPa ultimate strength in tension. What should be the width ***w*** if the structure is being designed to support a 20 KN load P with a factor of safety of 3?

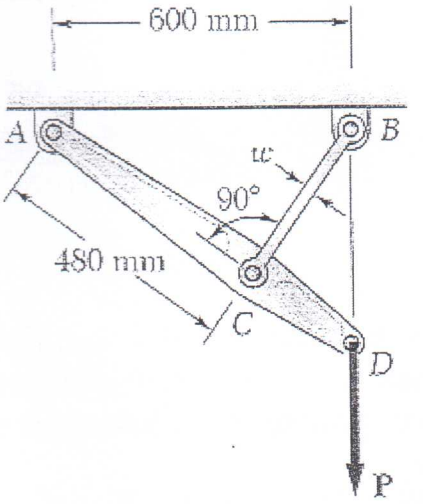



Figure 10.