Faculty of Science and Applied Sciences, Ain Beida
Department of Mechanical Engineering
Strength of Materials 2nd year Bachelor's degree in Mechanical Engineering
Chapter 1_ Tutorial Classes 1 Tension & Compression

Exercize 1 :

In Fig. 1, determine an expression for the total elongation of an initially straight bar of length L, cross-sectional area A, and modulus of elasticity E if a tensile load P acts on the ends of the bar.

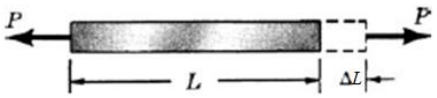


Figure 1

Exercize 2 :

A steel bar of cross section 500 mm^2 is acted upon by the forces shown in Fig. 2. Determine the total elongation of the bar. For steel, consider E = 200 GPa.

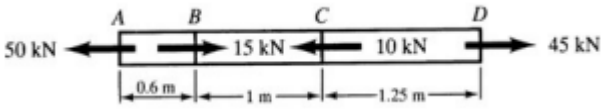
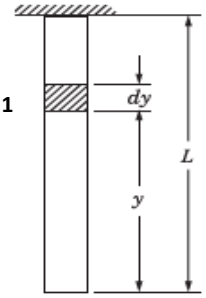


Figure 2

Exercize 3 :

Determine the total increase in length of a bar of constant section suspended vertically and subjected to its own weight as the only load (Fig. 3). The bar is initially straight.

Figure 1



Exercize 4 :

For the bar in Figure 4, given: P, a, E and A, plot the diagrams of the forces Nx, the stresses σ_x, the stains ε_x and the displacements u. For the bar of Figure 5, given in addition q, plot the diagrams of the forces Nx and u.

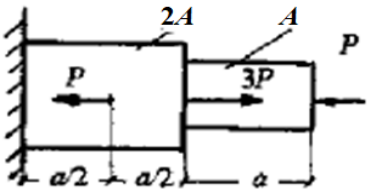


Figure 4

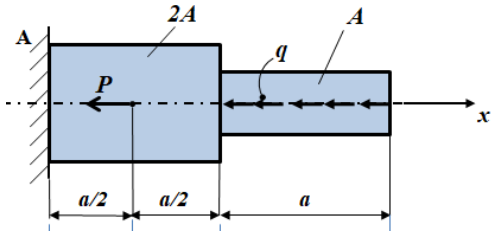


Figure 5

Exercize 5 :

A fiber-optic cable capable of handling 40 000 telephone calls simultaneously was laid under the Pacific Ocean, a distance of 13 300 km. The cable was unreeled from shipboard at a mean temperature of 22°C and dropped to the ocean floor having a mean temperature of 5°C. The coefficient of linear expansion of the cable is 75 × 10^{-6}/°C. Determine the length of cable that must be carried on the ship to span the 13 300 km.

Exercize 6 :

A square steel bar 50 mm on a side and 1 m long is subject to an axial tensile force of 250 kN. Determine the decrease **Δ*l*** in the lateral dimension due to this load. Use E = 200 GPa and ν = 0.3.

Exercize 7:

Two prismatic bars are rigidly fastened together and support a vertical load of 45 kN, as shown in Fig. 6. The upper bar is steel having length 10 m and cross-sectional area 60 cm2. The lower bar is brass having length 6 m and cross-sectional area 50 cm2 . For steel E = 200 GPa, for brass E = 100 GPa. Determine the maximum stress in each material.

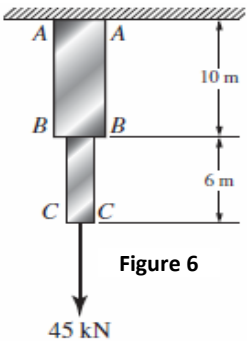


Figure 6

Exercize 8:

For the system in Figure 7, determine the allowable value of the force P from the strength condition. Consider : A = 2 cm^2, α = 30°, [σ] = 120 MPa

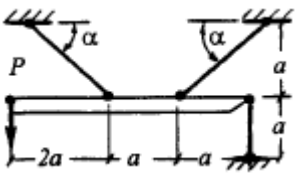


Figure 7

Exercize 9:

The pinned members shown in Fig. 8 carry the loads P and $2P$. All bars have cross-sectional area A. Determine the stresses in bars AB and AF.
Same question for the system in figure 9.

Exercize 10:

The three-bar assembly shown in Fig. 10 supports the vertical load P. Bars AB and BD are identical, each of length L and cross-sectional area A_1. The vertical bar BC is also of length L but of area A_2. All bars have the same modulus E and are pinned at A, B, C, and D. Determine the axial force in each of the bars.

Exercize 11:

The rigid bar AD is pinned at A and attached to the bars BC and ED, as shown in Fig.11. The entire system is initially stress free and the weights of all bars are negligible. The temperature of bar BC is lowered 25°C and that of bar ED is raised 25°C. Find the normal stresses in bars BC and ED. For BC, which is brass, assume E = 90 GPa, α = 20 × 10–6/°C, and for ED, which is steel, take E = 200 GPa and α = 12 × 10–6/°C. The cross-sectional area of BC is 500 mm^2 and of ED is 250 mm^2.

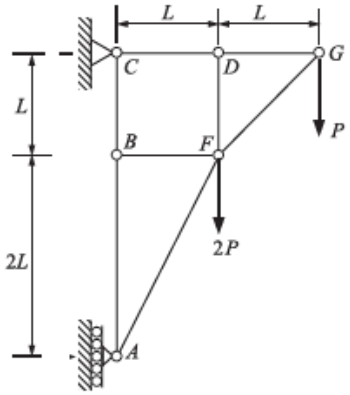


Figure 8

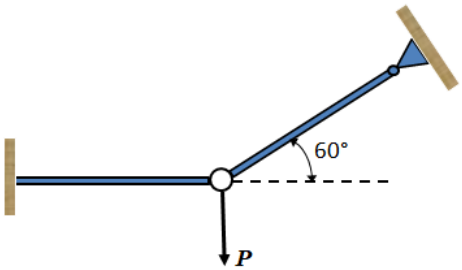


Figure 9

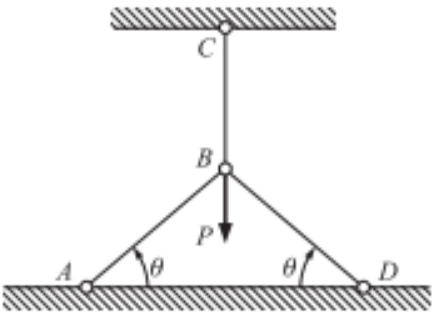


Figure 10

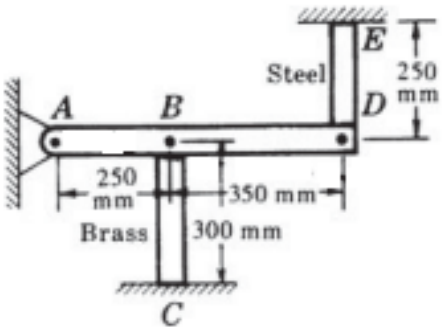


Figure 11