Name: _____ Date: _____

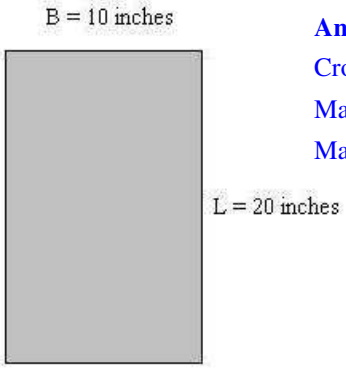
Strength of Materials Math Worksheet Answers

1. Calculate the maximum tensile and compressive forces allowed for the cross-sectional area shown in Figure 1. The maximum tensile strength is 500 lb/in^2 (pounds per inches squared). The maximum compressive strength is 5,000 lb/in^2. Use the following equations to complete the problem. Show your work and calculations.

cross-sectional area = (B) x (L)

maximum tensile force = (maximum tensile strength) x (cross-sectional area)

maximum compressive force = (maximum compressive strength) x (cross-sectional area)



Answer:

Cross-sectional area = (10 inches) x (20 inches) = 200 in^2

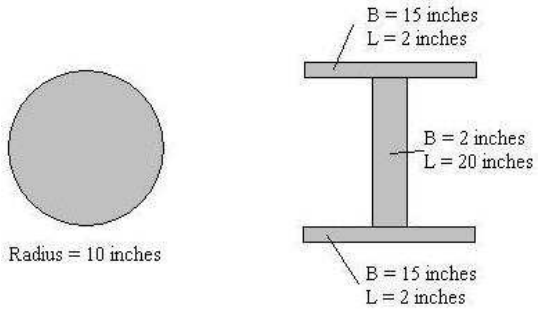
Maximum tensile force = (500 lb/in^2) x (200 in^2) = 100,000 lb

Maximum compressive force = (5,000 lb/in^2) x (200 in^2) = 1,000,000 lbs

Figure 1: Cross-sectional area.

2. Calculate the maximum tensile and compressive forces allowed for the following two cross-sectional areas shown in Figure 2. The maximum tensile strength is 3,750 lb/in^2. The maximum compressive strength is 4,850 lb/in^2. Use the following equations along with those in #2 to complete the problem. Show your work and calculations.

cross-sectional area = π x (radius)^2 π = 3.14



Answer: **Figure 2: Cross-sectional areas.**

Cross-sectional area of circle = 3.14 x (10 inches)^2 = 314 in^2

Cross-sectional area of I-beam = (15 inches) x (2 inches) + (15 inches) x (2 inches) + (2 inches) x (20 inches) = 100 in^2

Maximum tensile force of circle = (3,750 lb/in^2) * (314 in^2) = 1,177,500 lb

Maximum compressive force of circle = (4,850 lb/in^2) * (314 in^2) = 1,522,900 lb

Maximum tensile force of I-beam = (3,750 lb/in^2) x (100 in^2) = 375,000 lb

Maximum compressive force of I-beam = (4,850 lb/in^2) x (100 in^2) = 485,000 lb

3. Part 1: Calculate the compressive force for the cross-sectional area shown in Figure 3. The original length of the member was 100-in long. After applying the compressive force, the member was 99-in long. The modulus of elasticity for the material used in the cross section is 10,000 lb/in^2. Use the following equations along with those in #2 and #3 to complete the problem. Show your work and calculations.

Part 2: Calculate the tension force for the cross-sectional area shown in Figure 3. The original length of the member was 100-in long. After applying the tensile force, the member was 103-in long. The modulus of elasticity for the material used in the cross section is the same as in #2 above. Use the following equations along with those in #2 and #3 to complete the problem. Show your work and calculations.

$\sigma = E * \varepsilon$ σ = stress

ε = change in length / original length ε = strain

E = modulus of elasticity

change in length = (length after force applied) – (original length)

If the change in length is negative, take the absolute value to get a positive number

force = σ * cross-sectional area

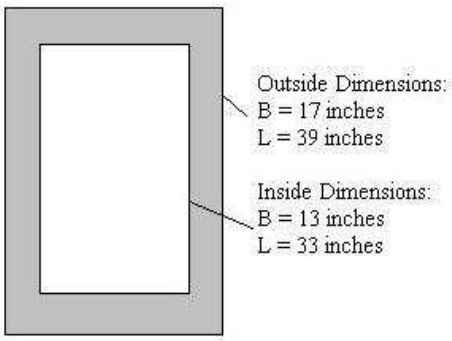


Figure 3: Cross-sectional area.

Part 1 Answer:

Change in length = 99 inches - 100 inches = -1 inch

Taking the absolute value, change in length = 1 inch

ε = 1 inch / 100 inches = 0.01

σ = (10,000 lb/in^2) x (0.01) = 100 lb/in^2

Cross-sectional area = (17 inches) x (39 inches) – (13 inches) x (33 inches) = 234 in^2

Force = (100 lb/in^2) x (234 in^2) = 23,400 lb

Part 2 Answer:

Change in length = 103 - 100 inches = 3 inches

ε = 3 inches / 100 inches = 0.03

σ = (10,000 lb/in^2) x (0.03) = 300 lb/in^2

Cross-sectional area = (17 inches) x (39 inches) – (13 inches) x (33 inches) = 234 in^2

Force = (300 lb/in^2) x (234 in^2) = 70,200 lb