Strength of Materials Math Worksheet

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/in² (pounds per inches squared). The maximum compressive strength is 5,000 lb/in². Use the following equations to complete the problem. Show your work and calculations.

\[ \text{cross-sectional area} = (B) \times (L) \]
\[ \text{maximum tensile force} = (\text{maximum tensile strength}) \times (\text{cross-sectional area}) \]
\[ \text{maximum compressive force} = (\text{maximum compressive strength}) \times (\text{cross-sectional area}) \]

\[ B = 10 \text{ inches} \]
\[ L = 20 \text{ inches} \]

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/in². The maximum compressive strength is 4,850 lb/in². Use the following equations along with those in #2 to complete the problem. Show your work and calculations.

\[ \text{cross-sectional area} = \pi \times (\text{radius})^2 \]
\[ \pi = 3.14 \]

\[ B = 15 \text{ inches} \]
\[ L = 2 \text{ inches} \]
\[ \text{Radius} = 10 \text{ inches} \]

Figure 2: Cross-sectional areas.
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.

\[ \sigma = E \times \varepsilon \]
\[ \varepsilon = \frac{\text{change in length}}{\text{original length}} \]
\[ E = \text{modulus of elasticity} \]

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 = \( \sigma \) * cross-sectional area

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**Figure 3: Cross-sectional area.**