LAB ASSIGNMENT

due by the beginning of the first lab: either Tuesday or Thursday.
Presentation does not count. Simply hand this sheet in. Show no work on this page – report final answers only.

Background: you are expected to know Strength of Materials. This assignment is partially a Strength of Materials review. You may need to refer back to your Strength of Materials course.

1. Compute the moment of inertia I (also called the 2nd moment of area) for the 1/8" x 2" beam cross-sectional area shown, with respect to the x-axis:

   ![Diagram of 1/8" x 2" Beam Cross-Section]

   \[ I = \frac{bh^3}{12} = \frac{(2)(0.125)^3}{12} = 0.000326 \text{ in}^4 \]

   Answer \[ I = 0.000326 \text{ in}^4 \]

2. A steel beam (E=29000 ksi), made of the previous cross-section, spans 16 inches, simply-supported. If it is subjected to a centerpoint load of 50 lbs, causing bending about the x-axis, use the appropriate deflection formula from the previous page to compute the maximum (midspan) deflection \( \Delta \) of this beam.

   ![Diagram of 16 in. Beam Beam Cross-Section with 50 lbs Load]

   \[ \Delta = \frac{FL^3}{48EI} = \frac{50(16)^3}{48(29000)(0.000326)} = 0.451 \text{ in.} \]

   Answer \[ \Delta = 0.451 \text{ in.} \]

3. Compute the moment of inertia I (also called the 2nd moment of area) for the 1" x 1" hollow square tube shown, with respect to the x-axis. The wall thickness of the tube is 1/16".

   ![Diagram of 1" x 1" Square Hollow Tube with Wall Thickness]

   \[ I = \frac{bh^3}{12} - \left( \frac{W^4}{12} \right) = 0.0345 \text{ in}^4 \]

   Answer \[ I = 0.0345 \text{ in}^4 \]

4. A steel beam, (E=29000 ksi) made of the previous cross-section, spans 16 inches, simply-supported. If it is subjected to a centerpoint load of 50 lbs, causing bending about the x-axis, use the appropriate deflection formula from the previous page to compute the maximum (midspan) deflection \( \Delta \) of this beam.

   ![Diagram of 16 in. Beam Beam Cross-Section with 50 lbs Load]

   \[ \Delta = 0.00426 \text{ in.} \]

   ![Answer for maximum deflection]

   \[ \Delta = (0.451) \left( \frac{0.000326}{0.0345} \right) = 0.00426 \text{ in.} \]
5. Compute the moment of inertia \( I \) for the cross-section shown, with respect to the x-axis. The cross-section consists of two \( \frac{3}{4}'' \) square hollow tubes, each a wall thickness of \( \frac{1}{16}'' \).

\[
A = \left( \frac{3}{4} \right)^2 \cdot \left( \frac{5}{8} \right)^2 = 0.1719 \text{ in}^2
\]

\[
I = \frac{\left( \frac{3}{4} \right)^4}{12} - \frac{\left( \frac{5}{8} \right)^4}{12} = 0.0137 \text{ in}^4
\]

\[
A_d^2 = 0.1719 \left( \frac{3}{4}^2 \right) = 1.547 \text{ in}^4
\]

\[
I = 2 \left( 0.0137 + 1.547 \right) = 3.12 \text{ in}^4
\]

**Cross-Section**
(2) \( \frac{3}{4}'' \) Square Hollow Tubes, each with \( \frac{1}{16}'' \) Wall Thickness.
(not to scale)

6. Compute the moment of inertia \( I \) for the cross-section shown, with respect to the x-axis. The cross-section consists of two \( 1'' \) square hollow tubes, and two \( 2'' \) square hollow tubes, all with all thickness of \( \frac{1}{16}'' \).

\[
A = 0.4841 \text{ in}^2
\]

\[
A = 0.234 \text{ in}^2
\]

\[
I = \frac{0.0345}{12} = 0.0029 \text{ in}^4
\]

\[
I = 0.303 \text{ in}^4
\]

\[
\bar{I} = 0.0345 \text{ in}^4
\]

\[
I = 2 \left( \frac{0.303 + 0.0345 + 0.484 \left( 4^2 \right) + 0.234 \left( 2.5 \right)^2}{12} \right)
\]

\[
= 19.1 \text{ in}^4
\]

**Cross-Section**
(2) 1'' Sq. Tubes & (2) 2'' Sq. Tubes, all with \( \frac{1}{16}'' \) Wall Thickness.
(not to scale)
7. Skim/Read the 2017 Steel Bridge Rules as follows:
   Sections 1, 2, 3, 4, and 5 are unimportant. No need to read these
   Section 6: 6.2.2 to 6.2.7 are important. Read these.
   Section 7: Skim this, but pay close attention to 7.1 (6) and 7.1 (7), particularly Table 7.1
   Section 8: Important. Read.
   Section 9: Skim
   Section 10: Skim
   Section 11: Skim, but read 11.5 very carefully

   a. A team builds its bridge in 6 minutes, using 4 builders and a temporary pier. However, one of the builders accidentally steps in the river, during timed construction. There are no other penalties. What is the Construction Economy (cost)?

\[
(5)(6)(50000) = 1,500,000 \\
30000 \text{ (Pier)}
\]

   Answer

   Construction Economy: $1,530,000

   b. What is the maximum size that a bridge member can be? i.e., a legal member must fit into a prismatic box of what dimensions?

   Answer

   Max. Size: 6\times4\times36"

   c. Given: A steel bridge enters the competition. The bridge, itself, weighs 200 lbs. During timed construction, it is assembled by 6 people in 10 minutes, using a temporary pier, with no penalties. It passes the lateral load test. During the vertical load test, it has vertical deflection measurements of \(D_{bl}=0.6"\), \(D_{bK}=0.4"\), and \(D_{cL}=0.4"\). What is the total cost of this bridge?

   \[
   C_c = (6)(10)(50000) = 3,000,000 \\
   + 30000 \text{ (Pier)}
   \]

   \[
   C_s = 200 \times (100000) + (1.4)(1,000,000) = 3,400,000
   \]

   Answer

   Total Cost: $6,43 million