ARCH 614. Assignment #4

Date: 2/17/15, due 2/24/15

Pass-fail work

Problems: from Ambrose & Tripeny, Appendix A & Chapter 3, pgs 654, 662, and 123.

Note: Problems marked with a * have been altered with respect to the problem stated in the text.

(25%) Problem A.1.D. * USE METRIC UNITS. Find the location of the centroid for the cross-sectional area shown in Figure A.3d. Use the reference axes indicated and compute the distances from the axes to the centroid, designated as $c_x$ and $c_y$, as shown in Figure A.3b. Also compute the moment of inertia about the centroid axes. (cross section properties)

Partial answers to check with: $\hat{x} = 32.2$ mm, $\hat{y} = 85.2$ mm,
$I_x = 24.7 \times 10^6$ mm$^4$, $I_y = 4.3 \times 10^6$ mm$^4$.

Figure A.3 Reference for Problem A.1.

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(10%) **Problem A.3.G***. USE US UNITS. Compute the moments of inertia with respect to the centroidal X-X axes for the built-up sections in Figure A.10g. Make use of any appropriate data from the tables of properties for steel shapes. **Note:** the plate at the bottom is the same as the top, and the W section is not in table A.3. Use a W 10 x 33. (cross section properties)

Partial answers to check with: \( I_x = 431.8 \text{ in}^4 \).

**Note:** The centroid location is obvious.

![Figure A.10](image)

(25%) **Problem 3.7.A***. USE US UNITS. A beam has an I-shaped cross section with an overall depth of 16 in. [400 mm], a web thickness of 2 in. [50 mm], and flanges that are 8 in. wide [200 mm] and 3 in. [75 mm] thick. Compute the critical bending and shear stresses and plot the distribution of shear stress on the cross section if the beam sustains a bending moment of 175 k-ft [237.3 kN-m] and a shear force of 20 kips [89 kN]. (bending and shear stresses)

Partial answers to check with: \( f_b = 7.53 \text{ ksi}, I_x = 2230.7 \text{ in}^4, Q_{\text{max}} = 181 \text{ in}^3 \).

**Note:** The centroid location is obvious, and the negative area method is quicker for finding \( I_x \).

(40%) **Problem 3.7.B***. USE METRIC UNITS. A T-shaped beam cross section has an overall depth of 18 in. [450 mm], a web thickness of 4 in. [100 mm], a flange width of 8 in. [200 mm] and a flange thickness of 3 in. [75 mm]. Compute the critical bending and shear stresses and plot the distribution of shear stress on the cross section if the beam sustains a bending moment of 300 k-ft [406.8 kN-m] and a shear force of 12 kips [53.4 kN]. And if there is one connector for the T joint to the stem with a capacity of 6.5 kN, determine the maximum required pitch spacing. (bending and shear stresses, and shear connectors)

Partial answers to check with: \( \bar{y} = 251.8 \text{ mm}, I_x = 988.0 \times 10^6 \text{ mm}^4, f_b = 103.6 \text{ MPa} \)

\( f_v = 1.7 \text{ MPa}, p = 49.9 \text{ mm} \).