ARCH 331. Assignment #3

Date: 2/5/15, due 2/12/15

Problems: from Onouye, Chapters 2, 3 & 6 (with required format)

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

Draw the appropriate FBD for each of the problems in this section. (equilibrium of rigid bodies)

(15%) 3.2.1  A 7-m span girder supports the reactions from three roof beams. Determine the support reactions at A and B.

Partial answers to check with: $A_x = 0 \text{ kN}, A_y = 3.8 \text{ kN}, B = 3.3 \text{ kN}$

Construct FBDs and solve for the support reactions in each problem. (equilibrium of rigid bodies)

(15%) 3.3.1  A double overhang beam is loaded as shown. Solve for the reactions at A and B.

Partial answers to check with: $A = 1733 \text{ lb}, B_x = 0 \text{ lb}, B_y = 3067 \text{ lb}$

Construct FBDs and solve for the support reactions in each problem. (equilibrium of rigid bodies)

(15%) 3.3.3  A cantilever beam has a 3-ft. upturn with a 400-lb. horizontal force applied. Determine the support reactions developed at C.

Partial answers to check with: $C_x = 400 \text{ lb}, C_y = 1100 \text{ lb}, M_{RC} = -9200 \text{ lb-ft}$

(20%) 4.1.15  A bowstring or crescent truss is loaded as shown. Determine the member forces in DE, EG, and GH. (method of sections)

Partial answers to check with: $HG = 5.5 \text{ k}, ED = -7.12 \text{ k}, EG = 1.77 \text{ k}$. 

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### Use metric units.

**6.1.3** A steel column carries a building load of 75 k (334 kN) to a 14" × 14" (356 mm × 356 mm) base plate that is bolted to a concrete footing pad that measures 1 foot (305 mm) in thickness. The column has a cross-sectional area $A = 11.7$ in.² ($A = 7580$ mm² = $7.58 × 10^{-3}$ m²). Determine the following:

a. the average compressive stress developed in the W8 × 40 (W200 × 59) column
b. the bearing stress between the steel base plate and the concrete footing
c. the footing size, assuming that the allowable soil bearing pressure is $q = 4$ ksf (191 kPa) and the density of concrete is 150 pcf ($2400$ kg/m³ = $23.6$ kN/m³)

**Partial answers to check with:**
- a) 44.1 MPa,
- b) 2.64 MPa,
- c) $x = 1.35$ m

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### Use US customary units.

**6.1.3** A steel column carries a building load of 75 k (334 kN) to a 14" × 14" (356 mm × 356 mm) base plate that is bolted to a concrete footing pad that measures 1 foot (305 mm) in thickness. The column has a cross-sectional area $A = 11.7$ in.² ($A = 7580$ mm² = $7.58 × 10^{-3}$ m²). Determine the following:

a. the average compressive stress developed in the W8 × 40 (W200 × 59) column
b. the bearing stress between the steel base plate and the concrete footing
c. the footing size, assuming that the allowable soil bearing pressure is $q = 4$ ksf (191 kPa) and the density of concrete is 150 pcf ($2400$ kg/m³ = $23.6$ kN/m³)

**Partial answers to check with:**
- a) 44.1 MPa,
- b) 2.64 MPa,
- c) $x = 1.35$ m

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**6.1.7** Three 2×4 S4S blocks are glued together as shown. Assuming the glue has a shear capacity of 80 psi, determine the minimum length $L$ required.

**Partial answers to check with:**
- $L = 20$ in.

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**6.2.8** A large chandelier weighing 1500 lb. is suspended from the roof of a theater lobby. The steel pipe from which it hangs is 20 feet long. Determine the diameter of a solid rod necessary to carry the chandelier safely. Use A36 steel. What is the resulting elongation of the pipe? Use the section properties table in the Appendix to determine the appropriate

**Partial answers to check with:**
- $d = 0.29$ in., $\delta = 0.18$ in.

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**6.4.8** An aluminum curtain wall panel 12' (3.66 m) high is attached to large concrete columns (top and bottom) when the temperature is 65°F (18.3°C). No provision is made for differential thermal movement vertically. Because of insolation between them, the sun heats up the wall panel to 120°F (48.9°C) but the column only to 80°F (26.7°C). Determine the consequent compressive stress in the curtain wall.

**Partial answers to check with:**
- $\delta_{\text{restrained}} = 0.0895$ in, $f = 6215$ psi