

## ARCH 631. Assignment #4

**Date:** 9/17/13, due 10/3/13

Worth 25 pts.

### Problems:

1. Complete text problem 9.2 on page 349. (*Note: The frame shown has pinned supports.*)

9.2. Using an approximate method of analysis, analyze a single-bay frame of the type generally illustrated in Figure 9.4 that carries a horizontal load of 3000 lb acting at the upper-left joint. Assume that  $h = 12\text{ft}$  and  $L = 22\text{ft}$ . Draw shear and moment diagrams. Indicate numerical values.

Answer:  $M_{\max} = 18,000\text{ ft-lb}$  and  $V_{\max} = 1636\text{ lb}$

2. Complete text problem 9.4 on page 349.

9.4 Draw a sketch that diagrammatically illustrates possible member-size variations (along the lines of the sketches in Figure 9.18) for the frame analyzed in Question 9.2.

*Partial Answer:* If the moment is bigger, the section needs to be deeper.

3. For the frame of problem 1 (text problem 9.2), replace the pin supports with fixed support and use an approximate method of analysis to draw the shear and moment diagrams. Indicate numerical values. Describe how the change in support condition affects the shear values and moment distribution. (*Note: The portal frame method is used in the text in Figure 9.5 on page 331.*)

Answer:  $M_{\max} = 9900\text{ lb-ft}$  and  $V_{\max} = 1500\text{ lb}$ .

4. Complete text problem 9.7 on page 349. *Submit the three model files (.mfd) on E-learning, and provide a print of all diagrams.* Use the following values:

9.7 A fully fixed single-bay frame has a span of **40 ft** and a height of **12.5 ft** and carries a uniform loading of **3.6 k/ft** on the horizontal beam. Using a computer-based structural analysis program available at your school, analyze the structure (**axial force, shears and moments**) for a situation where the moment of inertia of the beam is (a) equal to that of the columns, (b) [**approximately**] twice that of the columns, and (c) [**approximately**] three times that of the columns. Compare your results [**which means specifically state any noticeable differences**]. (Assume any  $I_c$ -value for the columns that you wish or  $I_c = 1200\text{ in}^4$  Use the following sections).

#### Section Properties (American section library):

sections	A (in <sup>2</sup> )	I <sub>x</sub> (in <sup>4</sup> )	S <sub>x</sub> top & bottom (in <sup>3</sup> )
Columns: W 10 x 45	13.3	248	49.1
a) Beam: W 10 x 45	13.3	248	49.1
b) Beam: W 18 x 35	10.3	510	57.6
c) Beam: W 16 x 57	16.8	758	92.2

*Partial answers:*  $P_{(\text{in column})} = 72.0\text{ k}$ ;  $V_{\max(\text{in beam})} = 72.0\text{ k}$ ;  $V_{\max(\text{in column})} = \text{a) } 49.5\text{ k, b) } 43.2\text{ k, c) } 38.7\text{ k}$ ;  $M_{(\text{at beam ends})} = \text{a) } 414.5\text{ k-ft, b) } 361.9\text{ k-ft, c) } 323.9\text{ k-ft}$ ;  $M_{(\text{at beam midspan})} = \text{a) } 305.5\text{ k-ft, b) } 358.1\text{ k-ft, c) } 396.1\text{ k-ft}$ ;  $M_{(\text{at supports})} = \text{a) } 204.7\text{ k-ft, b) } 178.2\text{ k-ft, c) } 160.4\text{ k-ft}$

5. With the results found from problem 4-case a), calculate the maximum stress at the ends of both columns from combined bending ( $M/S$ ) and compression stresses ( $P/A$ ) and compare to the stress results from the program.

*Partial answers:*  $f_{\max\text{-top}} = 106.7\text{ ksi}$ ,  $f_{\max\text{-bottom}} = 55.5\text{ ksi}$