ARCH 631. Assignment #3

Date: 9/12/17, *due 9/21/17* *Worth 25 pts.*

Problems:

1. Complete text problem 7.2 on page 298.

7.2 An unbraced pin-ended steel column has rectangular cross-sectional dimensions of 3 in. × 2 in. and is 25 ft long. What is the critical buckling load for this column? Assume that $E = 29.6 \times 10^6$ lb/in.^{2}

(Note: This is not a square cross section, i.e. $I_x \neq I_y$. Moment of inertia equations can be found in Note Set 2.1)

Answer: 6492 lb

2. Complete text problem 7.5 on page 298.

7.5 An unbraced steel column of rectangular cross section 1.5 in. × 2 in. and pinned at each end is subjected to an axial force. Assume that $F_y = 36{,}000$ lb/in.^{2} and $E = 29.6 \times 10^6$ lb/in.^{2} Find the transition point between short- and long-column behavior.

(Note: This is not a square cross section, i.e. $I_x \neq I_y$.)

Answer: 3.25 ft (by weak axis)

3. A pin-ended steel column is braced at mid-height about the weak axis and is 14.5 m long. It is a W250 x 49 with $I_x = 70.7 \times 10^6$ mm^4 and $I_y = 15.2 \times 10^6$ mm^4. What is the critical buckling load for this column? Assume that $E = 200 \times 10^3$ MPa. [1 kN/mm^2 = 10^3 MPa]

Answer: 570.8 kN

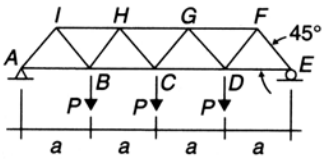
4. Is a 4 x 6 (3.5 in. x 5.5 in.) timber column, fixed at the base and pinned at the top, which is 18 ft (216 in.) high adequate to support an axial loading of 4,500 lb? Assume that the crushing strength, $F_c = 1300$ lb/in^2 and the allowable stress for buckling, $F'_c = 225$ lb/in^2.

Answer: no ($f_{actual} = 234$ lb/in.$^2 \not< F'_c$)

5. Complete text problem 4.6 on page 167. *(Note: The direction is not provided in the answer but must be shown in your work.)*

4.6 Determine the force in member *GH* in the truss shown in Figure 4.37(Q4) by using a method-of-sections approach.

Answer: $F_{GH} = 4P$.

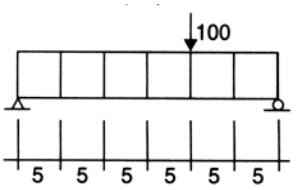


(Q4)

6. Complete text problem 4.9 on page 167. *Note: You must include a shear diagram and section cuts for each diagonal.*

4.9 Consider the parallel chord truss shown in Figure 4.37(Q9). Obviously, the truss needs diagonal elements for stability. Add the diagonal elements in an arrangement such that *all* the diagonals are in a state of tension under the loading condition indicated.

***Partial** Answer*: consider how it would flex if a solid beam, and determine what diagonal of the rectangle will stretch.



(Q9)

7. Complete text problem 5.3 on page 208 using the following SI units:

5.3 What is the maximum force developed in a cable carrying a uniform load of **7.3 kN/m** that spans **60 m**? Assume that the cable has a maximum midspan sag of **6 m**.

Answer: 590 kN.

8. Complete text problem 5.8 on page 208.

5.8 A simple arch spans 100 feet and has a rise of 10 feet. It carries a total dead and live load of 800 lb/ft along its length. What is the maximum force developed in the arch and where does it occur? What is the force at the crown of the arch?

Answers: 107,703 lb (at the base), 100,000 lb.