

ARCH 631. Assignment #6

Date: 2/19/19, due 3/7/19

Worth 20 pts.

NOTE: Questions requiring computer analysis must be completed individually.

Problems:

1. Determine the ultimate moment capacity, $\phi_f M_n$, of a beam with dimensions $b = 14$ in., $d_{\text{effective}} = 17.5$ in., and $h = 20$ in., and that has three No. 10 bars (3.81 in.²) of tension-reinforcing steel. $F_y = 60$ ksi, and $f'_c = 4$ ksi.

Answer: $\phi_f M_n = 258.9$ k-ft

2. For the beam of Problem 1 which is simply supported and 32 ft long, and where the loads are dead load = 320 lb/ft (not including self weight) and live load = 185 lb/ft, determine if the beam is adequate in bending. $\gamma = 150$ lb/ft³ (normal weight).

Answer: yes ($M_u = 131.8$ k-ft)

3. For the beam of Problem 1, check whether the amount of tension steel is within the limits for ductile beam behavior. (Refer to the table for maximum ρ in Note Set 10.1)

Partial Answer: yes ($A_s\text{-max} = 4.43$ in.²)

4. For the beam of Problem 1 and 2, calculate the shear capacity, $\phi_v V_c$, and determine if the beam will require stirrups. Also, determine the spacing, s , if #3 U stirrups are required of grade 60 steel ($f_y = 60$ ksi). Assume $\lambda = 1.0$ for normal weight concrete.

Answer: yes ($V_u = 15.0$ k at d, and $> \frac{\phi_v V_c}{2} = 11.6$ k, $s_{req'd} = 18.86$ in., $s_{max} = 8.75$ in.)

5. A reinforced concrete column in a rigid frame has a design compression load of $P_u = 170$ kips, and a design moment of $M_u = 34$ k-ft. With the interaction diagram provided on the next page, determine the amount of reinforcement (number and size of bars) required for a 10 in. square column.

Partial Answer: more than 4-#7.

6. A two story, three bay portal frame has lateral loads from wind at each story as shown. All columns are W12 x 40's while all beams are W 18 x 55's. Using a computer-based structural analysis program, determine the shear, bending moment and axial load in each member (V , M & P). Identify the column and beam with the critical design values. *Submit the model file (.vap) on E-learning, and provide a print of the diagrams.*

Partial Answers: V_{max} (2nd windward column, 1st story) = 31.35 kN

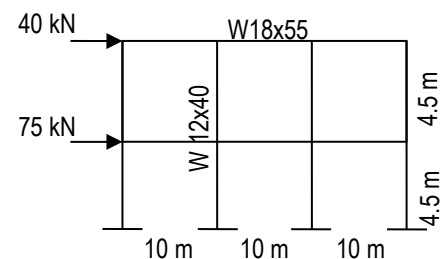
V_{max} (1st windward beam, 1st story) = 11.10 kN

P_{max} (exterior columns, 1st story) = 14.9 kN

P_{max} (1st windward beam, 1st story) = 54.19 kN

M_{max} (2nd windward column, 1st story) = 75.76 kN-m

M_{max} (1st windward beam, 1st story) = 60.43 kN-m



7. Is the ultimate tensile capacity of 2-#6 grade 40 reinforcing bars greater than that of 1-#8 grade 60 bar?

Partial Answer: 2-#6 $T = 35.2$ kips, 1-#8 $T = 47.4$ kips

