ARCH 614. Assignment #10

Date: 4/1/14, due 4/8/14

Pass-fail work

Problems: all but 10A, B, & C from Ambrose & Tripeny, Chapters 12 & 13, pgs 405, 428 & 429.

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

(15%) 10A) Determine the capacity of the welded connection shown. The weld size is 3/16 in. Assume the base metal is A36 steel and electrodes are E70XX in each problem.

Use L = 4.5". (LRFD connection analysis)

Partial answers to check with:
\[ \phi P_{n-v} = 58.5 \text{ k}, \phi P_{n-t} = 50.625 \text{ k} \]

(10%) Problem 12.2.D. Using data from Table 12.1, select the lightest steel deck for the Two-span condition, span of 6 ft, total load of 50 psf. (decking design charts)

Partial answers to check with: WR22

(15%) 10B) For the singly reinforced concrete beam sections described below, determine i) depth of the compressive stress block ii) acceptability of reinforcement ratio to minimum and maximums iii) design moment capacity. (reinforced concrete beam analysis)

1) \[ f_y = 60 \text{ ksi} \quad f'_c = 6000 \text{ psi} \quad A_s = 7.07 \text{ in}^2 \quad b = 16 \text{ in} \quad d = 30 \text{ in} \]

2) \[ f_y = 60 \text{ ksi} \quad f'_c = 5000 \text{ psi} \quad A_s = 3.01 \text{ in}^2 \quad b = 12 \text{ in} \quad d = 20 \text{ in} \]

Partial answers to check with: 1.i) \( a = 5.20 \text{ in} \), ii) \( 0.0039 > \rho = 0.0147 < 0.027 \), iii) \( \phi M_n = 872 \text{ k-ft} \); 2.) \( a = 3.54 \text{ in} \), ii) \( 0.0035 > \rho = 0.0125 < 0.024 \), iii) \( \phi M_n = 247 \text{ k-ft} \)

(15%) Problem 13.3.C. USE US UNITS. Find the area of steel reinforcement required and select the bars for the beam in Problem 13.3.A if the section dimensions are \( b = 16 \text{ in} \) [406 mm], and \( d = 32 \text{ in} \) [813 mm]. (Problem 13.3.A is listed NEXT.) (reinforced concrete beam design)

Partial answers to check with: 6- #6 (least area)

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Problem 13.3.A*. USE US UNITS. A rectangular concrete beam has $f'_c = 3000$ psi [20.7 MPa] and steel with $f_y = 40$ ksi [276 MPa]. Select the beam dimensions and reinforcement for a balanced section maximum reinforcement ratio if the beam sustains a moment as a result of dead load of 60 k-ft [81.4 kN-m] and a moment as a result of live load of 90 k-ft [122 kN-m]. The depth of the beam should be approximately twice the width and in whole inches. Use $h \approx 1.1d$ ($b=0.55d$) to get started. Place steel that fit in a single layers of bars. Do not exceed $\rho$ based on a tensile strain of 0.005. If the area is too big for the number of bars to fit, make the beam deeper and wider, but check $R_n$ for a revised reinforcement ratio. (reinforced concrete beam design)

Partial answers to check with: $R_n \approx 760$ psi of chart (or $\rho_{max} = 0.023$, $d_{needed} \approx 19$ in., $b > 10.5$ in., $h > 21.375$ in., bars won’t fit in 11 in., possible number of bars is 3 or 4.

(20%) 10C) A 24 ft long, simply supported beam carries only a uniform live load, $w_L$. The beam has the following cross-sectional properties: $b = 14”$, $d = 26$ in., $h = 30”$, $f_y = 60$ ksi, $f'_c = 3000$ psi, $A_s = 5$ - #8 bars. Determine the maximum distributed service live load the beam can carry. Include the weight of the beam. (reinforced concrete beam analysis and load factors)

Partial answers to check with: $w_L \leq 3170$ lb/ft