ARCH 331. Assignment #9

Date: 6/25/18, *due 6/27/18* *Pass-fail work*

Problems: as stated (none from Onouye & Kane, Chapter)

(18%) 9A) 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 ksi f'_c = 6000 psi A_s = 7.07 in^2 b = 16 in d = 30 in
2) f_y = 60 ksi f'_c = 5000 psi A_s = 3.01 in^2 b = 12 in d = 20 in

Partial answers to check with: 1.i) a = 5.20 in, ii) 0.0039 > ρ = 0.0147 < 0.0239, iii) ϕM_n = 872 k-ft; 2.i) a = 3.54 in, ii) 0.0035 > ρ = 0.0125 < 0.0213, iii) ϕM_n = 247 k-ft

(22%) 9B) A rectangular concrete beam is to be designed using f'_c = 3000 psi, f_y = 40 ksi, density of 150 lb/ft^3, b = 16 in., d = 32 in., and h = 36 in. for a simply supported span of 35 feet. Determine the area of steel required to carry superimposed loads (*not* including self weight) of 150 lb/ft dead and 400 lb/ft live. Assume the maximum coarse aggregate size is 1 in.. Check if the steel fits and if the steel reinforcement ratio is within limit. *(reinforced concrete beam design)*

Partial answers to check with: M_u = 235.8 k-ft, R_n < 200 psi (ρ_{min}), ρ = 0.0052 and ϕM_n=243 k-ft

(25%) 9C) Design a rectangular beam for a 22-ft simple span if a dead load of 2 k/ft (including an estimated self weight) and a live load of 2.9 k/ft are to be supported. Use f'_c = 4000 psi and f_y = 60 ksi, The height of the beam should be between 1.5 to 2 times the width (which should be in whole inches). Assume there are #3 U stirrups and a minimum of 1" clearance between bars and between rows (3/4" aggregate). Do not use bars larger than #11's.
(reinforced concrete beam design)

Partial answers to check with: M_u = 425.9 k-ft. Your R_n with chosen b & h can range from 400 up to 860 psi where $\rho_{max\text{-}0.005}$ =0.0181. To check if the bars fit, subtract 3.75 in for cover and stirrups, the total number of bar diameters and spaces (no. of bars – 1) of 1 inch each. (Bars larger than #8's have custom diameters.) If the number is negative, the section is invalid. If your final reinforcement ratio is bigger than the max, the section is invalid.

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(20%) 9D) Find the area of steel reinforcement required for a concrete T-beam for the following data: f'_c = 3 ksi, f_y = 60 ksi, d = 18 in., t = 4.5 in., b_w = 10 in., b_f = 36 in., 3/4" aggregate, and the section sustains a total factored bending moment 82 k-ft. *Note: the effective width does not need to be determined because the flange width is provided.*

(reinforced concrete T-beam design)

Partial answers to check with: $a > 0.7$ in, $A_{s\text{-}min} = 0.6$ in.^{2}

(20%) 9E) A one-way solid concrete slab is to be used for a simple span of 16 ft. In addition to its own weight, the slab carries a superimposed dead load of 55 lb/ft^2 and a live load of 120 lb/ft^2. Using f'_c = 4 ksi, and f_y = 60 ksi, design the slab for minimum overall thickness.

(reinforced concrete slab design)

Partial answers to check with: $t \approx 10$ in., $R_n = 179$ psi, so ρ_{min} governs,
$A_s \geq 0.35$ in.^{2}/ft, $A_{temp\text{-}min} \approx 0.22$ in.^{2}/ft (transverse direction)