ARCH 331. Assignment #9

Date: 6/28/13, *due 7/2/13*   *Pass-fail work*

Problems: as stated (none from Onouye)
<u>*Selected problems not required to be worked will be announced in class.*</u>

(17%) 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

(18%) 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 290 up to 470 psi where ρ_{max} =0.0205. 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 <u>factored</u> 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 ≈ 10 in., R_n = 179 psi, so ρ_{min} governs,
A_s ≥ 0.35 in.^{2}/ft, $A_{temp\text{-}min}$ ≈ 0.22 in.^{2}/ft (transverse direction)*