

## ARCH 331. Assignment #10

**Date:** 7/2/13, due 7/24/13

*Pass-fail work*

**Problems:** as stated (none from Onouye)

Selected problems not required to be worked will be announced in class.

- (7%) 10A) At a certain location along the span, a reinforced concrete beam section with  $d = 14$  in. and  $b = 10$  in. is subject to a design shear of  $V_u = 50$  k. Using No. 4 U stirrups, compute the required stirrup spacing at the given location. Assume  $f'_c = 3$  ksi, and  $f_y = 40$  ksi.

*(reinforced concrete beam shear design)*

*Partial answers to check with:  $s_{req'd} = 4.4$  in.,  $s_{max} = 3.5$  in.*

- (18%) 10B) A concrete beam that is simply supported sustains a uniform live load of 1.8 kips/ft and a uniform dead load (not including self weight) of 1 kips/ft on a span of 24 ft. Determine the layout for a set of No. 3 U-stirrups with  $f_y = 60$  ksi and  $f'_c = 3.5$  ksi. The beam section dimensions are  $b = 12$  in.,  $d = 26$  in., and  $h = 28$  in..

*(reinforced concrete beam shear analysis and design)*

*Partial answers to check with:  $V_{u@ d} = 44.25$  k;  $V_s$  needed:  $s_{req'd} = 15.5$  in.,  $s_{max} = 13$  in.;  
 $s_{req'd} = 22$  in.,  $s_{max} = 13$  in., stirrups end after 107.2 in.*

- (10%) 10C) Determine the layout for a set of No. 3 U-stirrups for a beam with the same data as Problem 10B, except the uniform live load is 0.75 kips/ft and the uniform dead load (not including self weight) is 0.5 kips/ft.

*(reinforced concrete beam shear analysis and design)*

*Partial answers to check with:  $V_{u-max} < \phi V_c$  so maximum spacing governs with 6 stirrups*

- (24%) 10D) A solid one-way slab is to be used for a framing system of a one-way slab supported on beams on girders. Column spacing is 33 ft, with regularly spaced beams occurring at 11 ft center to center. (Assume the beams are 1 ft wide.) Superimposed dead load on the structures is 50 psf, and live load is 75 psf. Use  $f'_c = 4$  ksi and  $f_y = 60$  ksi. Determine the thickness for the slab and select the size and spacing for the bars in both directions. Assuming there is proper bar spacing and cover, determine the minimum development lengths of the flexural reinforcement chosen.

*(frame analysis by coefficients, reinforced concrete slab design, development length)*

*Partial answers to check with:  $V_{u-max} = 1.5$  k,  $\phi V_c = 4.6$  k,  $M_{u+end} = 1.8$  k-ft,  $M_{u+mid} = 1.6$  k-ft,  
 $M_{u-} = 2.1$  k-ft,  $A_s \approx 0.12$  in<sup>2</sup>,  $A_{temp-min} \approx 0.11$  in<sup>2</sup>,  $L_d = 14.25$  (#3 for ex.)*

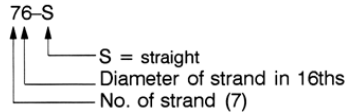
*MORE NEXT PAGE*

(5%) 10E) Size hollow core planks for the system and loads of problem 10D) when there are only beams at the columns (33 ft on center). Assume that the inverted T-beams the simply supported planks will be supported by are 1 ft wide in the stem. Choose the shallowest plank with the least reinforcement that will span the 32 feet while supporting the loads. Assume 2 in. of normal weight topping.

(floor span system design)

Partial answers to check with: estimated long term camber of 0.3 in.

**Strand Pattern Designation**



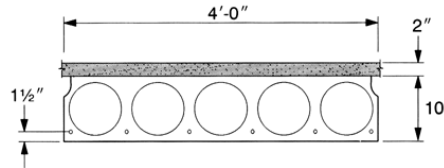
Safe loads shown include dead load of 10 psf for untopped members and 15 psf for topped members. Remainder is live load. Long-time cambers include superimposed dead load but do not include live load.

Capacity of sections of other configurations are similar. For precise values, see local hollow-core manufacturer.

**Key**

- 239— Safe superimposed service load, psf
- 0.3— Estimated camber at erection, in.
- 0.4— Estimated long-time camber, in.

**HOLLOW-CORE**  
4'-0" x 10"  
Normal Weight Concrete



$f'_c = 5,000$  psi  
 $f'_{ci} = 3,500$  psi

**Section Properties**

	Untopped	Topped
A =	259 in <sup>2</sup>	—
I =	3,223 in <sup>4</sup>	5,328 in <sup>4</sup>
y <sub>b</sub> =	5.00 in.	6.34 in.
y <sub>t</sub> =	5.00 in.	5.66 in.
S <sub>b</sub> =	645 in <sup>3</sup>	840 in <sup>3</sup>
S <sub>t</sub> =	645 in <sup>3</sup>	941 in <sup>3</sup>
b <sub>w</sub> =	10.50 in.	10.50 in.
wt =	270 plf	370 plf
	68 psf	93 psf
V/S =	2.23 in.	

**4HC10+2**

**Table of safe superimposed service load (psf) and cambers (in.)**

**2" Normal Weight Topping**

Strand Designation Code	Span, ft																						
	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
48-S	293	258	229	203	181	161	143	127	113	101	89	79	69	60	50								
	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.0								
	0.3	0.3	0.3	0.2	0.2	0.2	0.1	0.1	0.0	-0.1	-0.2	-0.3	-0.4	-0.6	-0.8								
58-S		297	268	241	216	194	175	157	142	128	115	103	92	79	68	58	48						
		0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.3	0.2	0.1							
		0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.2	0.1	0.0	-0.1	-0.2	-0.4	-0.5	-0.7	-0.9						
68-S			286	272	259	244	221	200	182	165	150	136	123	109	96	84	73	63	54				
			0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.5	0.5	0.4	0.3				
			0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.4	0.4	0.3	0.2	0.0	-0.1	-0.3	-0.5	-0.7	-0.9				
78-S				295	278	265	250	239	226	218	201	184	168	154	138	124	111	98	87	77	67	58	49
				0.7	0.8	0.8	0.9	0.9	0.9	0.9	0.9	1.0	1.0	1.0	0.9	0.9	0.9	0.8	0.8	0.7	0.6	0.5	0.4
				0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.6	0.5	0.4	0.3	0.2	0.0	-0.2	-0.4	-0.6	-0.9	-1.2
88-S					287	271	259	245	232	224	213	202	193	179	163	148	134	121	110	99	88	78	69
					0.9	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.1	1.1	1.1	1.0	0.9
					1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9	0.8	0.7	0.6	0.5	0.3	0.1	-0.1	-0.3	-0.6

Strength based on strain compatibility; bottom tension limited to  $6\sqrt{f'_c}$ ; see pages 2-2-2-6 for explanation.

(9%) 10F) Select the minimum size square tied column and its reinforcement when the column has a dead load of 200 k, live load of 150 k, dead load bending moment of 100 k-ft, and live load bending moment of 100 k-ft. Determine the axial capacity (without moment) of the column and reinforcement chosen if ties are used. Assume  $f'_c = 5$  ksi and  $f_y = 60$  ksi.

(reinforced concrete column design aids)

Partial answers to check with:  $e = 7$  in,  $\phi P_n = 1078$  kips

(8%) 10G) Select the minimum size round column and its reinforcement for the same load and bending moments of problem 10F). Determine the axial capacity of the column and reinforcement chosen if spiral reinforcement is used. Assume  $f'_c = 5$  ksi and  $f_y = 60$  ksi.  
*(reinforced concrete column design aids)*

*Partial answers to check with:  $\phi P_n = 1295$  kips*

(19%) 10H) For a 24 in. thick 9.5 ft. square reinforced concrete footing carrying 372 kips dead load and 117 kips live load on a 22 in. square column, determine if the footing thickness is adequate for 3000 psi. A 3 in. cover is required with concrete in contact with soil. Also determine the moment for reinforced concrete design.

*(reinforced concrete spread footing analysis and design)*

*Partial answers to check with: one way:  $V_u = 15.2$  k/1 ft width and OK;*

*two way:  $V_u = 547.6$  k and OK,  $M_u = 51.6$  k-ft/1 ft width*

