ARCH 331. Assignment #10

Date: 7/1/14, *due 7/3/14* *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 reinforce 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: $V_{u\text{-}max} < \phi V_c$ *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: $V_{u\text{-}max} = 1.5$ *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*^{2}, $A_{temp\text{-}min} \approx 0.11$ *in*^{2}, $L_d = 14.25$ *(#3 for ex.)*

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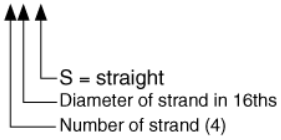
(5%) 10E) Size hollow core planks for the system and loads of problem 10D) when there are only beams at the columns (33 ft on center). Assume that the inverted T-beams the simply supported planks will be supported by are 1 ft wide in the stem. Choose the shallowest plank with the least reinforcement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

3.6 Hollow-Core Load Tables (cont.)

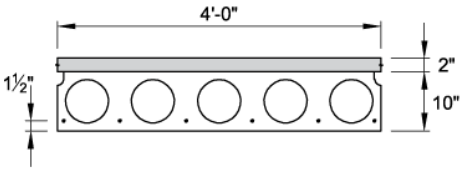
Strand Pattern Designation
48-S



Safe loads shown include dead load of 10 lb/ft² for untopped members and 15 lb/ft² 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.

4'-0" × 10"
Normalweight Concrete



f'_c = 5000 psi

f_{pu} = 270,000 psi

Section Properties

		No Topping		2 in. topping	
A	=	259	in.²	-	
I	=	3223	in.⁴	5328	in.⁴
y_b	=	5.00	in.	6.34	in.
y_t	=	5.00	in.	5.66	in.
S_b	=	645	in.³	840	in.³
S_t	=	645	in.³	941	in.³
wt	=	270	lb/ft	370	lb/ft
DL	=	68	lb/ft²	93	lb/ft²
V/S	=	2.23	in.		

Key
210– Safe superimposed service load, lb/ft²
0.3 – Estimated camber at erection, in.
0.4 – Estimated long-time camber, in.

4HC10 + 2

Table of safe superimposed service load, lb/ft², and cambers, in. **2 in. Normalweight 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	43	44	45	46
48-S	255	238	223	209	197	181	163	146	131	117	107	96	86	74	63	52	43	34	26								
	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	–0.1	–0.2	–0.3	–0.4								
	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	–1.0	–1.2	–1.4	–1.7								
58-S	317	298	282	267	252	237	219	198	180	163	148	134	120	105	92	80	69	59	50	41	33	26					
	0.4	0.4	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	0.2	0.1	0.0	–0.1	–0.3	–0.4					
	0.4	0.4	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	–1.2	–1.5	–1.8	–2.1					
68-S	326	307	291	273	258	246	234	222	212	202	188	171	153	137	122	108	96	84	74	64	55	46	38	31			
	0.5	0.5	0.6	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	0.2	0.1	–0.1	–0.2			
	0.5	0.6	0.6	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	–1.2	–1.5	–1.8	–2.2			
78-S	335	313	297	279	267	252	240	228	218	208	196	189	181	165	150	135	122	109	97	86	76	67	58	50	42	35	28
	0.6	0.7	0.7	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	0.3	0.1	0.0	–0.2
	0.7	0.7	0.7	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	–1.6	–1.9	–2.3	–2.8
88-S	344	322	306	288	273	258	246	234	221	211	202	195	184	178	172	158	144	130	118	107	96	87	77	68	60	52	44
	0.7	0.8	0.8	0.9	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	1.2	1.1	1.1	1.0	0.9	0.8	0.7	0.5	0.3
	0.8	0.8	0.9	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	0.4	0.3	0.1	–0.1	–0.3	–0.6	–0.9	–1.3	–1.6	–2.0

Strength is based on strain compatibility; bottom tension is limited to $7.5\sqrt{f'_c}$; see pages 3–8 through 3–11 for explanation.
See item 3, note 4, Section 3.3.2 for explanation of vertical line.

(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. Also determine the axial capacity 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, ϕP_n = 1078 kips

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(8%) 10G) Select the minimum size round column and its reinforcement for the same load and bending moments of problem 10F). Also 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: ϕP_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*