ARCH 331. Assignment #13

Date: 4/17/14, *due 4/24/14* *Pass-fail work*

Problems: (none from Onouye)

(37%) 13A) 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 for flexure requirements. 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,* ϕV_c *= 4.6 k,* M_{u+end} *= 1.8 k-ft,* M_{u+mid} *= 1.6 k-ft,* $M_{u\text{-}}$ *= 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.)*

(7%) 13B) Size hollow core planks for the system and loads of problem 13A) 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.

(14%) 13C) 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 (without moment) of the chosen column and reinforcement 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*

(12%) 13D) Select the minimum size round tied column and its reinforcement for the same load and bending moments of problem 13C). 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*

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(30%) 13E) 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

Strand Pattern Designation

76–S
- S = straight
- Diameter of strand in 16ths
- No. of strand (7)

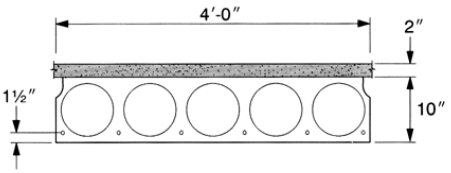
Safe loads shown include dead load of 10 psf for untopped members and 15 psf for topped members. Remainder is live load. Long-time cambers include superimposed dead load but do not include live load.

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

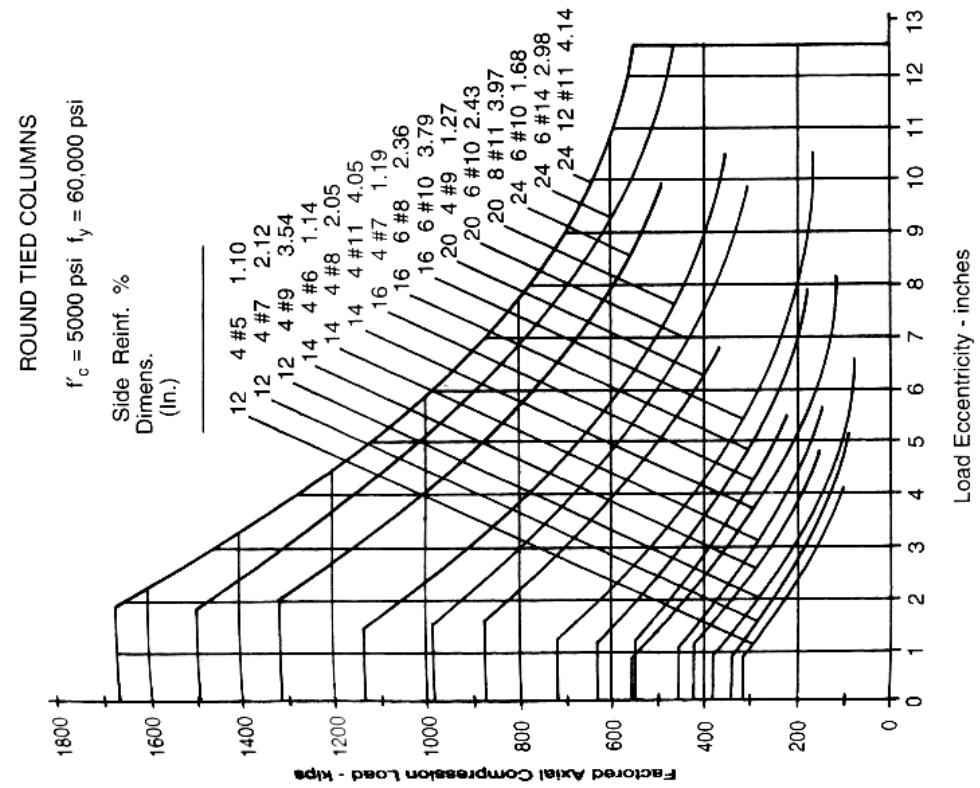
		Untopped		Topped	
A	=	259	in²	—	
I	=	3,223	in⁴	5,328	in⁴
y_b	=	5.00	in.	6.34	in.
y_t	=	5.00	in.	5.66	in.
S_b	=	645	in³	840	in³
S_t	=	645	in³	941	in³
b_w	=	10.50	in.	10.50	in.
wt	=	270	plf	370	plf
		68	psf	93	psf
V/S	=	2.23	in.		

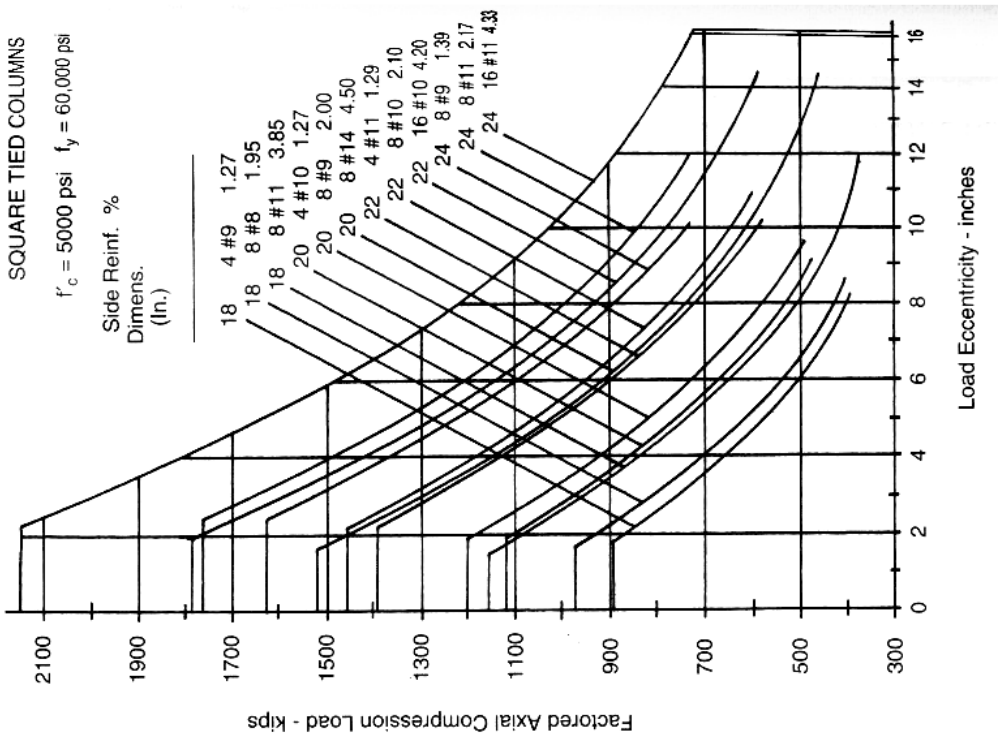
4HC10+2

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	0.2	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	1.2	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.


ROUND TIED COLUMNS
f'c = 5000 psi fy = 60,000 psi
Side Reinf. %
Dimens.
(In.)
12 4 #5 1.10
12 4 #7 2.12
12 4 #9 3.54
14 4 #6 1.14
14 4 #8 2.05
14 4 #11 4.05
16 4 #7 1.19
16 6 #8 2.36
16 6 #10 3.79
20 4 #9 1.27
20 6 #10 2.43
20 8 #11 3.97
24 6 #10 1.68
24 6 #14 2.98
24 12 #11 4.14
Factored Axial Compression Load - kips
1800
1600
1400
1200
1000
800
600
400
200
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13
Load Eccentricity - inches


SQUARE TIED COLUMNS
f'c = 5000 psi fy = 60,000 psi
Side Reinf. %
Dimens.
(In.)
18 4 #9 1.27
18 8 #8 1.95
18 8 #11 3.85
20 4 #10 1.27
20 8 #9 2.00
20 8 #14 4.50
22 4 #11 1.29
22 8 #10 2.10
22 16 #10 4.20
24 8 #9 1.39
24 8 #11 2.17
24 16 #11 4.33
Factored Axial Compression Load - kips
2100
1900
1700
1500
1300
1100
900
700
500
300
0 2 4 6 8 10 12 14 16
Load Eccentricity - inches