ARCH 331. Assignment #10

Date: 7/1/15, due 7/3/15

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; \(\lambda = 1\).

Partial answers to check with: \(s_{req'd} = 4.4\) in., \(s_{max} = 3.5\) in.

(reinforced concrete beam shear design)

(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; \(\lambda = 1\). The beam section dimensions are \(b = 12\) in., \(d = 26\) in., and \(h = 28\) in..

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.

(reinforced concrete beam shear analysis and design)

(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.

Partial answers to check with: \(V_u\) max \(< \phi V_c\) so maximum spacing governs with 6 stirrups.

(reinforced concrete beam shear analysis and design)

(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 structure is 50 psf, and live load is 75 psf. Use \(f'_c = 4\) ksi and \(f_y = 60\) ksi; \(\lambda = 1\). 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. \(A_{temp-min} = 0.11\) in², \(L_d = (14.25\) in for a #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.

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

### 3.6 Hollow-Core Load Tables (cont.)

**Table of safe superimposed service load, lb/ft², and cambers, in.**

<table>
<thead>
<tr>
<th>Strand designation code</th>
<th>Span, ft</th>
<th>2 in. Normalweight Topping</th>
</tr>
</thead>
<tbody>
<tr>
<td>48-S</td>
<td>20</td>
<td>22 21 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>58-S</td>
<td>317</td>
<td>296 282 267 252 237 219 196 180 163 148 134 120 105 92 80 69 59 50 41 33 26 24 22</td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>68-S</td>
<td>326</td>
<td>301 291 273 258 246 234 222 212 202 188 171 153 137 122 108 96 84 74 64 55 46 38 31</td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>78-S</td>
<td>335</td>
<td>313 297 279 267 252 240 226 218 208 196 182 165 150 135 122 109 97 86 76 67 58 50 42 36 28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>88-S</td>
<td>344</td>
<td>327 306 288 273 256 246 234 224 213 202 195 184 172 159 144 130 118 107 96 87 77 66 56 44</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Strength is based on strain compatibility; bottom tension is limited to 7.5\(f_c\); 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 \(f' = 5\) ksi and \(f_y = 60\) ksi.

**Partial answers to check with:** \(e = 7\) in, \(\varphi P_n = 1078\) kips

MORE NEXT PAGE
(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.

*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.

*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*