ARCH 331. Assignment #8

Date: 6/25/14, due 6/27/14

Problems: supplemental problems (8A, etc.) and from Onouye Chapter 10

Notes: Problems marked with a * have been altered with respect to the problem stated in the text. Selected problems not required to be worked will be announced in class.

(14%) * 10.3.5 A two-story, continuous W12 x 100 column supports a roof load of 200 kips and an intermediate (second floor) load of 300 kips. Assume the top and bottom have pin connections. Is the column section shown adequate? (unified ASD column analysis)
Assume A36 steel (F_y = 36 ksi, E = 29 x 10^3 ksi)

Partial answers to check with:
{kL/r_x = 57.4, kL/r_y = 54.4, Pn/Ω = 510 k, so...}

(8%) 8A) For the column of problem 10.3.5, assume the roof load is a live load, and the 2nd floor framing load is a dead load.
Using LRFD design and the tables for the critical unfactored compressive stress, determine if the column section shown is adequate. (LRFD column analysis)

Partial answers to check with:
{ϕP_n = 767 k, so...}

(22%) * 10.3.9 What is the most economical wide flange column for Problem 10.3.8 to support a load of 92 k dead and 140 k live and a length of L = 20 ft. Assume F_y = 50 ksi and K = 1.0. (LRFD steel column design)

Partial answers to check with:
{LRFD: A_{req'd} ≥ 10.2 in^2 with ϕF_{c} = 16.35 ksi, so...}

(6%) 8B) For the column of problem 10.3.9, use the LRFD column capacity tables provided to determine to determine the most economical wide flange column.
(LRFD column design by tables)

Partial answers to check with: LRFD: P_u = 334.4 k, ϕP_n = ___ k, so ....

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For the column of problem 10.3.5 (A36), the roof load (live) is applied at an eccentricity of 4 inches out of plane of the wall (y), and the dead load at the 2nd floor framing has been reduced to 200 k. Is the W12x96 adequate when $\phi M_{wz} = 545$ k-ft? (LRFD beam-column analysis)

Partial answers to check with: $P_r/P_c = 0.73, P_{el} = 2450$ k, $B_1 = 1.0$, interaction value < 1.0.
<table>
<thead>
<tr>
<th>Shape</th>
<th>wf 8</th>
<th>wf 10</th>
<th>wf 12</th>
<th>wf 14</th>
<th>wf 16</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ASD</td>
<td>UBD</td>
<td>ASD</td>
<td>UBD</td>
<td>ASD</td>
</tr>
<tr>
<td>Pn,kips</td>
<td>38.6</td>
<td>23.8</td>
<td>40.2</td>
<td>24.7</td>
<td>41.8</td>
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<td>24.7</td>
<td>41.8</td>
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</table>

Note: Heavy line indicates $P_n$ is equal to or greater than 200.
(12%) 8D) Determine the capacity of this butt splice based on shear, bearing, and tension. The plates are made of A36 steel and the four bolts on each side of the splice are A325-SC with standard round holes at 3 inch spacing. Assume the hole spacing is such that block shear rupture is not a concern.

(LRFD steel connection analysis)

Partial answers to check with: 76.0 k (shear), 156.6 k (bearing), 129.6 k (yielding), 135.9 k (rupture), so ...

(6%) 8E) Determine the capacity of the welded connection shown. The weld size is 3/16 in.. Assume the base metal is A36 steel and electrodes are E70XX in each problem. Use L = 4.5”.

(LRFD steel connection analysis)

Partial answers to check with: 50.625 k (yielding), 58.52 k (shear), so ...

(14%) 8F) Determine the capacity and adequacy of the framed beam connection shown when the factored beam reaction is 300 k and ½” angles of sufficient length are used. The column and beam are A992 steel. The angles are A36 steel with 3” spacing of holes and 1 ¼” edge distances (see table). The bolts are A490-X.

(LRFD steel connection analysis)

Partial answers to check with: 529.9 k (shear), 314.2 k (bearing), 606.9 k (bearing), 344 k (angles), so ...

<table>
<thead>
<tr>
<th>Column W18 x 35 (A992, GR 50)</th>
<th>Beam W24 x 76 (A992, GR 50, $F_y = 50$ ksi, $F_u = 65$ ksi) $T = 21$ in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(14) ½” φ A490-X</td>
<td>A 36 STEEL CLIP ANGLES (7) ½” φA490-X</td>
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</table>

**TABLE NEXT PAGE**
### Table 10-1 (continued)

#### All-Bolted Double-Angle Connections

<table>
<thead>
<tr>
<th>Angle Thickness, in.</th>
<th>1/16</th>
<th>5/32</th>
<th>3/32</th>
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<td>LRFD</td>
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<td>123</td>
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<td>122</td>
<td>144</td>
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<tr>
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<tr>
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<tr>
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<td>STD</td>
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<td>144</td>
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