Appendix A.1: Snow Drift

Angela Mincemoyer	Snow Drift	Tech Report 2	17/43

First Floor Roof - North side - Green Roof & Plaza Deck:

Determine if drift load is required: (section 7.7.1)

$h_c/h_b < 0.2 \Rightarrow$ not required

$\gamma = 0.13 p_g + 14 < 30$ pcf

$= 0.13(45) + 14 = 19.85$ pcf < 30 ✓

$h_b = \frac{p_f}{\gamma} = \frac{35}{19.85} \rightarrow h_b = 1.76'$

$h_c = 45' - 1.76' = 43.24'$

$\frac{h_c}{h_b} = \frac{43.24}{1.76} = 24.6 \rightarrow$ drift is required

Leeward: (Fig. 7-9)

$h_d = 0.43 \sqrt[3]{I_u} \sqrt[4]{p_g+10} - 1.5$

$I_u = 98'$

$= 0.43 \sqrt[3]{98'} \sqrt[4]{45+10'} - 1.5$

$h_d = 3.90$ ft

Windward: (Fig. 7-9)

$I_u = 20$ ft

$h_d = (0.43 \sqrt[3]{20} \sqrt[4]{45+10} - 1.5)\ 3/4$

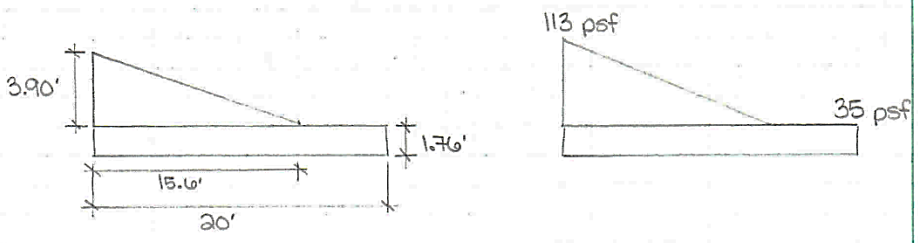
$h_d = 1.26$ ft

$\rightarrow h_d = 3.90$ ft should be used in design

$h_d < h_c \rightarrow \quad w = 4h_d = 4(3.90) = 15.6$ ft

$h_d\gamma = 3.90'(19.85) = 78$ psf

Angela Mincemoyer	Snow Drift	Tech Report 2	18/43



First Floor Roof - East Side - Plaza Deck:

Determine if drift load is required: (section 7.7.1)

$h_c/h_b < 0.2 \Rightarrow$ not required

$\gamma = 19.85$ pcf (see calculation on previous page)

$h_b = 1.76'$ (see calculation on previous page)

$h_c = 47' - 1.76' = 45.24'$

$\frac{h_c}{h_b} = \frac{45.24}{1.76} = 25.7 \rightarrow$ drift is required

Leeward: (Fig. 7-9)

$h_d = 0.43 \sqrt[3]{I_u} \sqrt[4]{p_g+10} - 1.5$

$I_u = 237'$

$h_d = 0.43 \sqrt[3]{237} \sqrt[4]{45+10} - 1.5$

$h_d = 5.75'$

Angela Mincemoyer	Snow Drift	Tech Report 2	19/43

Windward:

$l_u = 14.5'$

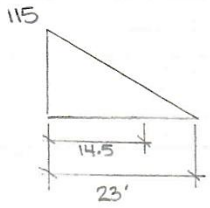
$h_d = (0.43\sqrt[3]{14.5}\sqrt[4]{45+10} - 1.5)^{3/4}$

$h_d = 1.02'$

$\rightarrow h_d = 5.75$ ft should be used in design

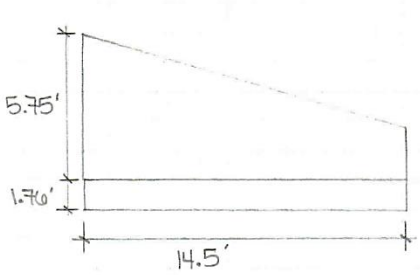
$h_d < h_c \rightarrow w = 4h_d = 4(5.75) = 23$ ft

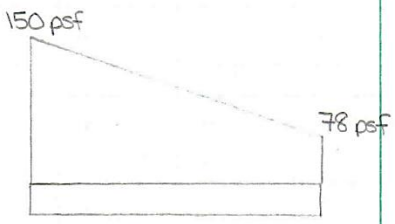
$h_d\gamma = 5.75(19.85) = 115$ psf



$\frac{115}{23} = \frac{x}{23-14.5}$

$x = 43$ psf





Angela Mincemoyer | Snow Drift

Third Floor Roof - South side Section 7.7.1

$h_c/h_b < 0.2 \Rightarrow$ not required

$\gamma = 0.13 p_g + 14 < 30$ pcf

$= 0.13(45)+14 = 19.85$ pcf < 30 pcf ✓

$h_b = \frac{p_s}{\gamma} = \frac{35}{19.85} = 1.76'$

$h_c = 18.33 - 1.76 = 10.41'$

$\frac{h_c}{h_b} = \frac{10.41}{1.76} = 5.9 \rightarrow$ drift required

Leeward: (figure 7-9)

$l_u = 50'$

$h_d = 0.43 \sqrt[3]{l_u} \sqrt[4]{p_g+10} - 1.5$

$= 0.43 \sqrt[3]{50} \sqrt[4]{45+10} - 1.5$

$h_d = 2.82$ ft

Windward: (figure 7-9)

$l_u = 35'$

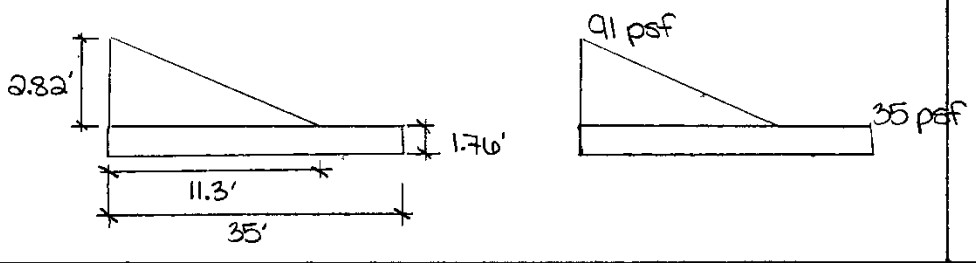
$h_d = [.43 \sqrt[3]{35} \sqrt[4]{45+10} - 1.5](.75)$

$h_d = 1.75$ ft

→ $h_d = 2.82$ ft should be used in design

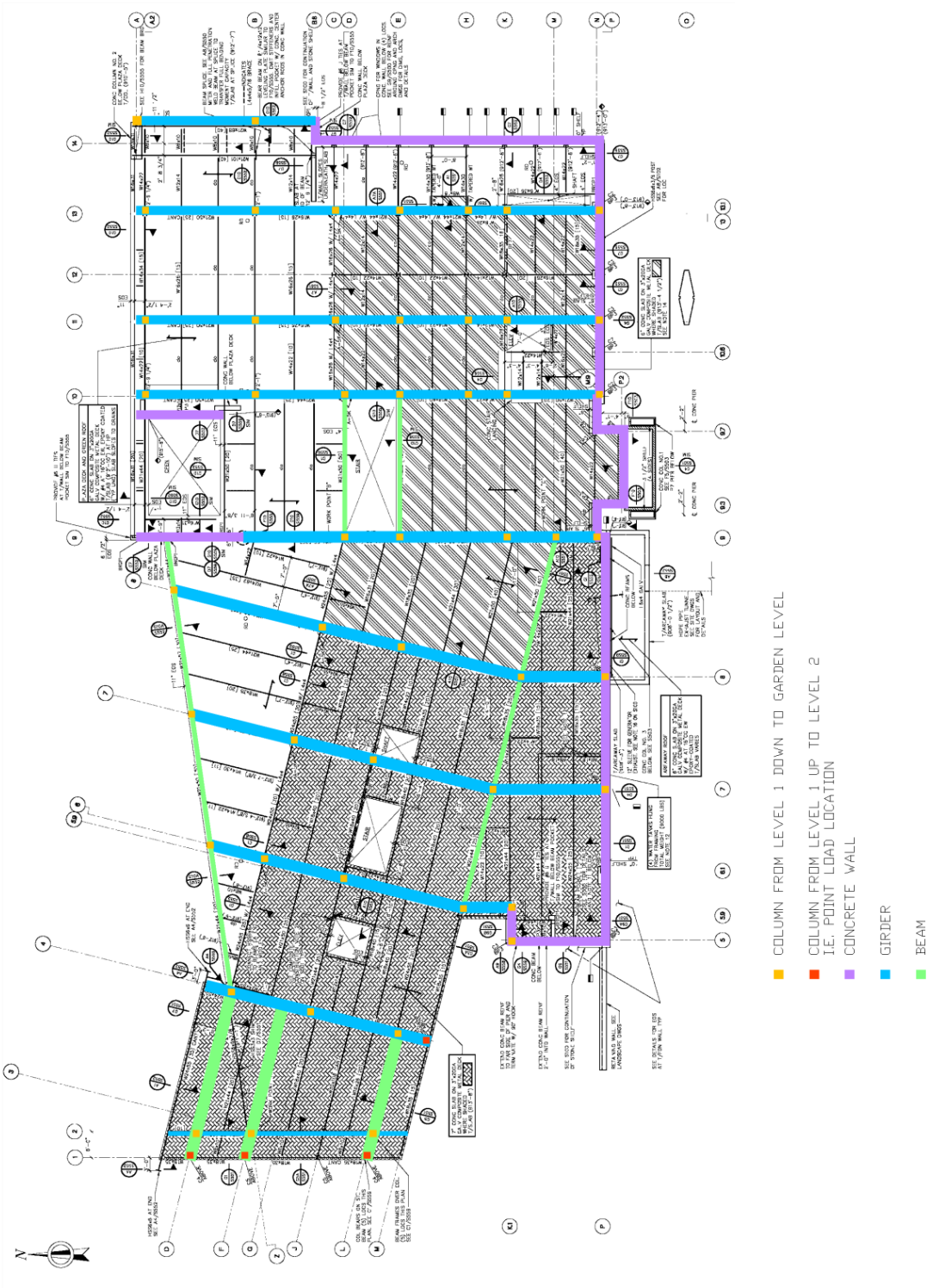
$h_d < h_c \rightarrow w = 4h_d = 4(2.82) = 11.3$ ft

$h_d\gamma = 2.82(19.85) = 56$ psf

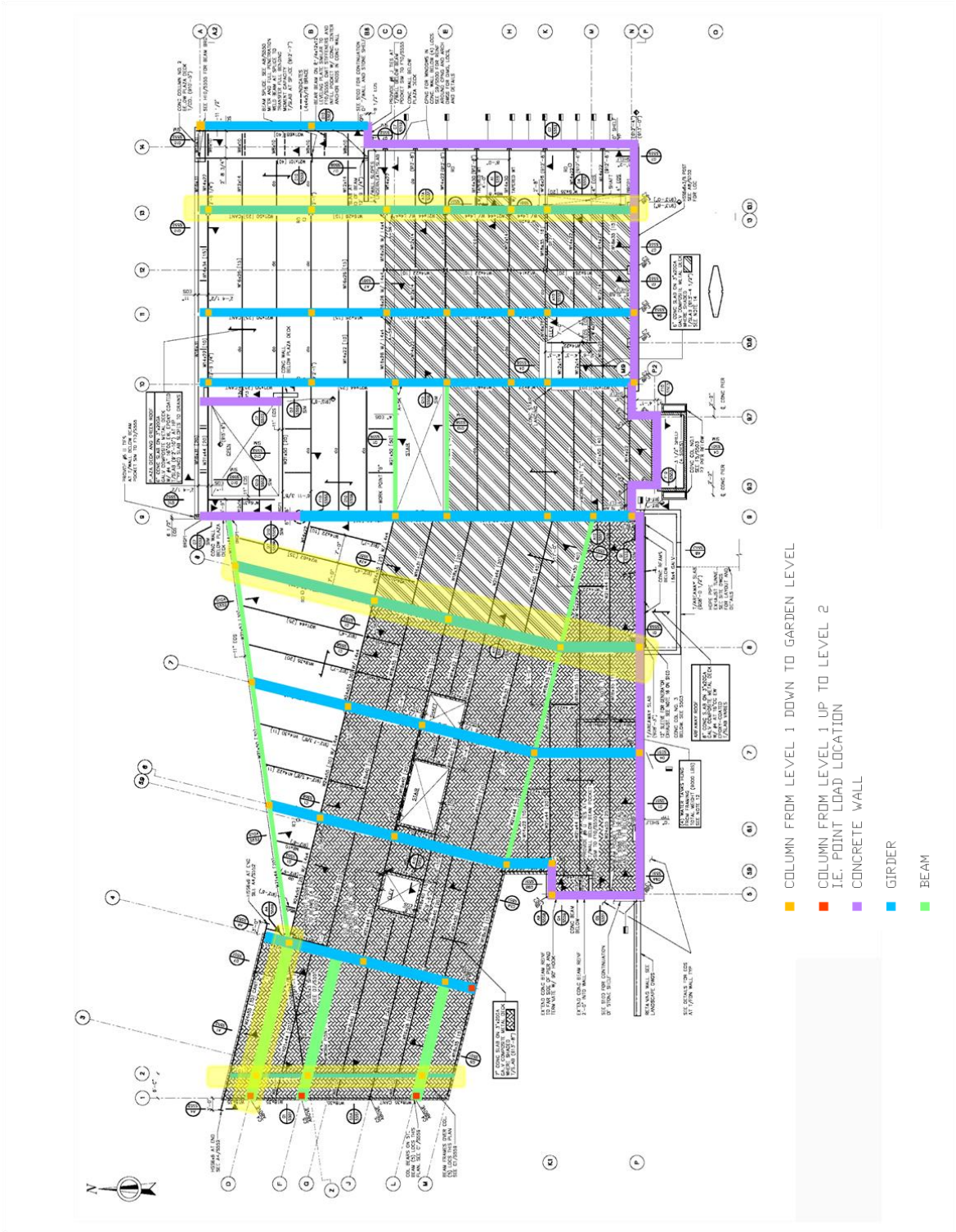


Appendix A.2: Framing Layouts

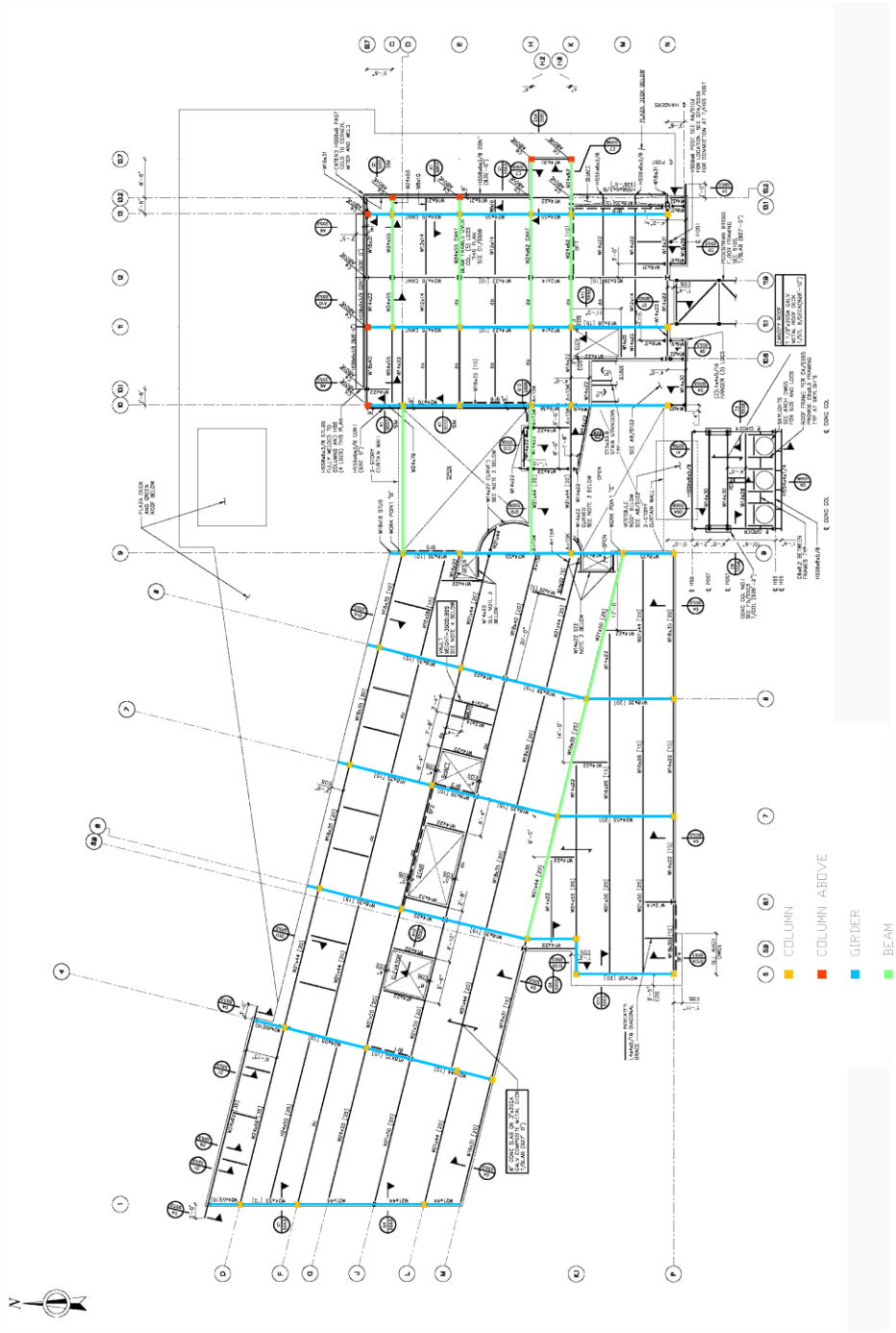
Gravity Framing for Level 1



Gravity Framing for Level 1 with Designed Members Indicated



Framing Layout for Level 2

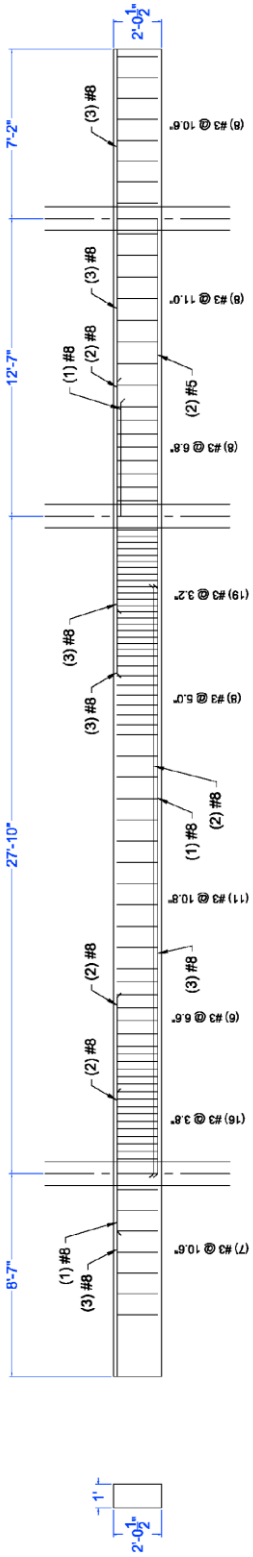


Framing Layout for Level 3

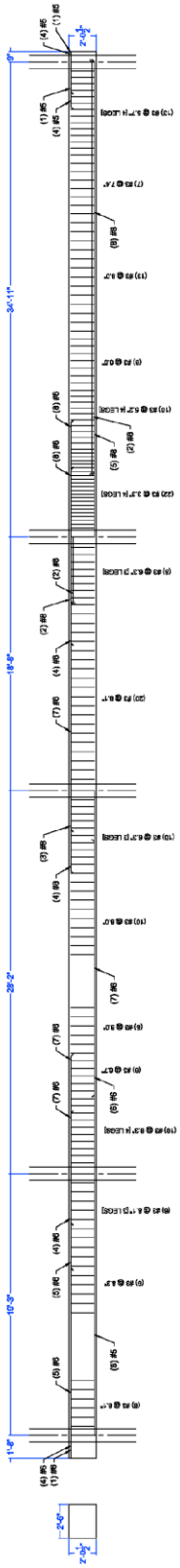
Framing Layout for Roof

Appendix A.3: Girder Designs

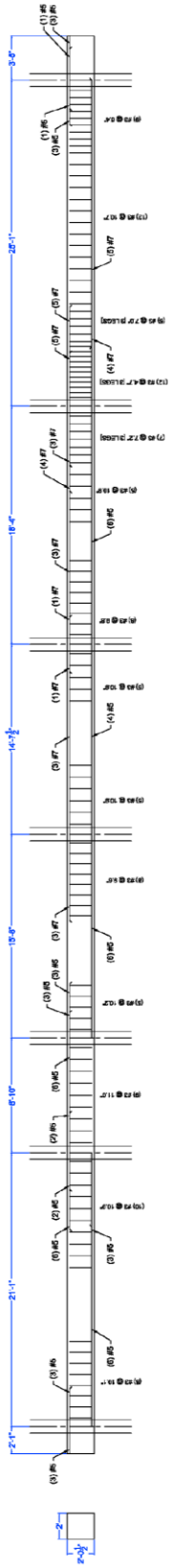
Level 1 Column Line 2 Girder



Level 1 Column Line 8 Girder



Level 1 Column Line 13 Girder



Appendix A.4: spBeam Output for Girders

Level 1 Column Line 2 Girder

spBeam v3.60 © StructurePoint 02-03-2014, 02:10:11 PM
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E:\SPRING\Gravity\Girder Design\Column Line 2\Column Line 2 Girder.slb Page 1

```
                    oooooo
                    oo   oo
  ooooo   oooooo    oo   oo    ooooo    ooooo   o oooooooooo
 oo    o  oo   oo   oo   oo   oo   oo  o    oo   oo   oo   oo
 oo       oo   oo   ooooooo   oo   oo   oooooo   oo   oo   oo
  ooooo   oo   oo   oo    oo  oo   oo  oo   oo   oo   oo   oo
      oo  oooooo    oo    oo  ooooo    oo   oo   oo   oo   oo
o    oo   oo        oo    oo  oo    o  oo   oo   oo   oo   oo
 ooooo    oo        ooooooo    ooooo    ooooo o  oo   oo   oo  (TM)
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Reinforced Concrete Beams and One-way Slab Systems

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[2] DESIGN RESULTS
==

Top Reinforcement
=================
Units: Width (ft), Mmax (k-ft), Xmax (ft), As (in^2), Sp (in)

Span	Zone	Width	Mmax	Xmax	AsMin	AsMax	AsReq	SpProv	Bars
1	Left	1.00	23.94	2.828	0.378	4.877	0.238	3.155	3-#8 *3
	Midspan	1.00	82.47	5.252	0.900	4.877	0.837	3.155	3-#8 *3
	Right	1.00	195.09	8.080	0.900	4.877	2.066	9.236	4-#8
2	Left	2.78	233.48	0.500	0.900	4.877	2.512	9.236	4-#8
	Midspan	2.78	0.00	13.915	0.000	4.877	0.000	1.645	---
	Right	2.78	375.86	27.330	0.900	4.877	4.323	5.541	6-#8
3	Left	1.26	348.88	0.500	0.887	4.805	4.039	2.352	6-#8 2L
	Midspan	1.26	201.92	4.553	0.900	4.877	2.145	4.703	3-#8
	Right	1.26	155.58	12.080	0.900	4.877	1.623	4.703	3-#8
4	Left	1.00	171.12	0.500	0.900	4.877	1.795	3.155	3-#8
	Midspan	1.00	72.36	2.834	0.900	4.877	0.732	3.155	3-#8 *3
	Right	1.00	21.02	4.835	0.378	4.877	0.209	3.155	3-#8 *3

NOTES:
*3 - Design governed by minimum reinforcement.

Top Bar Details
===============
Units: Length (ft)

Span	Left Bars	Left Length	Left Bars	Left Length	Continuous Bars	Continuous Length	Right Bars	Right Length	Right Bars	Right Length
1	---		---		3-#8	8.58	1-#8	2.44	---	
2	2-#8	7.47	2-#8	3.44	---		3-#8	6.67	3-#8	3.95
3	2-#8	5.67	1-#8	4.80	3-#8	12.58	---		---	
4	---		---		3-#8	7.17	---		---	

Bottom Reinforcement
====================
Units: Width (ft), Mmax (k-ft), Xmax (ft), As (in^2), Sp (in)

Span	Width	Mmax	Xmax	AsMin	AsMax	AsReq	SpProv	Bars
1	1.00	0.00	4.040	0.000	8.421	0.000	0.000	---
2	1.00	399.45	12.842	0.873	22.962	4.149	2.104	6-#8 2L
3	1.00	18.14	7.152	0.381	11.481	0.178	6.576	2-#5 *3
4	1.00	0.00	3.835	0.000	7.343	0.000	0.000	---

NOTES:
*3 - Design governed by minimum reinforcement.

Bottom Bar Details

Units: Start (ft), Length (ft)

	Long Bars			Short Bars		
Span	Bars	Start	Length	Bars	Start	Length
1	---			---		
2	3-#8	0.00	27.83	3-#8	0.00	24.77
3	2-#5	0.00	12.58	---		
4	---			---		

Flexural Capacity

Units: x (ft), As (in^2), PhiMn (k-ft)

Span	x	AsTop	AsBot	PhiMn-	PhiMn+
1	0.000	2.37	0.00	-221.38	0.00
	2.828	2.37	0.00	-221.38	0.00
	4.290	2.37	0.00	-221.38	0.00
	5.252	2.37	0.00	-221.38	0.00
	6.141	2.37	0.00	-221.38	0.00
	8.080	3.16	0.00	-286.91	0.00
	8.580	3.16	0.00	-286.91	0.00
2	0.000	3.16	4.74	-286.91	455.02
	0.500	3.16	4.74	-286.91	455.02
	1.078	3.16	4.74	-286.91	455.02
	3.435	1.58	4.74	-151.71	455.02
	5.116	1.58	4.74	-151.71	455.02
	7.473	0.00	4.74	0.00	455.02
	9.890	0.00	4.74	0.00	455.02
	13.915	0.00	4.74	0.00	455.02
	17.939	0.00	4.74	0.00	455.02
	19.831	0.00	4.74	0.00	455.02
	21.162	0.00	4.10	0.00	396.81
	23.866	2.37	2.80	-221.38	277.38
	23.881	2.37	2.79	-221.38	276.71
	24.765	3.15	2.37	-285.73	237.29
	26.585	4.74	2.37	-405.58	237.29
	27.330	4.74	2.37	-405.58	237.29
	27.830	4.74	2.37	-405.58	237.29
3	0.000	4.74	0.62	-398.47	62.89
	0.500	4.74	0.62	-398.47	62.89
	0.501	4.74	0.62	-398.47	62.89
	1.373	4.58	0.62	-388.63	62.89
	4.553	2.83	0.62	-259.25	62.89
	4.797	2.69	0.62	-248.46	62.89
	5.669	2.37	0.62	-221.38	62.89
	6.290	2.37	0.62	-221.38	62.89
	8.027	2.37	0.62	-221.38	62.89
	12.080	2.37	0.62	-221.38	62.89
	12.580	2.37	0.62	-221.38	62.89
4	0.000	2.37	0.00	-221.38	0.00
	0.500	2.37	0.00	-221.38	0.00
	2.834	2.37	0.00	-221.38	0.00
	3.585	2.37	0.00	-221.38	0.00
	4.835	2.37	0.00	-221.38	0.00
	7.170	2.37	0.00	-221.38	0.00

Longitudinal Beam Shear Reinforcement Required

Units: d (in), Start, End, Xu (ft), PhiVc, Vu (kip), Av/s (in^2/in)

Span	d	PhiVc	Start	End	Vu	Xu	Av/s
1	22.50	25.61	0.000	2.068	12.36	2.068	0.0000
			2.068	4.137	24.72	4.137	0.0100
			4.137	7.830	37.08	6.205	0.0113
2	21.83	24.86	0.750	5.632	78.82	2.319	0.0549
			5.632	8.945	55.34	5.632	0.0310
			8.945	12.258	31.86	8.945	0.0100
			12.258	15.572	20.40	15.572	0.0100
			15.572	18.885	43.88	18.885	0.0194
			18.885	22.198	67.36	22.198	0.0433
			22.198	27.080	90.84	25.511	0.0672
3	22.17	25.23	0.750	4.976	53.78	2.347	0.0286
			4.976	7.604	34.15	4.976	0.0100
			7.604	11.830	29.38	10.233	0.0100
4	22.50	25.61	0.750	4.773	36.89	2.375	0.0111

4.773	7.170	18.44	4.773	0.0100	

Longitudinal Beam Shear Reinforcement Details

Units: spacing & distance (in).
Span Size Stirrups (2 legs each unless otherwise noted)

1 #3 <-- 21.8 --> + 7 @ 10.6
2 #3 16 @ 3.8 + 6 @ 6.6 + 11 @ 10.8 + 8 @ 5.0 + 19 @ 3.2
3 #3 8 @ 6.8 + 8 @ 11.0
4 #3 8 @ 10.6

Beam Shear Capacity

Units: d, Sp (in), Start, End, Xu (ft), PhiVc, PhiVn, Vu (kip), Av/s (in^2/in)

Span	d	PhiVc	Start	End	Av/s	Sp	PhiVn	Vu	Xu
1	22.50	25.61	0.000	0.250	-----	-----	12.81	1.49	0.250
			0.250	2.068	-----	-----	12.81	12.36	2.068
			2.068	7.830	0.0207	10.6	46.56	37.08	6.205
			7.830	8.580	-----	-----	46.56	37.08	6.205
2	21.83	24.86	0.000	0.750	-----	-----	82.04	78.82	2.319
			0.750	5.632	0.0582	3.8	82.04	78.82	2.319
			5.632	8.945	0.0332	6.6	57.48	55.34	5.632
			8.945	18.885	0.0203	10.8	44.79	43.88	18.885
			18.885	22.198	0.0443	5.0	68.35	67.36	22.198
			22.198	27.080	0.0695	3.2	93.11	90.84	25.511
			27.080	27.830	-----	-----	93.11	90.84	25.511
3	22.17	25.23	0.000	0.750	-----	-----	57.69	53.78	2.347
			0.750	4.976	0.0325	6.8	57.69	53.78	2.347
			4.976	11.830	0.0201	11.0	45.25	34.15	4.976
			11.830	12.580	-----	-----	45.25	29.38	10.233
4	22.50	25.61	0.000	0.750	-----	-----	46.67	36.89	2.375
			0.750	6.920	0.0208	10.6	46.67	36.89	2.375
			6.920	7.170	-----	-----	46.67	1.92	6.920

Slab Shear Capacity

Units: b, d (in), Xu (ft), PhiVc, Vu(kip)

Span	b	d	Vratio	PhiVc	Vu	Xu
1 --- Not checked ---						
2 --- Not checked ---						
3 --- Not checked ---						
4 --- Not checked ---						

Deflections

Section properties

Units: Ig, Icr, Ie (in^4), Mcr, Mmax (k-ft)

	Ie,avg						Load Level			
							Dead		Dead+Live	
Span	Dead	Dead+Live	Zone	Ig	Icr	Mcr	Mmax	Ie	Mmax	Ie
1	8135	7259	Right	14706	7061	47.45	-91.30	8135	-160.31	7259
2	13098	11954	Left	14706	7061	47.45	-115.53	7591	-203.38	7158
			Midspan	30610	13180	69.24	146.27	15029	259.03	13513
			Right	14706	9450	47.45	-157.50	9593	-278.88	9476
3	18954	18555	Left	14706	9130	47.45	-139.04	9351	-246.18	9170
			Midspan	23211	2102	60.86	0.00	23211	0.00	23211
			Right	14706	5676	47.45	-68.42	8689	-121.40	6215
4	7486	6000	Left	14706	5676	47.45	-81.09	7486	-143.86	6000

Maximum Instantaneous Deflections

Units: D (in)

Span	Ddead	Dlive	Dtotal
1	-0.091	-0.073	-0.164
2	0.261	0.233	0.494
3	-0.029	-0.024	-0.053
4	0.112	0.109	0.221

Maximum Long-term Deflections

Time dependant factor for sustained loads = 2.000
Units: D (in)

Span	Dsust	Lambda	Dcs	Dcs+lu	Dcs+l	Dtotal
1	-0.091	2.000	-0.183	-0.256	-0.256	-0.347
2	0.261	2.000	0.522	0.755	0.755	1.016
3	-0.029	2.000	-0.058	-0.082	-0.082	-0.111
4	0.112	2.000	0.223	0.332	0.332	0.444

Material Takeoff
================

Reinforcement in the Direction of Analysis

Top Bars:	419.8 lb	<=>	7.48 lb/ft	<=>	0.334 lb/ft^2
Bottom Bars:	447.5 lb	<=>	7.97 lb/ft	<=>	0.356 lb/ft^2
Stirrups:	173.9 lb	<=>	3.10 lb/ft	<=>	0.138 lb/ft^2
Total Steel:	1041.3 lb	<=>	18.54 lb/ft	<=>	0.828 lb/ft^2
Concrete:	565.2 ft^3	<=>	10.06 ft^3/ft	<=>	0.449 ft^3/ft^2

Level 1 Column Line 8 Girder

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[2] DESIGN RESULTS

Top Reinforcement

Units: Width (ft), Mmax (k-ft), Xmax (ft), As (in^2), Sp (in)

Span	Zone	Width	Mmax	Xmax	AsMin	AsMax	AsReq	SpProv	Bars
1	Left	2.50	0.85	0.409	0.950	12.260	0.008	8.162	4-#6 *3 *5
	Midspan	2.50	2.80	0.760	0.950	12.260	0.027	8.162	4-#6 *3 *5
	Right	2.50	6.51	1.170	0.950	12.260	0.064	6.122	5-#6 *3 *5
2	Left	2.50	1.93	0.500	0.950	12.260	0.019	6.122	5-#6 *3
	Midspan	2.50	134.17	12.363	1.784	12.260	1.341	6.122	5-#6 *3
	Right	2.50	564.66	18.750	2.263	12.260	6.017	1.884	14-#6
3	Left	2.82	575.93	0.500	2.263	12.260	6.148	2.176	14-#6
	Midspan	2.82	0.00	14.085	0.000	12.294	0.000	0.000	---
	Right	2.82	369.43	27.670	2.250	12.192	3.842	4.052	7-#8
4	Left	2.50	361.75	0.500	2.250	12.192	3.757	4.052	7-#8
	Midspan	2.50	483.61	11.986	2.250	12.192	5.119	4.052	7-#8
	Right	2.50	949.30	18.170	2.236	12.115	11.039	2.587	15-#8
5	Left	3.49	987.87	0.500	2.250	12.192	11.479	2.587	15-#8
	Midspan	3.49	0.00	17.460	0.000	12.294	0.000	0.000	---
	Right	3.49	92.02	34.420	1.213	12.294	0.912	9.120	5-#5 *3 *5
6	Left	2.50	0.37	0.500	0.953	12.294	0.004	9.120	5-#5 *3
	Midspan	2.50	0.17	0.588	0.953	12.294	0.002	8.192	4-#5 *3
	Right	2.50	0.06	0.662	0.953	12.294	0.001	8.192	4-#5 *3

NOTES:
*3 - Design governed by minimum reinforcement.
*5 - Number of bars governed by maximum allowable spacing.

Top Bar Details

Units: Length (ft)

Span	Left		Continuous		Right			
	Bars	Length	Bars	Length	Bars	Length	Bars	Length
1	---		---		4-#6	1.67	1-#6	1.67	---	
2	---		---		5-#6	19.25	5-#6	6.94	4-#6	3.64
3	7-#6	8.63	7-#6	4.45	---		4-#8	5.91	3-#8	2.87
4	---		---		7-#8	18.67	4-#8	7.83	4-#8	4.77
5	8-#8	8.39	8-#8	4.94	---		4-#5	3.30	1-#5	2.19
6	1-#5	0.75	---		4-#5	0.75	---		---	

Bottom Reinforcement

==========
Units: Width (ft), Mmax (k-ft), Xmax (ft), As (in^2), Sp (in)

Span	Width	Mmax	Xmax	AsMin	AsMax	AsReq	SpProv	Bars
1	2.50	0.00	0.585	0.000	12.294	0.000	0.000	---
2	2.50	245.99	7.500	2.269	19.370	2.450	3.511	8-#5
3	2.50	536.71	15.172	2.263	26.160	5.406	2.041	13-#6
4	2.50	0.00	9.335	0.000	18.926	0.000	0.000	---
5	2.50	1077.77	19.495	2.223	30.408	11.266	2.026	15-#8 2L
6	2.50	0.00	0.625	0.000	12.294	0.000	0.000	---

Bottom Bar Details
==========
Units: Start (ft), Length (ft)

	Long Bars			Short Bars		
Span	Bars	Start	Length	Bars	Start	Length
1	---			---		
2	8-#5	0.00	19.25	---		
3	7-#6	0.00	28.17	6-#6	5.79	18.62
4	---			---		
5	8-#8	0.00	34.92	7-#8	4.73	30.19
6	---			---		

Flexural Capacity
==========
Units: x (ft), As (in^2), PhiMn (k-ft)

Span	x	AsTop	AsBot	PhiMn-	PhiMn+
1	0.000	2.20	0.00	-217.58	0.00
	0.409	2.20	0.00	-217.58	0.00
	0.760	2.20	0.00	-217.58	0.00
	0.835	2.20	0.00	-217.58	0.00
	1.000	2.20	0.00	-217.58	0.00
	1.170	2.20	0.00	-217.58	0.00
	1.670	2.20	0.00	-217.58	0.00
2	0.000	2.20	2.48	-217.58	248.96
	0.500	2.20	2.48	-217.58	248.96
	6.887	2.20	2.48	-217.58	248.96
	9.625	2.20	2.48	-217.58	248.96
	12.307	2.20	2.48	-217.58	248.96
	12.363	2.24	2.48	-221.82	248.96
	15.074	4.40	2.48	-422.35	248.96
	15.615	4.40	2.48	-422.35	248.96
	18.382	6.16	2.48	-576.94	248.96
	18.750	6.16	2.48	-576.94	248.96
	19.250	6.16	2.48	-576.94	248.96
3	0.000	6.16	3.08	-576.94	309.13
	0.500	6.16	3.08	-576.94	309.13
	2.001	6.16	3.08	-576.94	309.13
	4.448	3.08	3.08	-301.03	309.13
	5.789	3.08	3.08	-301.03	309.13
	6.187	3.08	3.51	-301.03	351.10
	8.261	0.47	5.72	-47.59	567.00
	8.635	0.00	5.72	0.00	567.00
	10.009	0.00	5.72	0.00	567.00
	14.085	0.00	5.72	0.00	567.00
	18.161	0.00	5.72	0.00	567.00
	21.937	0.00	5.72	0.00	567.00
	22.263	0.00	5.37	0.00	533.42
	24.322	3.16	3.17	-306.73	318.29
	24.409	3.16	3.08	-306.73	309.13
	25.298	3.16	3.08	-306.73	309.13
	27.358	5.53	3.08	-519.44	309.13
	27.670	5.53	3.08	-519.44	309.13
	28.170	5.53	3.08	-519.44	309.13
4	0.000	5.53	0.00	-519.44	0.00
	0.500	5.53	0.00	-519.44	0.00
	6.684	5.53	0.00	-519.44	0.00
	9.335	5.53	0.00	-519.44	0.00
	10.839	5.53	0.00	-519.44	0.00
	11.986	6.38	0.00	-591.97	0.00
	13.898	7.79	0.00	-708.74	0.00
	15.109	9.59	0.00	-844.93	0.00

	18.169	11.85	0.00	-999.74	0.00	
	18.170	11.85	0.00	-999.74	0.00	
	18.670	11.85	0.00	-999.74	0.00	
5	0.000	12.64	6.32	-1039.64	624.35	
	0.500	12.64	6.32	-1039.64	624.35	
	0.501	12.64	6.32	-1039.64	624.35	
	3.945	7.74	6.32	-704.24	624.35	
	4.733	5.50	6.32	-516.62	624.35	
	4.942	4.90	6.53	-464.51	643.83	
	8.386	0.00	9.95	0.00	959.62	
	10.298	0.00	11.85	0.00	1130.93	
	12.372	0.00	11.85	0.00	1130.93	
	17.460	0.00	11.85	0.00	1130.93	
	22.548	0.00	11.85	0.00	1130.93	
	31.622	0.00	11.85	0.00	1130.93	
	32.622	1.24	11.85	-124.56	1130.93	
	32.731	1.24	11.85	-124.56	1130.93	
	33.731	1.55	11.85	-155.07	1130.93	
	34.420	1.55	11.85	-155.07	1130.93	
	34.920	1.55	11.85	-155.07	1130.93	
6	0.000	1.55	0.00	-155.07	0.00	
	0.375	1.55	0.00	-155.07	0.00	
	0.500	1.55	0.00	-155.07	0.00	
	0.588	1.55	0.00	-155.07	0.00	
	0.662	1.55	0.00	-155.07	0.00	
	0.750	1.55	0.00	-155.07	0.00	

Longitudinal Beam Shear Reinforcement Required

Units: d (in), Start, End, Xu (ft), PhiVc, Vu (kip), Av/s (in^2/in)

Span	d	PhiVc	Start	End	Vu	Xu	Av/s
1	22.63	64.39	0.000	0.920	0.00	0.000	0.0000
2	22.63	64.39	0.750	4.454	50.39	2.385	0.0250
			4.454	6.522	30.26	4.454	0.0000
			6.522	8.591	22.23	8.591	0.0000
			8.591	10.659	41.48	10.659	0.0250
			10.659	12.728	61.61	12.728	0.0250
			12.728	14.796	81.74	14.796	0.0250
			14.796	18.500	101.87	16.865	0.0368
3	22.50	64.04	0.750	5.721	125.19	2.375	0.0604
			5.721	9.066	92.63	5.721	0.0282
			9.066	12.412	60.07	9.066	0.0250
			12.412	15.758	27.50	12.412	0.0000
			15.758	19.104	45.39	19.104	0.0250
			19.104	22.449	77.95	22.449	0.0250
			22.449	27.420	110.51	25.795	0.0459
4	22.50	64.04	0.750	4.695	47.12	2.375	0.0250
			4.695	7.015	38.58	7.015	0.0250
			7.015	9.335	48.99	9.335	0.0250
			9.335	11.655	68.54	11.655	0.0250
			11.655	13.975	88.66	13.975	0.0250
			13.975	17.920	108.78	16.295	0.0442
5	22.23	63.28	0.750	6.669	191.95	2.353	0.1286
			6.669	10.985	142.69	6.669	0.0794
			10.985	15.302	95.11	10.985	0.0318
			15.302	19.618	48.66	15.302	0.0250
			19.618	23.935	46.21	23.935	0.0250
			23.935	28.251	92.10	28.251	0.0288
			28.251	34.170	137.99	32.567	0.0747
6	22.69	64.57	0.750	0.750	0.00	0.750	0.0000

Longitudinal Beam Shear Reinforcement Details

Units: spacing & distance (in).

Span	Size Stirrups (2 legs each unless otherwise noted)
1	#5 --- None ---
2	#3 6 @ 8.1 + <-- 49.6 --> + 9 @ 8.3 + 6 @ 8.1 [3L]
3	#3 10 @ 6.3 [4L] + 6 @ 6.7 + 5 @ 8.0 + <-- 40.1 --> + 10 @ 8.0 + 10 @ 6.3 [3L]
4	#3 20 @ 8.1 + 8 @ 6.3 [3L]
5	#3 22 @ 3.3 [4L] + 10 @ 5.2 [4L] + 8 @ 6.5 + 13 @ 8.0 + 7 @ 7.4 + 13 @ 5.7 [4L]
6	#5 --- None ---

Beam Shear Capacity

Units: d, Sp (in), Start, End, Xu (ft), PhiVc, PhiVn, Vu (kip), Av/s (in^2/in)

Span	d	PhiVc	Start	End	Av/s	Sp	PhiVn	Vu	Xu
1	22.63	64.39	0.000	1.670	-----	-----	32.20	0.00	0.000

2	22.63	64.39	0.000	0.750	-----	-----	92.11	50.39	2.385
			0.750	4.454	0.0272	8.1	92.11	50.39	2.385
			4.454	8.591	-----	-----	32.20	30.26	4.454
			8.591	14.796	0.0266	8.3	91.46	81.74	14.796
			14.796	18.500	0.0408	8.1	105.97	101.87	16.865
			18.500	19.250	-----	-----	105.97	101.87	16.865
3	22.50	64.04	0.000	0.750	-----	-----	134.99	125.19	2.375
			0.750	5.721	0.0701	6.3	134.99	125.19	2.375
			5.721	9.066	0.0329	6.7	97.32	92.63	5.721
			9.066	12.412	0.0274	8.0	91.78	60.07	9.066
			12.412	15.758	-----	-----	32.02	27.50	12.412
			15.758	22.449	0.0274	8.0	91.78	77.95	22.449
			22.449	27.420	0.0526	6.3	117.25	110.51	25.795
			27.420	28.170	-----	-----	117.25	110.51	25.795
4	22.50	64.04	0.000	0.750	-----	-----	91.41	47.12	2.375
			0.750	13.975	0.0270	8.1	91.41	88.66	13.975
			13.975	17.920	0.0523	6.3	116.97	108.78	16.295
			17.920	18.670	-----	-----	116.97	108.78	16.295
5	22.23	63.28	0.000	0.750	-----	-----	196.53	191.95	2.353
			0.750	6.669	0.1332	3.3	196.53	191.95	2.353
			6.669	10.985	0.0849	5.2	148.27	142.69	6.669
			10.985	15.302	0.0340	6.5	97.27	95.11	10.985
			15.302	23.935	0.0276	8.0	90.90	48.66	15.302
			23.935	28.251	0.0297	7.4	93.02	92.10	28.251
			28.251	34.170	0.0774	5.7	140.75	137.99	32.567
			34.170	34.920	-----	-----	140.75	137.99	32.567
6	22.69	64.57	0.000	0.750	-----	-----	32.28	0.00	0.750

Slab Shear Capacity
==========

Units: b, d (in), Xu (ft), PhiVc, Vu(kip)

Span	b	d	Vratio	PhiVc	Vu	Xu
1	--- Not checked ---					
2	--- Not checked ---					
3	--- Not checked ---					
4	--- Not checked ---					
5	--- Not checked ---					
6	--- Not checked ---					

Deflections
==========

Section properties

Units: Ig, Icr, Ie (in^4), Mcr, Mmax (k-ft)

	Ie,avg						Load Level			
							Dead		Dead+Live	
Span	Dead	Dead+Live	Zone	Ig	Icr	Mcr	Mmax	Ie	Mmax	Ie
1	36765	36765	Right	36765	6377	118.63	-5.67	36765	-9.70	36765
2	41350	41146	Left	36765	6377	118.63	-10.94	36765	-19.36	36765
			Midspan	47650	7731	137.46	71.57	47650	125.95	47650
			Right	36765	14804	118.63	-276.61	16537	-462.93	15174
3	28101	18467	Left	36765	14804	118.63	-287.56	16346	-480.37	15135
			Midspan	55571	16767	148.90	220.21	28763	359.72	19519
			Right	36765	13448	118.63	-106.12	36765	-224.49	16889
4	41922	39300	Left	36765	13448	118.63	-81.26	36765	-187.43	19361
			Midspan	47059	47059	136.54	0.00	47059	0.00	47059
			Right	36765	22983	118.63	-577.64	23102	-796.60	23028
5	31046	29103	Left	36765	24698	118.63	-632.29	24777	-870.21	24728
			Midspan	59799	30728	154.40	626.36	31164	859.42	30897
			Right	36765	4731	118.63	-100.53	36765	-137.95	25107
6	36765	36765	Left	36765	4731	118.63	-1.91	36765	-2.66	36765

Maximum Instantaneous Deflections

Units: D (in)

Span	Ddead	Dlive	Dtotal
1	-0.004	-0.003	-0.008
2	0.010	0.009	0.019
3	0.192	0.219	0.411
4	-0.117	-0.057	-0.174
5	0.851	0.385	1.236
6	-0.058	-0.026	-0.085

Maximum Long-term Deflections

Time dependant factor for sustained loads = 2.000

Units: D (in)

Span	Dsust	Lambda	Dcs	Dcs+lu	Dcs+l	Dtotal
1	-0.004	2.000	-0.009	-0.012	-0.012	-0.017

2	0.010	2.000	0.021	0.029	0.029	0.040
3	0.192	2.000	0.384	0.604	0.604	0.796
4	-0.117	2.000	-0.233	-0.291	-0.291	-0.408
5	0.851	2.000	1.702	2.087	2.087	2.938
6	-0.058	2.000	-0.117	-0.143	-0.143	-0.201

Material Takeoff
==========

Reinforcement in the Direction of Analysis

Top Bars:	1242.9	lb	<=>	12.02	lb/ft	<=>	0.444	lb/ft^2
Bottom Bars:	1934.7	lb	<=>	18.71	lb/ft	<=>	0.692	lb/ft^2
Stirrups:	699.0	lb	<=>	6.76	lb/ft	<=>	0.250	lb/ft^2
Total Steel:	3876.7	lb	<=>	37.48	lb/ft	<=>	1.386	lb/ft^2
Concrete:	1480.1	ft^3	<=>	14.31	ft^3/ft	<=>	0.529	ft^3/ft^2

Level 1 Column Line 13 Girder

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spBeam v3.60 © StructurePoint                                                    02-04-2014, 04:23:13 PM
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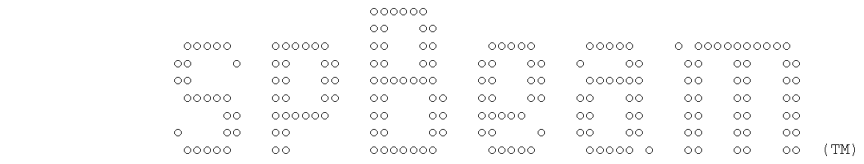

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==========================================================================================
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================================================================================================================
[2] DESIGN RESULTS
================================================================================================================

Top Reinforcement
=================
   Units: Width (ft), Mmax (k-ft), Xmax (ft), As (in^2), Sp (in)
   Span Zone       Width       Mmax       Xmax       AsMin      AsMax      AsReq    SpProv     Bars
   ---- ------- -------- ---------- -------- -------- -------- -------- -------- -------
      1 Left        2.00       1.11     0.553    0.762    9.835    0.011    9.288    3-#5 *3
        Midspan     2.00       3.71     1.027    0.762    9.835    0.036    9.288    3-#5 *3
        Right       2.00       8.67     1.580    0.762    9.835    0.085    9.288    3-#5 *3

      2 Left        2.11      15.82     0.500    0.762    9.835    0.155    9.936    3-#5 *3
        Midspan     2.11       0.00    10.540    0.000    9.835    0.000    0.000     ---
        Right       2.11     216.69    20.580    1.815    9.835    2.201    2.839    8-#5

      3 Left        2.00     214.44     0.500    1.815    9.835    2.177    2.654    8-#5
        Midspan     2.00     126.66     3.240    1.685    9.835    1.267    3.715    6-#5 *3
        Right       2.00      82.66     5.590    1.091    9.835    0.821    3.715    6-#5 *3

      4 Left        2.00      70.43     0.500    0.928    9.835    0.698    3.715    6-#5 *3
        Midspan     2.00       0.00     7.835    0.000    9.835    0.000    0.000     ---
        Right       2.00     126.36    15.170    1.690    9.781    1.271    9.200    3-#7 *3

      5 Left        2.00     126.72     0.500    1.695    9.781    1.275    9.200    3-#7 *3
        Midspan     2.00      35.98     9.360    0.758    9.781    0.356    9.200    3-#7 *3 *5
        Right       2.00     159.62    14.130    1.805    9.781    1.615    6.133    4-#7 *3

      6 Left        2.00     151.87     0.500    1.805    9.781    1.534    6.133    4-#7 *3
        Midspan     2.00      85.50    11.765    1.136    9.781    0.854    9.200    3-#7 *3 *5
        Right       2.00     501.25    17.830    1.805    9.781    5.415    2.044   10-#7

      7 Left        2.51     512.63     0.500    1.805    9.781    5.551    2.722   10-#7
        Midspan     2.51       0.00    12.540    0.000    9.835    0.000    0.000     ---
        Right       2.51      70.28    24.580    0.926    9.835    0.696    8.224    4-#5 *3 *5

      8 Left        2.00      42.62     0.500    0.762    9.835    0.420    8.224    4-#5 *3
        Midspan     2.00      18.06     1.522    0.762    9.835    0.177    9.288    3-#5 *3
        Right       2.00       5.27     2.398    0.762    9.835    0.052    9.288    3-#5 *3
   NOTES:
   *3 - Design governed by minimum reinforcement.
   *5 - Number of bars governed by maximum allowable spacing.

Top Bar Details
===============
   Units: Length (ft)
              _____Left_____          ___Continuous__          _____Right_____
   Span    Bars  Length    Bars  Length    Bars  Length    Bars  Length    Bars  Length
   ---- ------- ------- ------- ------- ------- ------- ------- ------- ------- -------
      1     ---             ---             3-#5    2.08     ---             ---

      2    3-#5    2.89     ---              ---             6-#5    5.86    2-#5    2.80

      3    2-#5    3.03     ---             6-#5    8.83     ---             ---
```

4	3-#5	4.13	3-#5	1.94	---		3-#7	6.61	---	
5	---		---		3-#7	14.63	1-#7	2.08	---	
6	1-#7	2.07	---		3-#7	18.33	4-#7	6.50	3-#7	4.51
7	5-#7	7.59	5-#7	4.08	---		3-#5	3.38	1-#5	2.17
8	1-#5	2.39	---		3-#5	3.42	---		---	

Bottom Reinforcement
====================
Units: Width (ft), Mmax (k-ft), Xmax (ft), As (in^2), Sp (in)

Span	Width	Mmax	Xmax	AsMin	AsMax	AsReq	SpProv	Bars
1	2.00	0.00	0.790	0.000	9.835	0.000	0.000	---
2	2.00	252.07	9.177	1.815	19.841	2.508	2.322	9-#5
3	2.00	0.00	4.415	0.000	10.470	0.000	0.000	---
4	2.00	125.68	7.462	1.654	15.703	1.244	3.715	6-#5 *3
5	2.00	84.94	7.687	1.115	14.907	0.838	6.192	4-#5 *3
6	2.00	166.26	7.680	1.815	17.737	1.648	3.715	6-#5 *3
7	2.00	484.10	14.154	1.805	22.847	4.892	2.300	9-#7
8	2.00	0.00	1.960	0.000	9.835	0.000	0.000	---

NOTES:
*3 - Design governed by minimum reinforcement.

Bottom Bar Details
==================
Units: Start (ft), Length (ft)

	Long Bars			Short Bars		
Span	Bars	Start	Length	Bars	Start	Length
1	---			---		
2	6-#5	0.00	21.08	3-#5	0.00	15.38
3	---			---		
4	6-#5	0.00	15.67	---		
5	4-#5	0.00	14.63	---		
6	6-#5	0.00	18.33	---		
7	5-#7	0.00	25.08	4-#7	4.57	20.51
8	---			---		

Flexural Capacity
=================
Units: x (ft), As (in^2), PhiMn (k-ft)

Span	x	AsTop	AsBot	PhiMn-	PhiMn+
1	0.000	0.93	0.00	-93.52	0.00
	0.553	0.93	0.00	-93.52	0.00
	1.027	0.93	0.00	-93.52	0.00
	1.040	0.93	0.00	-93.52	0.00
	1.580	0.93	0.00	-93.52	0.00
	2.080	0.93	0.00	-93.52	0.00
2	0.000	0.93	2.79	-93.52	279.95
	0.500	0.93	2.79	-93.52	279.95
	1.886	0.93	2.79	-93.52	279.95
	2.886	0.00	2.79	0.00	279.95
	7.528	0.00	2.79	0.00	279.95
	10.540	0.00	2.79	0.00	279.95
	13.552	0.00	2.79	0.00	279.95
	13.946	0.00	2.79	0.00	279.95
	15.219	0.00	1.97	0.00	198.19
	15.381	0.26	1.86	-26.44	187.72
	16.377	1.86	1.86	-184.17	187.72
	18.275	1.86	1.86	-184.17	187.72
	19.434	2.48	1.86	-243.02	187.72
	20.580	2.48	1.86	-243.02	187.72
	21.080	2.48	1.86	-243.02	187.72
3	0.000	2.48	0.00	-243.02	0.00
	0.500	2.48	0.00	-243.02	0.00
	1.802	2.48	0.00	-243.02	0.00

	3.028	1.86	0.00	-184.17	0.00
	3.240	1.86	0.00	-184.17	0.00
	4.415	1.86	0.00	-184.17	0.00
	5.590	1.86	0.00	-184.17	0.00
	8.330	1.86	0.00	-184.17	0.00
	8.830	1.86	0.00	-184.17	0.00
4	0.000	1.86	1.86	-184.17	186.97
	0.500	1.86	1.86	-184.17	186.97
	0.940	1.86	1.86	-184.17	186.97
	1.940	0.93	1.86	-93.52	186.97
	3.131	0.93	1.86	-93.52	186.97
	4.131	0.00	1.86	0.00	186.97
	5.635	0.00	1.86	0.00	186.97
	7.835	0.00	1.86	0.00	186.97
	9.063	0.00	1.86	0.00	186.97
	10.036	1.06	1.86	-105.60	186.97
	10.717	1.80	1.86	-177.40	186.97
	15.170	1.80	1.86	-177.40	186.97
	15.670	1.80	1.86	-177.40	186.97
5	0.000	1.80	1.24	-177.40	125.21
	0.500	1.80	1.24	-177.40	125.21
	5.271	1.80	1.24	-177.40	125.21
	7.315	1.80	1.24	-177.40	125.21
	9.360	1.80	1.24	-177.40	125.21
	12.554	1.80	1.24	-177.40	125.21
	14.130	2.40	1.24	-234.15	125.21
	14.630	2.40	1.24	-234.15	125.21
6	0.000	2.40	1.86	-234.15	187.40
	0.500	2.40	1.86	-234.15	187.40
	0.570	2.40	1.86	-234.15	187.40
	2.068	1.80	1.86	-177.40	187.40
	6.565	1.80	1.86	-177.40	187.40
	9.165	1.80	1.86	-177.40	187.40
	11.765	1.80	1.86	-177.40	187.40
	11.831	1.80	1.86	-177.40	187.40
	13.821	2.99	1.86	-288.93	187.40
	15.839	5.11	1.86	-475.31	187.40
	17.829	6.00	1.86	-549.63	187.40
	17.830	6.00	1.86	-549.63	187.40
	18.330	6.00	1.86	-549.63	187.40
7	0.000	6.00	3.00	-549.63	299.84
	0.500	6.00	3.00	-549.63	299.84
	0.995	6.00	3.00	-549.63	299.84
	4.081	3.00	3.00	-289.70	299.84
	4.507	3.00	3.00	-289.70	299.84
	4.572	2.94	3.00	-283.87	299.84
	7.593	0.00	5.03	0.00	497.07
	8.149	0.00	5.40	0.00	532.88
	8.928	0.00	5.40	0.00	532.88
	12.540	0.00	5.40	0.00	532.88
	16.152	0.00	5.40	0.00	532.88
	21.696	0.00	5.40	0.00	532.88
	22.696	0.93	5.40	-93.52	532.88
	22.910	0.93	5.40	-93.52	532.88
	23.910	1.24	5.40	-124.05	532.88
	24.580	1.24	5.40	-124.05	532.88
	25.080	1.24	5.40	-124.05	532.88
8	0.000	1.24	0.00	-124.05	0.00
	0.500	1.24	0.00	-124.05	0.00
	1.391	1.24	0.00	-124.05	0.00
	1.522	1.20	0.00	-120.06	0.00
	1.710	1.14	0.00	-114.33	0.00
	2.391	0.93	0.00	-93.52	0.00
	2.398	0.93	0.00	-93.52	0.00
	3.420	0.93	0.00	-93.52	0.00

Longitudinal Beam Shear Reinforcement Required

Units: d (in), Start, End, Xu (ft), PhiVc, Vu (kip), Av/s (in^2/in)

Span	d	PhiVc	Start	End	Vu	Xu	Av/s
1	22.69	51.66	0.000	1.330	0.00	0.000	0.0000
2	22.69	51.66	0.750	4.719	47.21	2.391	0.0200
			4.719	7.047	31.04	4.719	0.0200
			7.047	9.376	14.87	7.047	0.0000
			9.376	11.704	18.41	11.704	0.0000
			11.704	14.033	34.59	14.033	0.0200
			14.033	16.361	50.76	16.361	0.0200
			16.361	20.330	66.93	18.689	0.0200
3	22.69	51.66	0.750	8.080	39.53	2.391	0.0200

4	22.56	51.37	0.750	4.562	36.57	2.380	0.0200
			4.562	6.744	21.41	4.562	0.0000
			6.744	8.926	13.15	8.926	0.0000
			8.926	11.108	28.31	11.108	0.0200
			11.108	14.920	43.47	13.290	0.0200
5	22.56	51.37	0.750	4.848	37.18	2.380	0.0200
			4.848	7.315	20.04	4.848	0.0000
			7.315	9.782	23.45	9.782	0.0000
			9.782	13.880	40.59	12.250	0.0200
6	22.56	51.37	0.750	4.642	59.95	2.380	0.0200
			4.642	6.903	35.29	4.642	0.0200
			6.903	9.165	25.41	9.165	0.0000
			9.165	11.427	48.34	11.427	0.0200
			11.427	13.688	71.21	13.688	0.0200
			13.688	17.580	93.92	15.950	0.0419
7	22.56	51.37	0.750	5.283	120.81	2.380	0.0684
			5.283	8.186	91.78	5.283	0.0398
			8.186	11.089	62.76	8.186	0.0200
			11.089	13.991	33.74	11.089	0.0200
			13.991	16.894	27.41	16.894	0.0200
			16.894	19.797	56.43	19.797	0.0200
			19.797	24.330	85.45	22.700	0.0336
8	22.69	51.66	0.750	3.420	10.29	2.391	0.0000

Longitudinal Beam Shear Reinforcement Details

Units: spacing & distance (in).

Span	Size Stirrups (2 legs each unless otherwise noted)
1	#5 --- None ---
2	#3 8 @ 10.1 + <-- 55.9 --> + 10 @ 10.9
3	#3 9 @ 11.0
4	#3 5 @ 10.2 + <-- 52.4 --> + 8 @ 9.6
5	#3 5 @ 10.9 + <-- 59.2 --> + 5 @ 10.9
6	#3 8 @ 9.8 + <-- 27.1 --> + 5 @ 10.9 + 7 @ 7.2 [3L]
7	#3 12 @ 4.7 [3L] + 5 @ 7.0 [3L] + 13 @ 10.7 + 9 @ 6.4
8	#5 --- None ---

Beam Shear Capacity

Units: d, Sp (in), Start, End, Xu (ft), PhiVc, PhiVn, Vu (kip), Av/s (in^2/in)

Span	d	PhiVc	Start	End	Av/s	Sp	PhiVn	Vu	Xu
1	22.69	51.66	0.000	2.080	-----	-----	25.83	0.00	0.000
2	22.69	51.66	0.000	0.750	-----	-----	73.95	47.21	2.391
			0.750	7.047	0.0218	10.1	73.95	47.21	2.391
			7.047	11.704	-----	-----	25.83	18.41	11.704
			11.704	20.330	0.0202	10.9	72.27	66.93	18.689
			20.330	21.080	-----	-----	72.27	66.93	18.689
3	22.69	51.66	0.000	0.750	-----	-----	72.08	39.53	2.391
			0.750	8.080	0.0200	11.0	72.08	39.53	2.391
			8.080	8.830	-----	-----	72.08	18.02	6.439
4	22.56	51.37	0.000	0.750	-----	-----	73.34	36.57	2.380
			0.750	4.562	0.0216	10.2	73.34	36.57	2.380
			4.562	8.926	-----	-----	25.69	21.41	4.562
			8.926	14.920	0.0229	9.6	74.66	43.47	13.290
			14.920	15.670	-----	-----	74.66	43.47	13.290
5	22.56	51.37	0.000	0.750	-----	-----	71.81	37.18	2.380
			0.750	4.848	0.0201	10.9	71.81	37.18	2.380
			4.848	9.782	-----	-----	25.69	23.45	9.782
			9.782	13.880	0.0201	10.9	71.81	40.59	12.250
			13.880	14.630	-----	-----	71.81	40.59	12.250
6	22.56	51.37	0.000	0.750	-----	-----	74.06	59.95	2.380
			0.750	6.903	0.0223	9.8	74.06	59.95	2.380
			6.903	9.165	-----	-----	25.69	25.41	9.165
			9.165	13.688	0.0203	10.9	71.95	71.21	13.688
			13.688	17.580	0.0459	7.2	98.00	93.92	15.950
			17.580	18.330	-----	-----	98.00	93.92	15.950
7	22.56	51.37	0.000	0.750	-----	-----	122.21	120.81	2.380
			0.750	5.283	0.0698	4.7	122.21	120.81	2.380
			5.283	8.186	0.0474	7.0	99.46	91.78	5.283
			8.186	19.797	0.0205	10.7	72.21	62.76	8.186
			19.797	24.330	0.0344	6.4	86.28	85.45	22.700
			24.330	25.080	-----	-----	86.28	85.45	22.700
8	22.69	51.66	0.000	3.420	-----	-----	25.83	10.29	2.391

Slab Shear Capacity
==========
Units: b, d (in), Xu (ft), PhiVc, Vu(kip)

Span	b	d	Vratio	PhiVc	Vu	Xu
1	--- Not checked ---					
2	--- Not checked ---					
3	--- Not checked ---					
4	--- Not checked ---					
5	--- Not checked ---					
6	--- Not checked ---					
7	--- Not checked ---					
8	--- Not checked ---					

Deflections
==========
Section properties

Units: Ig, Icr, Ie (in^4), Mcr, Mmax (k-ft)

	Ie,avg						Load Level			
							Dead		Dead+Live	
Span	Dead	Dead+Live	Zone	Ig	Icr	Mcr	Mmax	Ie	Mmax	Ie
1	29412	29412	Right	29412	2931	94.91	-6.96	29412	-11.40	29412
2	37649	18083	Left	29412	2931	94.91	-21.64	29412	-35.41	29412
			Midspan	43290	8671	117.53	113.53	43290	185.74	17443
			Right	29412	6861	94.91	-114.92	19562	-188.40	9744
3	29165	27346	Left	29412	6861	94.91	-107.11	22548	-175.65	10418
			Midspan	30531	30531	97.04	0.00	30531	0.00	30531
			Right	29412	5381	94.91	-27.07	29412	-42.79	29412
4	35697	34295	Left	29412	5381	94.91	-31.38	29412	-49.72	29412
			Midspan	38391	5849	110.39	51.31	38391	82.47	38391
			Right	29412	5171	94.91	-65.01	29412	-111.64	20065
5	34956	32138	Left	29412	5171	94.91	-62.78	29412	-108.53	21384
			Midspan	37331	4029	108.73	12.87	37331	28.04	37331
			Right	29412	6596	94.91	-84.35	29412	-117.37	18659
6	35165	33357	Left	29412	6596	94.91	-87.86	29412	-121.01	17603
			Midspan	40920	5943	114.17	82.86	40920	105.59	40920
			Right	29412	13670	94.91	-324.48	14064	-447.09	13821
7	19644	18025	Left	29412	13670	94.91	-337.77	14020	-466.31	13803
			Midspan	46364	15609	121.64	260.05	18756	364.16	16755
			Right	29412	3784	94.91	-69.01	29412	-96.49	28173
8	29412	29412	Left	29412	3784	94.91	-33.73	29412	-47.01	29412

Maximum Instantaneous Deflections

Units: D (in)

Span	Ddead	Dlive	Dtotal
1	-0.017	-0.029	-0.046
2	0.052	0.092	0.145
3	-0.007	-0.007	-0.013
4	0.013	0.009	0.022
5	-0.002	0.003	0.002
6	-0.012	-0.007	-0.019
7	0.264	0.132	0.396
8	-0.112	-0.055	-0.166

Maximum Long-term Deflections

Time dependant factor for sustained loads = 2.000
Units: D (in)

Span	Dsust	Lambda	Dcs	Dcs+lu	Dcs+l	Dtotal
1	-0.017	2.000	-0.033	-0.062	-0.062	-0.079
2	0.052	2.000	0.104	0.197	0.197	0.249
3	-0.007	2.000	-0.013	-0.020	-0.020	-0.026
4	0.013	2.000	0.026	0.035	0.035	0.048
5	-0.000	2.000	-0.000	0.002	0.002	0.002
6	-0.012	2.000	-0.024	-0.031	-0.031	-0.043
7	0.264	2.000	0.528	0.660	0.660	0.924
8	-0.112	2.000	-0.223	-0.278	-0.278	-0.389

Material Takeoff
==========
Reinforcement in the Direction of Analysis

Top Bars:	615.9 lb	<=>	5.64 lb/ft	<=>	0.263 lb/ft^2
Bottom Bars:	877.8 lb	<=>	8.04 lb/ft	<=>	0.375 lb/ft^2
Stirrups:	322.3 lb	<=>	2.95 lb/ft	<=>	0.138 lb/ft^2
Total Steel:	1816.0 lb	<=>	16.64 lb/ft	<=>	0.776 lb/ft^2
Concrete:	1241.4 ft^3	<=>	11.38 ft^3/ft	<=>	0.530 ft^3/ft^2

Appendix A.5: Assumed Column Loads From Above

Column Line 2 Loading From Above to Apply to Cantilevered Beam

COLUMN LOADING FROM ABOVE

Frame 2

		Live Load				Dead Load							Exterior Wall Load				
	Location	Live Load (psf)	Live Load (ksf)	Area (sf)	Point LL (kip)	Misc Dead Load (psf)	Misc Dead Load (ksf)	Area (sf)	Misc Point DL (kip)	Pan Joist Pt DL (kip)	Girder Pt DL (kip)	Column Pt DL (kip)	Dead Load (psf)	Dead Load (ksf)	Height (ft)	Width (ft)	Point DL (kip)
Roof	1D	35	0.035	335.6	11.8	31.0	0.031	335.6	10.5	14.0	4.6	0.0	28	0.028	9.5	14.8	4.0
	1F	35	0.035	490.4	17.2	31.0	0.031	490.4	15.3	20.5	7.3	0.0	28	0.028	9.5	6.2	1.7
													14	0.014	9.5	17.7	2.4
	1L	35	0.035	524	18.4	31.0	0.031	524.0	16.3	21.9	8.0	0.0	14	0.014	9.5	25.8	3.5
Level 3	1D	80	0.080	286.7	23.0	21.0	0.021	286.7	6.1	12.0	4.5	2.8	28	0.028	16.3	14.5	6.6
	1F	80	0.080	348.3	27.9	21.0	0.021	348.3	7.4	14.6	6.2	2.8	28	0.028	16.3	6.3	2.9
													14	0.014	16.3	13.8	3.2
	1L	80	0.080	346	27.7	21.0	0.021	346.0	7.3	14.5	6.8	2.8	14	0.014	16.3	22.0	5.1
Level 2	1D	80	0.080	271.1	21.7	21.0	0.021	271.1	5.7	11.4	4.2	2.8	28	0.028	13.3	13.8	5.2
	1F	80	0.080	348.8	28.0	21.0	0.021	348.8	7.4	14.6	6.2	2.8	28	0.028	13.3	6.0	2.3
													14	0.014	13.3	14.0	2.7
	1L	80	0.080	344.8	27.6	21.0	0.021	344.8	7.3	14.4	6.8	2.8	14	0.014	13.3	22.0	4.2
Level 1	2D	-	-	-	-	-	-	-	-	-	-	-	28	0.028	13.3	13.0	4.9
	2F	-	-	-	-	-	-	-	-	-	-	-	28	0.028	13.3	6.3	2.4
		-	-	-	-	-	-	-	-	-	-	-	14	0.014	13.3	14.0	2.7
	2L	-	-	-	-	-	-	-	-	-	-	-	14	0.014	13.3	21.8	4.1

Point Load to Apply to Cantilevered Beam			
	Point LL (kip)	Point DL (kip)	Point Snow (kip)
2D	44.7	99.3	11.8
2F	55.9	125.4	17.2
2L	55.3	125.8	18.4

Column Line 8 Loading From Above

COLUMN LOADING FROM ABOVE

Frame 8

	Location	Live Load (psf)	Live Load Live Load (ksf)	Area (sf)	Point LL (kip)	Dead Load Misc Dead Load (psf)	Misc Dead Load (ksf)	Area (sf)	Misc Point DL (kip)	Pan Joist Pt DL (kip)	Girder Pt DL (kip)	Column Pt DL (kip)	Exterior Wall Load Dead Load (psf)	Dead Load (ksf)	Height (ft)	Width (ft)	Point DL (kip)
Roof	8D	35	0.035	436.1	15.3	31.0	0.031	436.1	13.6	18.2	13.6	0.0	14	0.014	9.5	24.2	3.3
	8G	35	0.035	611.7	21.5	31.0	0.031	611.7	19.0	25.6	18.0	0.0	0	0	9.5	0.0	0.0
	8M	35	0.035	657.5	23.1	31.0	0.031	657.5	20.4	27.5	17.1	0.0	14	0.014	9.5	29.8	4.0
Level 3	8D	80	0.080	284.3	22.8	21.0	0.021	284.3	6.0	11.9	9.2	2.8	14	0.014	16.3	23.8	5.5
	8G	80	0.080	611.7	49.0	21.0	0.021	611.7	12.9	25.6	18.0	2.8	0	0	16.3	0.0	0.0
	8M	80	0.080	417.8	33.5	21.0	0.021	417.8	8.8	17.5	10.8	2.8	14	0.014	8.1	29.8	3.4
		91	0.091	261.2	23.8	99.0	0.099	261.2	25.9	10.9	7.5	2.8					
	8P	35	0.035	323.5	11.4	99.0	0.099	323.5	32.1	13.5	8.7	2.8	14	0.014	16.3	28.8	6.6
Level 2	8D	80	0.080	284.3	22.8	21.0	0.021	284.3	6.0	11.9	9.2	2.8	14	0.014	13.3	23.8	4.5
	8G	80	0.080	611.7	49.0	21.0	0.021	611.7	12.9	25.6	18.2	2.8	0	0	13.3	0.0	0.0
	8M	80	0.080	679.1	54.4	21.0	0.021	679.1	14.3	28.4	18.2	2.8	0	0	13.3	0.0	0.0
	8P	80	0.080	276.2	22.1	21.0	0.021	276.2	5.9	11.6	7.5	2.8	14	0.014	13.3	28.8	5.4
Level 1	8Z	-	-	-	-	-	-	-	-	-	-	-	14	0.014	13.3	20.7	3.9
	8D	-	-	-	-	-	-	-	-	-	-	-	0	0	13.3	0.0	0.0
	8G	-	-	-	-	-	-	-	-	-	-	-	0	0	13.3	0.0	0.0
	8M	-	-	-	-	-	-	-	-	-	-	-	0	0	13.3	0.0	0.0
	8P	-	-	-	-	-	-	-	-	-	-	-	14	0.014	13.3	28.8	5.4

Column Line 13 Loading From Above

COLUMN LOADING FROM ABOVE

Frame 13

	Location	Live Load (psf)	Live Load Live Load (ksf)	Area (sf)	Point LL (kip)	Dead Load Misc Dead Load (psf)	Misc Dead Load (ksf)	Area (sf)	Misc Point DL (kip)	Pan Joist Pt DL (kip)	Girder Pt DL (kip)	Column Pt DL (kip)	Exterior Wall Load Dead Load (psf)	Dead Load (ksf)	Height (ft)	Width (ft)	Point DL (kip)
Roof	13C	35	0.035	288.5	10.1	31.0	0.031	288.5	9.0	12.1	12.6	0.0	28	0.028	9.5	34.8	9.3
	13E	35	0.035	207.6	7.3	31.0	0.031	207.6	6.5	8.7	9.3	0.0	28	0.028	9.5	15.0	4.0
	13H	35	0.035	163.1	5.8	31.0	0.031	163.1	5.1	6.9	7.6	0.0	28	0.028	9.5	12.3	3.3
	13K	35	0.035	194.1	6.8	31.0	0.031	194.1	6.1	8.1	9.2	0.0	28	0.028	9.5	15.0	4.0
	13N	35	0.035	208.5	7.3	31.0	0.031	208.5	6.5	8.7	10.3	0.0	28	0.028	9.5	16.7	4.5
													14	0.014	9.5	12.3	1.7
Level 3	13C	80	0.080	146.7	11.8	21.0	0.021	146.7	3.1	6.2	7.9	2.8	28	0.028	16.3	25.0	11.4
	13E	80	0.080	153.2	12.3	21.0	0.021	153.2	3.3	6.4	9.3	2.8	28	0.028	16.3	15.0	6.9
	13H	80	0.080	124.1	10.0	21.0	0.021	124.1	2.7	5.2	7.6	2.8	28	0.028	16.3	12.3	5.6
	13K	80	0.080	151.5	12.2	21.0	0.021	151.5	3.2	6.4	9.2	2.8	28	0.028	16.3	15.0	6.9
	13N	80	0.080	152.9	12.3	21.0	0.021	152.9	3.3	6.4	9.3	2.8	28	0.028	16.3	15.0	6.9
													14	0.014	16.3	10.0	2.3
Level 2	13C	80	0.080	148.5	11.9	21.0	0.021	148.5	3.2	6.2	8.3	2.8	28	0.028	13.3	25.0	9.4
	13E	80	0.080	167.9	13.5	21.0	0.021	167.9	3.6	7.1	9.3	2.8	28	0.028	13.3	15.0	5.6
	13H	80	0.080	170.9	13.7	21.0	0.021	170.9	3.6	7.2	7.6	2.8	28	0.028	13.3	20.3	7.6
	13K	80	0.080	202.1	16.2	21.0	0.021	202.1	4.3	8.5	9.2	2.8	28	0.028	13.3	22.8	8.5
	13N	80	0.080	156.3	12.6	21.0	0.021	156.3	3.3	6.6	8.6	2.8	28	0.028	13.3	14.0	5.3
													14	0.014	13.3	11.3	2.1
Level 1	13A.2	-	-	-	-	-	-	-	-	-	-	-	28	0.028	6.7	22.8	4.3
	13B	-	-	-	-	-	-	-	-	-	-	-	0	0	6.7	0.0	0.0
	13C	-	-	-	-	-	-	-	-	-	-	-	0	0	6.7	0.0	0.0
	13E	-	-	-	-	-	-	-	-	-	-	-	0	0	6.7	0.0	0.0
	13H	-	-	-	-	-	-	-	-	-	-	-	0	0	6.7	0.0	0.0
	13K	-	-	-	-	-	-	-	-	-	-	-	0	0	6.7	0.0	0.0
	13N	-	-	-	-	-	-	-	-	-	-	-	0	0	6.7	0.0	0.0

Appendix A.6: spBeam Output

Column Line D Beam

spBeam v3.60 © StructurePoint   02-05-2014, 03:04:26 PM
Licensed to: Penn State University Park, License ID: 59919-1033950-4-22545-2CF68
E:\SPRING\Gravity\Beam Design\Beam along Column line D - updated.slb   Page 1

```
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 ooooo    oooooo    oo   oo    ooooo     ooooo    o oooooooooo
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 ooooo    oo        ooooooo    ooooo     ooooo o   oo   oo   oo   (TM)
```

spBeam v3.60 (TM)
A Computer Program for Analysis, Design, and Investigation of
Reinforced Concrete Beams and One-way Slab Systems

[2] DESIGN RESULTS

Top Reinforcement

Units: Width (ft), Mmax (k-ft), Xmax (ft), As (in^2), Sp (in)

Span	Zone	Width	Mmax	Xmax	AsPrime	AsMin	AsMax	AsReq	SpProv	Bars
1	Left	2.67	434.11	2.188	0.000	2.400	13.005	4.540	2.024	19-#8
	Midspan	2.67	812.71	4.063	0.000	2.400	13.005	9.025	2.024	19-#8
	Right	2.67	1261.98	6.250	2.295	2.344	12.701	14.996	2.024	19-#8 2L
2	Left	3.33	1178.08	0.500	0.772	2.400	13.005	13.777	2.012	19-#8 2L
	Midspan	3.33	547.39	11.788	0.000	2.400	13.005	5.822	4.887	8-#8
	Right	3.33	180.00	21.463	0.000	2.400	13.005	1.818	10.760	15-#8 *3
3	Left	13.45	0.03	0.500	0.000	1.307	7.288	0.003	10.760	15-#8 *3 *5
	Midspan	13.45	0.02	0.588	0.000	1.307	7.288	0.001	10.760	15-#8 *3 *5
	Right	13.45	0.01	0.662	0.000	1.307	7.288	0.001	10.760	15-#8 *3 *5

NOTES:
*3 - Design governed by minimum reinforcement.
*5 - Number of bars governed by maximum allowable spacing.

Top Bar Details

Units: Length (ft)

	Left				Continuous		Right			
Span	Bars	Length	Bars	Length	Bars	Length	Bars	Length	Bars	Length
1	---		---		19-#8	6.75	---		---	
2	6-#8	13.20	5-#8	6.12	8-#8	33.25	7-#8	2.52	---	
3	---		---		15-#8	0.75	---		---	

Bottom Reinforcement

Units: Width (ft), Mmax (k-ft), Xmax (ft), As (in^2), Sp (in)

Span	Width	Mmax	Xmax	AsPrime	AsMin	AsMax	AsReq	SpProv	Bars
1	2.67	0.00	3.125	0.000	2.420	13.113	2.295	3.797	8-#5 *3
2	2.67	46.58	32.750	0.000	1.026	30.390	0.772	8.859	4-#5 *3
3	13.45	0.00	0.625	0.000	0.000	7.835	0.000	0.000	---

NOTES:
*3 - Design governed by minimum reinforcement.

Bottom Bar Details

Units: Start (ft), Length (ft)

	Long Bars			Short Bars		
Span	Bars	Start	Length	Bars	Start	Length

1	8-#5	0.00	6.75	---
2	4-#5	0.00	33.25	---
3	---			---

Flexural Capacity

Units: x (ft), As (in^2), PhiMn (k-ft)

Span	x	AsTop	AsBot	PhiMn-	PhiMn+
1	0.000	15.01	2.48	-1265.93	279.75
	2.188	15.01	2.48	-1265.93	279.75
	3.375	15.01	2.48	-1265.93	279.75
	4.063	15.01	2.48	-1265.93	279.75
	6.250	15.01	2.48	-1265.93	279.75
	6.750	15.01	2.48	-1265.93	279.75
2	0.000	15.01	1.24	-1207.53	167.88
	0.500	15.01	1.24	-1207.53	167.88
	0.747	15.01	1.24	-1207.53	167.88
	6.125	11.06	1.24	-988.91	159.11
	7.827	11.06	1.24	-988.91	159.11
	11.788	7.57	1.24	-704.41	157.11
	13.205	6.32	1.24	-595.65	156.03
	16.625	6.32	1.24	-595.65	156.03
	21.463	6.32	1.24	-595.65	156.03
	30.735	6.32	1.24	-595.65	156.03
	31.735	11.85	1.24	-1048.74	159.44
	32.750	11.85	1.24	-1048.74	159.44
	33.250	11.85	1.24	-1048.74	159.44
3	0.000	11.85	0.00	-70.23	0.00
	0.375	11.85	0.00	-70.23	0.00
	0.500	11.85	0.00	-70.23	0.00
	0.588	11.85	0.00	-70.23	0.00
	0.662	11.85	0.00	-70.23	0.00
	0.750	11.85	0.00	-70.23	0.00

Longitudinal Beam Shear Reinforcement Required

Units: d (in), Start, End, Xu (ft), PhiVc, Vu (kip), Av/s (in^2/in)

Span	d	PhiVc	Start	End	Vu	Xu	Av/s
1	21.97	66.71	0.000	2.209	200.35	2.209	0.1352
			2.209	6.000	204.13	4.419	0.1390
2	21.97	66.71	0.750	6.415	62.39	2.331	0.0267
			6.415	10.499	55.41	6.415	0.0267
			10.499	14.583	48.44	10.499	0.0267
			14.583	18.667	41.46	14.583	0.0267
			18.667	22.751	34.49	18.667	0.0267
			22.751	26.835	27.51	22.751	0.0000
			26.835	32.500	20.54	26.835	0.0000

3 --- No beam ---

Longitudinal Beam Shear Reinforcement Details

Units: spacing & distance (in).

Span	Size Stirrups (2 legs each unless otherwise noted)
1	#3 8 @ 3.1 [4L] + 15 @ 3.1 [4L]
2	#3 34 @ 7.9 + <-- 117.0 -->
3	--- No beam ---

Beam Shear Capacity

Units: d, Sp (in), Start, End, Xu (ft), PhiVc, PhiVn, Vu (kip), Av/s (in^2/in)

Span	d	PhiVc	Start	End	Av/s	Sp	PhiVn	Vu	Xu
1	21.97	66.71	0.000	0.250	-----	-----	205.48	197.01	0.250
			0.250	2.209	0.1403	3.1	205.48	200.35	2.209
			2.209	6.000	0.1403	3.1	205.40	204.13	4.419
			6.000	6.750	-----	-----	205.40	204.13	4.419
2	21.97	66.71	0.000	0.750	-----	-----	94.31	62.39	2.331
			0.750	22.751	0.0279	7.9	94.31	62.39	2.331
			22.751	30.919	-----	-----	33.35	27.51	22.751
			30.919	32.500	-----	-----	33.35	13.56	30.919
			32.500	33.250	-----	-----	33.35	13.56	30.919

3 --- No beam ---

Slab Shear Capacity

Units: b, d (in), Xu (ft), PhiVc, Vu(kip)

Span	b	d	Vratio	PhiVc	Vu	Xu

```
      1 --- Not checked ---
      2 --- Not checked ---
      3   161.40     2.50    1.000        38.28         0.04         0.71

Deflections
===========
   Section properties
   ------------------
   Units: Ig, Icr, Ie (in^4), Mcr, Mmax (k-ft)                                  _______________Load Level_______________
          ________Ie,avg_________                                               ________Dead_______ ______Dead+Live_____
   Span         Dead    Dead+Live Zone              Ig          Icr      Mcr      Mmax          Ie      Mmax          Ie
   ---- ----------- ----------- ------- ----------- ----------- ------- -------- ----------- -------- -----------
      1       27765       27735 Right          39216       27717  126.54  -782.35       27765 -1084.07       27735
      2       53344       53338 Left           39216       28498  126.54  -701.74       28561  -962.45       28523
                                Midspan        61682        4280  162.01    22.71       61682    39.71       61682
                                Right          39216        3993  126.54    21.43       39216    39.71       39216
      3        1226        1226 Left            1226         244   21.53    -0.21        1226    -0.21        1226

   Maximum Instantaneous Deflections
   ---------------------------------
   Units:  D (in)
   Span    Ddead    Dlive   Dtotal
   ---- -------- -------- --------
      1    0.482    0.224    0.707
      2   -0.222   -0.142   -0.363
      3    0.009    0.008    0.016

   Maximum Long-term Deflections
   -----------------------------
   Time dependant factor for sustained loads = 2.000
   Units:  D (in)
   Span    Dsust Lambda      Dcs   Dcs+lu    Dcs+l   Dtotal
   ---- -------- ------ -------- -------- -------- --------
      1    0.482  1.708    0.824    1.048    1.048    1.531
      2   -0.220  1.753   -0.386   -0.529   -0.529   -0.749
      3    0.009  2.000    0.018    0.025    0.025    0.034

Material Takeoff
================
   Reinforcement in the Direction of Analysis
   ------------------------------------------
   Top Bars:      1423.0 lb    <=>  34.92 lb/ft    <=>  2.596 lb/ft^2
   Bottom Bars:    195.0 lb    <=>   4.79 lb/ft    <=>  0.356 lb/ft^2
   Stirrups:       253.2 lb    <=>   6.21 lb/ft    <=>  0.462 lb/ft^2
   Total Steel:   1871.2 lb    <=>  45.92 lb/ft    <=>  3.414 lb/ft^2
   Concrete:       383.3 ft^3  <=>   9.41 ft^3/ft  <=>  0.699 ft^3/ft^2
```

Appendix A.7: Load to Apply to Level 1 Columns

Column Line 2 Column Loads

Breakdown of Loads to Apply to Columns														
	Due to:													
	Beam D						Girder 2							
Column	Axial Load (kip)			Moment @ Top (k-ft)			Axial Load (kip)				Moment @ Top (k-ft)			
	Live Load	Dead Load	Snow Load	Live Load	Dead Load	Snow Load	LL Case 1	LL Case 2	Dead Load	Snow Load	LL Case 1	LL Case 2	Dead Load	Snow Load
2D	53.09	152.1	14.01	17.58	29.9	4.64	36.58	12.97	36.28	0	-1.19	-6.92	-5.43	0
2F	53.09	152.1	14.01	17.58	29.9	4.64	61.37	39.02	66.99	0	6.12	8.93	7.91	0
2L	53.09	152.1	14.01	17.58	29.9	4.64	46.32	27.92	60.36	0	-8.35	-14.3	-10.38	0

*NOTE: The loads due the Beam D account for the column loadings from the upper floors.

*NOTE: Positive axial forces denote compression.

*NOTE: Positive moments denote that the left hand face of the upper column is in tension and the right hand face of the bottom column is in tension.

Loads to Apply to Columns												
Column	Axial Load (kip)				Moment X-dirn @ Top (k-ft)				Moment Y-dirn @ Top (k-ft)			
	LL Case 1	LL Case 2	Dead Load	Snow Load	LL Case 1	LL Case 2	Dead Load	Snow Load	LL Case 1	LL Case 2	Dead Load	Snow Load
2D	89.67	66.06	188.38	14.01	17.58	17.58	29.90	4.64	-1.19	-6.92	-5.43	0.00
2F	114.46	92.11	219.09	14.01	17.58	17.58	29.90	4.64	6.12	8.93	7.91	0.00
2L	99.41	81.01	212.46	14.01	17.58	17.58	29.90	4.64	-8.35	-14.30	-10.38	0.00

Column Line 8 Column Loads

Breakdown of Loads to Apply to Columns											
	Due to:										
	Floors Above			Girder 8							
Column	Axial Load (kip)			Axial Load (kip)				Moment @ Top (k-ft)			
	Live Load	Dead Load	Snow Load	LL Case 1	LL Case 2	Dead Load	Snow Load	LL Case 1	LL Case 2	Dead Load	Snow Load
8Z	0.00	3.90	0.00	38.36	37.10	84.93	14.72	16.15	16.98	35.40	6.87
8D	45.60	118.50	15.30	85.84	51.62	160.21	36.46	-6.58	-10.91	-18.89	-4.54
8G	98.00	181.40	21.50	77.12	34.67	68.22	-7.84	3.42	8.35	9.39	1.28
8M	87.90	223.10	46.90	82.29	50.49	117.37	1.38	-2.69	-6.69	-4.39	-0.31
8P	22.10	102.30	11.40	30.68	26.22	33.30	-0.33	-4.66	-5.09	-2.40	0.14

*NOTE: Positive axial forces denote compression.

*NOTE: Positive moments denote that the left hand face of the upper column is in tension and the right hand face of the bottom column is in tension.

Loads to Apply to Columns								
Column	Axial Load (kip)				Moment @ Top (k-ft)			
	LL Case 1	LL Case 2	Dead Load	Snow Load	LL Case 1	LL Case 2	Dead Load	Snow Load
8Z	38.36	37.10	88.83	14.72	16.15	16.98	35.40	6.87
8D	131.44	97.22	278.71	51.76	-6.58	-10.91	-18.89	-4.54
8G	175.12	132.67	249.62	13.66	3.42	8.35	9.39	1.28
8M	170.19	138.39	340.47	48.28	-2.69	-6.69	-4.39	-0.31
8P	52.78	48.32	135.60	11.07	-4.66	-5.09	-2.40	0.14

Column Line 13 Column Loads

Breakdown of Loads to Apply to Columns											
	Due to:										
	Floors Above			Girder 13							
Column	Axial Load (kip)			Axial Load (kip)				Moment @ Top (k-ft)			
	Live Load	Dead Load	Snow Load	LL Case 1	LL Case 2	Dead Load	Snow Load	LL Case 1	LL Case 2	Dead Load	Snow Load
13A.2	0.00	4.30	0.00	33.42	25.23	70.45	10.89	6.94	7.76	13.26	1.86
13B	0.00	0.00	0.00	60.11	36.91	128.26	24.47	-2.50	-4.91	-5.42	-0.28
13C	23.70	104.30	10.10	41.25	22.40	55.57	19.29	-0.80	-2.20	-0.66	-0.85
13E	25.80	85.60	7.30	34.87	14.83	46.92	2.51	0.10	1.72	0.69	0.27
13H	23.70	75.60	5.80	30.06	10.84	25.25	2.97	-0.64	-1.74	-1.65	-0.20
13K	28.40	89.20	6.80	43.35	29.51	56.44	5.18	1.89	2.60	3.05	0.30
13N	24.90	91.40	7.30	23.11	18.89	33.03	3.16	-4.04	-4.41	-5.74	-0.55

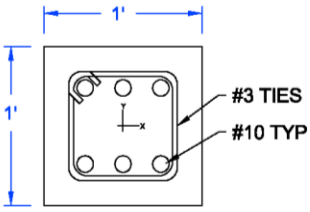
*NOTE: Positive axial forces denote compression.

*NOTE: Positive moments denote that the left hand face of the upper column is in tension and the right hand face of the bottom column is in tension.

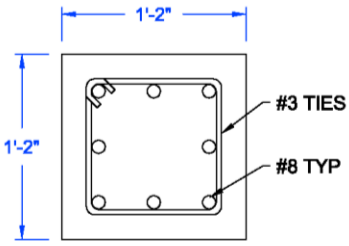
Loads to Apply to Columns								
Column	Axial Load (kip)				Moment @ Top (k-ft)			
	LL Case 1	LL Case 2	Dead Load	Snow Load	LL Case 1	LL Case 2	Dead Load	Snow Load
13A.2	33.42	25.23	74.75	10.89	6.94	7.76	13.26	1.86
13B	60.11	36.91	128.26	24.47	-2.50	-4.91	-5.42	-0.28
13C	64.95	46.10	159.87	29.39	-0.80	-2.20	-0.66	-0.85
13E	60.67	40.63	132.52	9.81	0.10	1.72	0.69	0.27
13H	53.76	34.54	100.85	8.77	-0.64	-1.74	-1.65	-0.20
13K	71.75	57.91	145.64	11.98	1.89	2.60	3.05	0.30
13N	48.01	43.79	124.43	10.46	-4.04	-4.41	-5.74	-0.55

Appendix A.8: Column Designs

Column Line 2 Columns



COLUMN 2D



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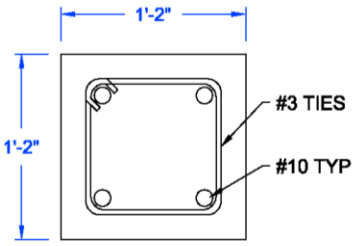
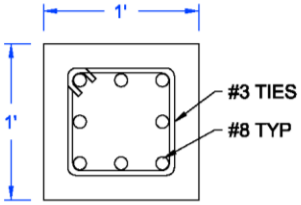


COLUMN 2L

Column Line 8 Columns



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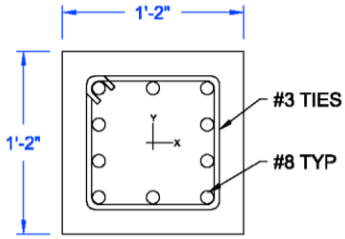
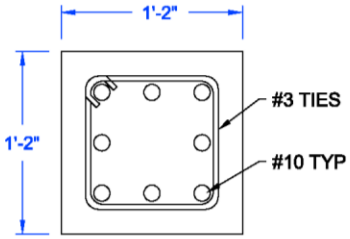
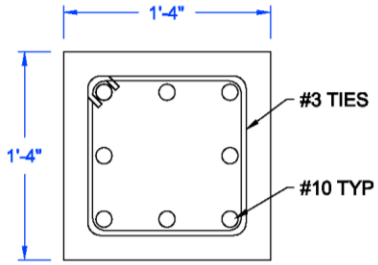


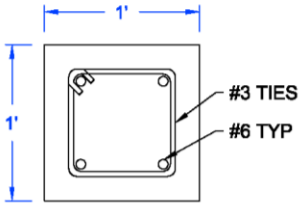
COLUMN 8D



COLUMN 8G

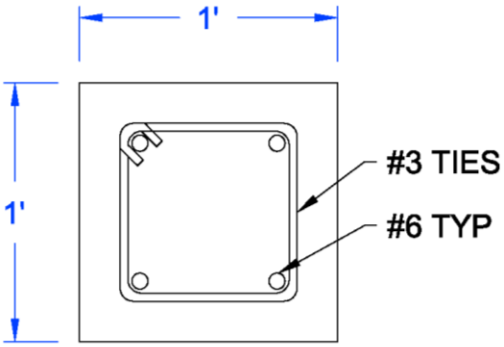


COLUMN 8M

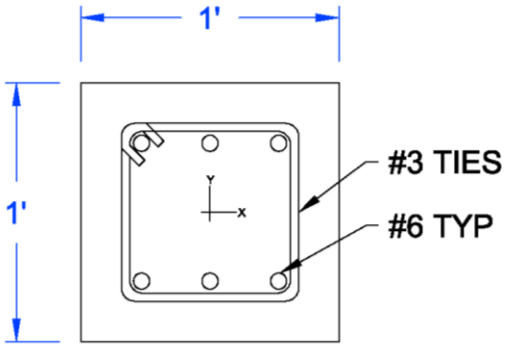


COLUMN 8P

Column Line 13 Columns



COLUMN 13A.2
COLUMN 13B
COLUMN 13E
COLUMN 13H
COLUMN 13K
COLUMN 13N

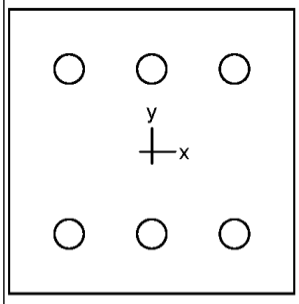


COLUMN 13C

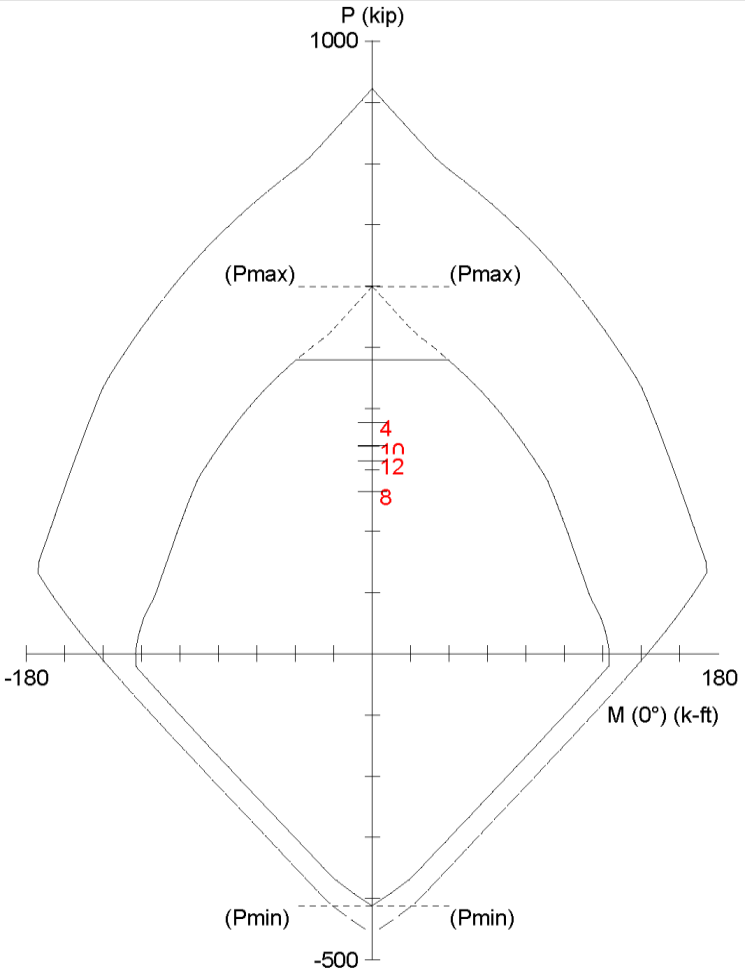
Appendix A.9: spColumn Output

Column Line 2 Columns

Column 2D



12 x 12 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/07/14

Time: 09:59:47

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

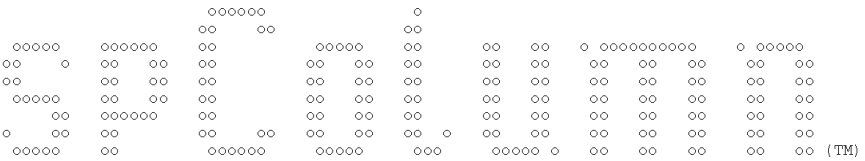
File: F:\SPRING\Gravity\Column Design\Frame 2\2D.col

Project: Gravity System

Column: 2D		Engineer: ahm	
f'c = 4 ksi	fy = 60 ksi	Ag = 144 in^2	6 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 7.62 in^2	rho = 5.29%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 1728 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 1728 in^4
Beta1 = 0.85		Min clear spacing = 2.22 in	Clear cover = 1.87 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



spColumn v4.81 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

General Information:
==========
File Name: F:\SPRING\Gravity\Column Design\Frame 2\2D.col
Project: Gravity System
Column: 2D Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 12 in Depth = 12 in

Gross section area, Ag = 144 in^2
Ix = 1728 in^4 Iy = 1728 in^4
rx = 3.4641 in ry = 3.4641 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 1.44 in^2, Asmax = 0.08 * Ag = 11.52 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area: As = 7.62 in^2 at rho = 5.29%
Minimum clear spacing = 2.22 in

6 #10 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	188.38	29.90	0.00	-5.43	0.00
	Live	89.67	17.58	0.00	-1.19	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	14.01	4.64	0.00	0.00	0.00
2	Dead	188.38	29.90	0.00	-5.43	0.00
	Live	66.06	17.58	0.00	-6.92	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	14.01	4.64	0.00	0.00	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow

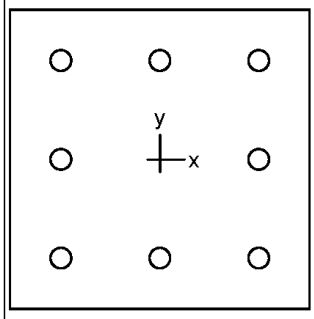
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

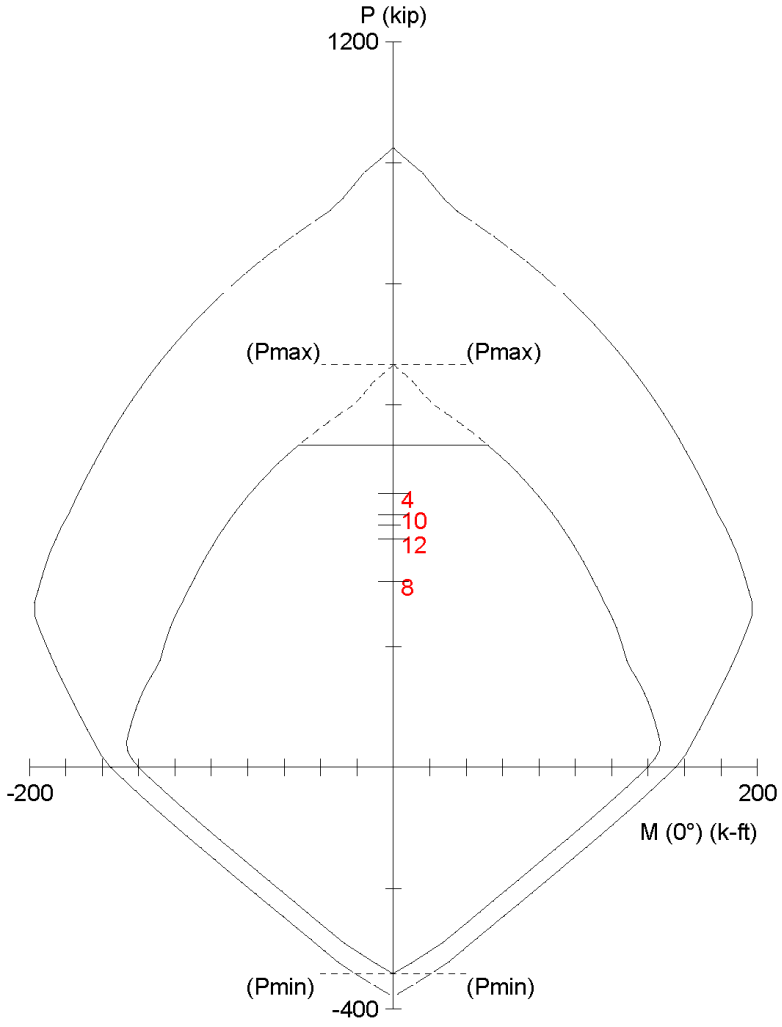
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	263.73	41.86	-7.60	81.01	-14.71	1.935	9.35	11.53	0.00070	0.650
2		263.73	0.00	0.00	93.36	0.00	999.999	7.75	9.49	0.00067	0.650
3	1 U2	376.53	66.33	-8.42	67.15	-8.52	1.012	11.17	11.04	-0.00003	0.650
4		376.53	0.00	0.00	70.45	0.00	999.999	10.00	9.49	-0.00015	0.650
5	1 U3	338.14	60.88	-7.71	74.02	-9.37	1.216	10.35	11.04	0.00020	0.650
6		338.14	0.00	0.00	79.44	0.00	999.999	9.14	9.49	0.00011	0.650
7	2 U1	263.73	41.86	-7.60	81.01	-14.71	1.935	9.35	11.53	0.00070	0.650
8		263.73	0.00	0.00	93.36	0.00	999.999	7.75	9.49	0.00067	0.650
9	2 U2	338.76	66.33	-17.59	67.24	-17.83	1.014	11.25	12.14	0.00024	0.650
10		338.76	0.00	0.00	79.30	0.00	999.999	9.16	9.49	0.00011	0.650
11	2 U3	314.53	60.88	-13.44	72.84	-16.08	1.196	10.51	11.83	0.00038	0.650
12		314.53	0.00	0.00	84.55	0.00	999.999	8.66	9.49	0.00029	0.650

*** End of output ***

Column 2F



14 x 14 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/07/14

Time: 10:07:38

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

File: F:\SPRING\Gravity\Column Design\Frame 2\2F.col

Project: Gravity System

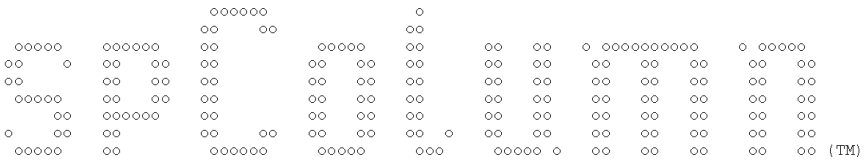
Column: 2F

Engineer: ahm

f'c = 4 ksi	fy = 60 ksi	Ag = 196 in^2	8 #8 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 6.32 in^2	rho = 3.22%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 3201.33 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 3201.33 in^4
Beta1 = 0.85		Min clear spacing = 3.62 in	Clear cover = 1.87 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



spColumn v4.81 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

General Information:
==========
File Name: F:\SPRING\Gravity\Column Design\Frame 2\2F.col
Project: Gravity System
Column: 2F Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 14 in Depth = 14 in

Gross section area, Ag = 196 in^2
Ix = 3201.33 in^4 Iy = 3201.33 in^4
rx = 4.04145 in ry = 4.04145 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 1.96 in^2, Asmax = 0.08 * Ag = 15.68 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area: As = 6.32 in^2 at rho = 3.22%
Minimum clear spacing = 3.62 in

8 #8 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	219.09	29.90	0.00	7.91	0.00
	Live	114.46	17.58	0.00	6.12	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	14.01	4.64	0.00	0.00	0.00
2	Dead	219.09	29.90	0.00	7.91	0.00
	Live	92.11	17.58	0.00	8.93	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	14.01	4.64	0.00	0.00	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow

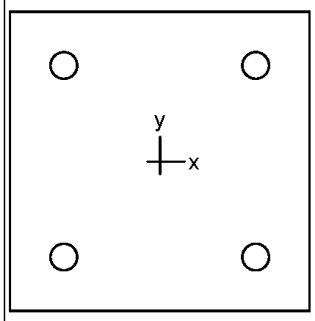
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

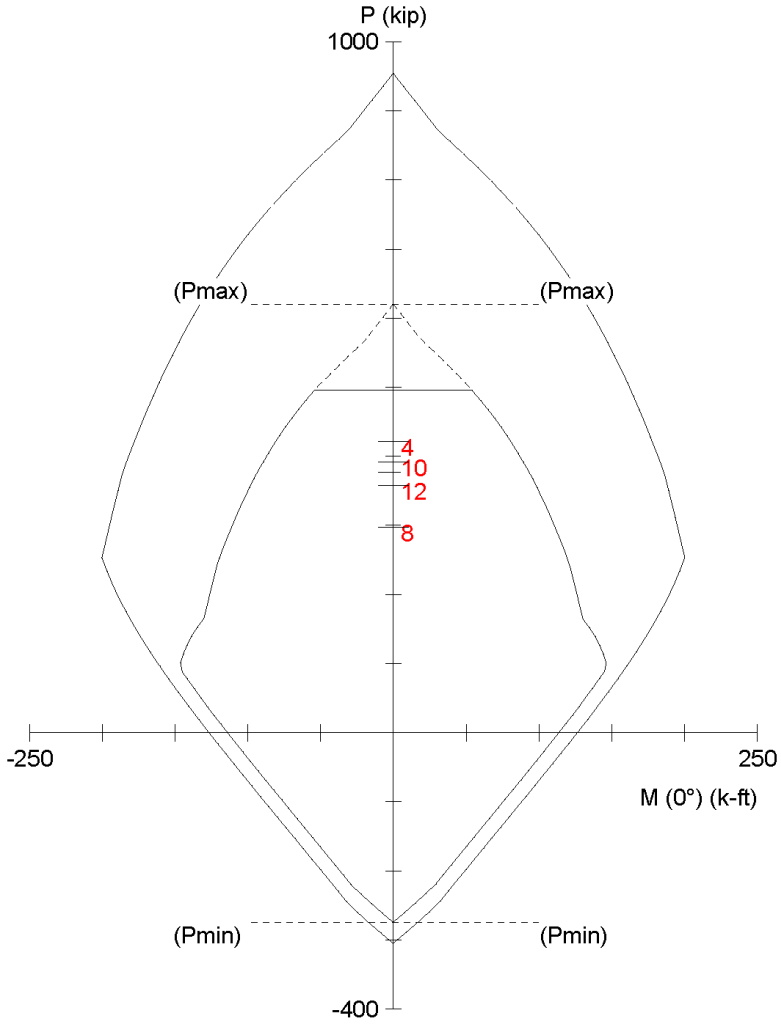
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	306.73	41.86	11.07	97.71	25.85	2.334	11.21	14.66	0.00092	0.650
2		306.73	0.00	0.00	110.36	0.00	999.999	9.11	11.63	0.00083	0.650
3	1 U2	453.05	66.33	19.28	72.15	20.98	1.088	14.36	14.54	0.00004	0.650
4		453.05	0.00	0.00	78.55	0.00	999.999	12.30	11.63	-0.00016	0.650
5	1 U3	399.78	60.88	15.61	84.61	21.70	1.390	13.02	14.43	0.00032	0.650
6		399.78	0.00	0.00	92.14	0.00	999.999	11.04	11.63	0.00016	0.650
7	2 U1	306.73	41.86	11.07	97.71	25.85	2.334	11.21	14.66	0.00092	0.650
8		306.73	0.00	0.00	110.36	0.00	999.999	9.11	11.63	0.00083	0.650
9	2 U2	417.29	66.33	23.78	77.37	27.74	1.166	13.85	15.05	0.00026	0.650
10		417.29	0.00	0.00	87.99	0.00	999.999	11.45	11.63	0.00005	0.650
11	2 U3	377.43	60.88	18.42	86.64	26.22	1.423	12.83	14.84	0.00047	0.650
12		377.43	0.00	0.00	97.07	0.00	999.999	10.55	11.63	0.00031	0.650

*** End of output ***

Column 2L



14 x 14 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/07/14

Time: 10:16:59

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

File: F:\SPRING\Gravity\Column Design\Frame 2\2L.col

Project: Gravity System

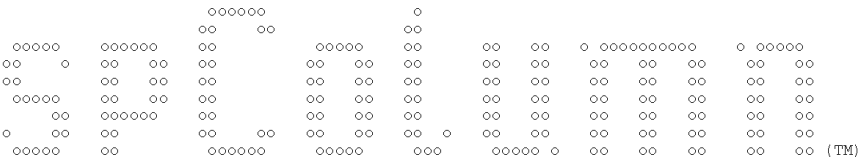
Column: 2L

Engineer: ahm

f'c = 4 ksi	fy = 60 ksi	Ag = 196 in^2	4 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 5.08 in^2	rho = 2.59%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 3201.33 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 3201.33 in^4
Beta1 = 0.85		Min clear spacing = 7.71 in	Clear cover = 1.87 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



spColumn v4.81 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

General Information:
==========
File Name: F:\SPRING\Gravity\Column Design\Frame 2\2L.col
Project: Gravity System
Column: 2L Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 14 in Depth = 14 in

Gross section area, Ag = 196 in^2
Ix = 3201.33 in^4 Iy = 3201.33 in^4
rx = 4.04145 in ry = 4.04145 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 1.96 in^2, Asmax = 0.08 * Ag = 15.68 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area: As = 5.08 in^2 at rho = 2.59%
Minimum clear spacing = 7.71 in

4 #10 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	212.46	29.90	0.00	-10.38	0.00
	Live	99.41	17.58	0.00	-8.35	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	14.01	4.64	0.00	0.00	0.00
2	Dead	212.46	29.90	0.00	-10.38	0.00
	Live	81.01	17.58	0.00	-14.30	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	14.01	4.64	0.00	0.00	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow

Factored Loads and Moments with Corresponding Capacities:

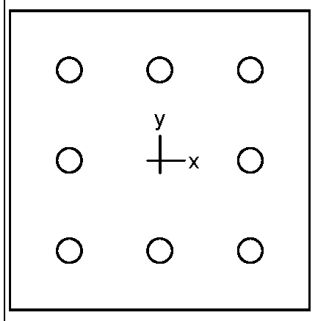
Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	297.44	41.86	-14.53	93.72	-32.54	2.239	11.65	14.97	0.00086	0.650
2		297.44	0.00	0.00	111.08	0.00	999.999	9.15	11.49	0.00077	0.650
3	1 U2	421.01	66.33	-25.82	69.56	-27.07	1.049	14.64	15.00	0.00007	0.650
4		421.01	0.00	0.00	80.86	0.00	999.999	12.16	11.49	-0.00016	0.650
5	1 U3	376.78	60.88	-20.81	81.26	-27.77	1.335	13.41	14.87	0.00033	0.650
6		376.78	0.00	0.00	93.29	0.00	999.999	11.01	11.49	0.00013	0.650
7	2 U1	297.44	41.86	-14.53	93.72	-32.54	2.239	11.65	14.97	0.00086	0.650
8		297.44	0.00	0.00	111.08	0.00	999.999	9.15	11.49	0.00077	0.650
9	2 U2	391.57	66.33	-35.34	70.97	-37.81	1.070	14.30	15.67	0.00029	0.650
10		391.57	0.00	0.00	89.37	0.00	999.999	11.39	11.49	0.00003	0.650
11	2 U3	358.38	60.88	-26.76	80.53	-35.39	1.323	13.33	15.39	0.00046	0.650
12		358.38	0.00	0.00	97.86	0.00	999.999	10.56	11.49	0.00027	0.650

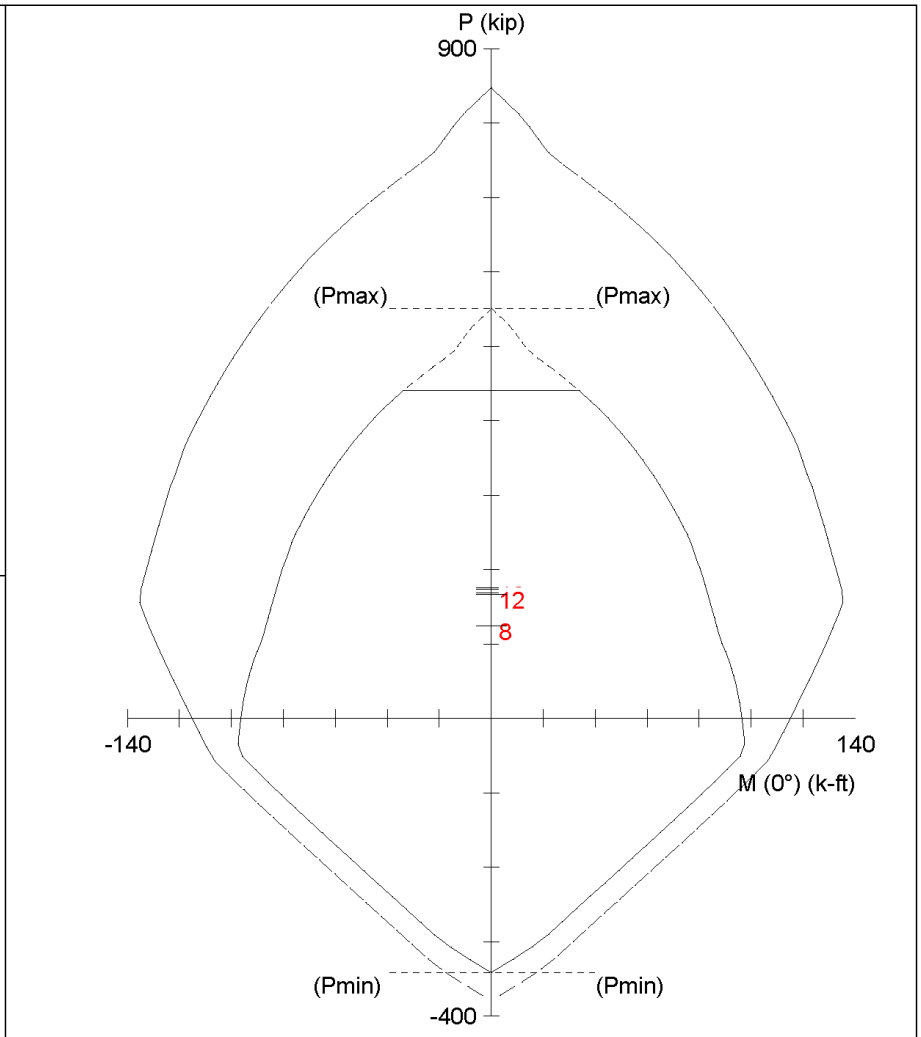
*** End of output ***

Column Line 8 Columns

Column 8Z



12 x 12 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/07/14

Time: 09:24:06

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

File: F:\SPRING\Gravity\Column Design\Frame 8\8Z.col

Project: Gravity System

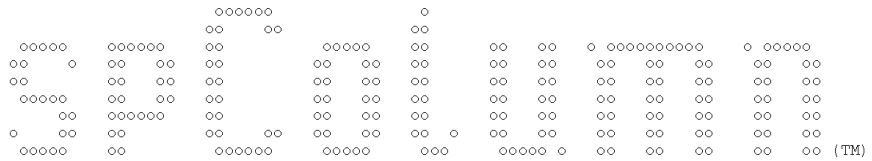
Column: 8Z

Engineer: ahm

f'c = 4 ksi	fy = 60 ksi	Ag = 144 in^2	8 #8 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 6.32 in^2	rho = 4.39%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 1728 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 1728 in^4
Beta1 = 0.85		Min clear spacing = 2.62 in	Clear cover = 1.87 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



General Information:
==========
File Name: F:\SPRING\Gravity\Column Design\Frame 8\8Z.col
Project: Gravity System
Column: 8Z Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 12 in Depth = 12 in

Gross section area, Ag = 144 in^2
Ix = 1728 in^4 Iy = 1728 in^4
rx = 3.4641 in ry = 3.4641 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 1.44 in^2, Asmax = 0.08 * Ag = 11.52 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area: As = 6.32 in^2 at rho = 4.39%
Minimum clear spacing = 2.62 in

8 #8 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	88.83	0.00	0.00	35.40	0.00
	Live	38.36	0.00	0.00	16.15	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	14.72	0.00	0.00	6.87	0.00
2	Dead	88.83	0.00	0.00	35.40	0.00
	Live	37.10	0.00	0.00	16.98	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	14.72	0.00	0.00	6.87	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow

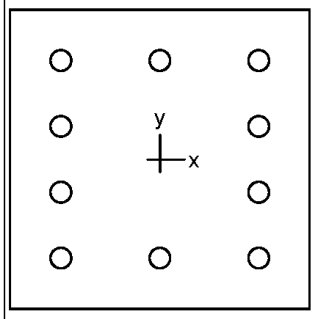
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

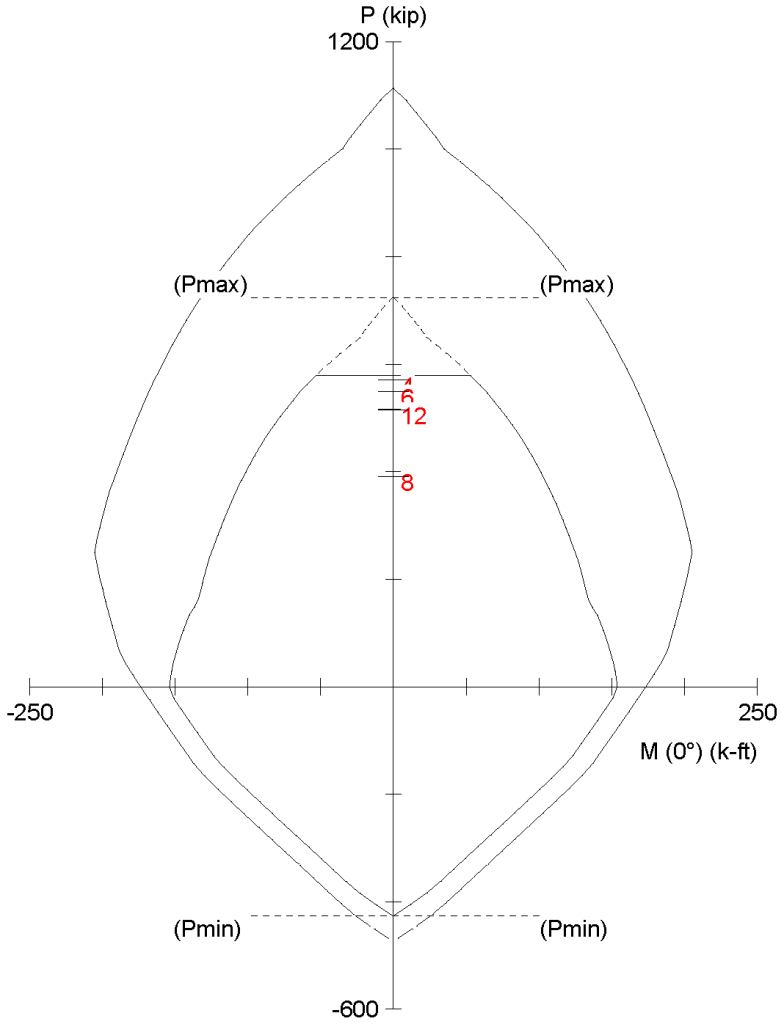
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	124.36	0.00	49.56	-0.00	86.67	1.749	5.93	9.63	0.00187	0.650
2		124.36	0.00	0.00	86.67	0.00	999.999	5.93	9.63	0.00187	0.650
3	1 U2	175.33	0.00	71.76	-0.00	82.56	1.151	6.59	9.63	0.00138	0.650
4		175.33	0.00	0.00	82.56	0.00	999.999	6.59	9.63	0.00138	0.650
5	1 U3	168.51	0.00	69.62	-0.00	83.12	1.194	6.50	9.63	0.00144	0.650
6		168.51	0.00	0.00	83.12	0.00	999.999	6.50	9.63	0.00144	0.650
7	2 U1	124.36	0.00	49.56	-0.00	86.67	1.749	5.93	9.63	0.00187	0.650
8		124.36	0.00	0.00	86.67	0.00	999.999	5.93	9.63	0.00187	0.650
9	2 U2	173.32	0.00	73.08	-0.00	82.73	1.132	6.56	9.63	0.00140	0.650
10		173.32	0.00	0.00	82.73	0.00	999.999	6.56	9.63	0.00140	0.650
11	2 U3	167.25	0.00	70.45	-0.00	83.23	1.181	6.48	9.63	0.00146	0.650
12		167.25	0.00	0.00	83.23	0.00	999.999	6.48	9.63	0.00146	0.650

*** End of output ***

Column 8D



14 x 14 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/07/14

Time: 09:36:01

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

File: F:\SPRING\Gravity\Column Design\Frame 8\8D.col

Project: Gravity System

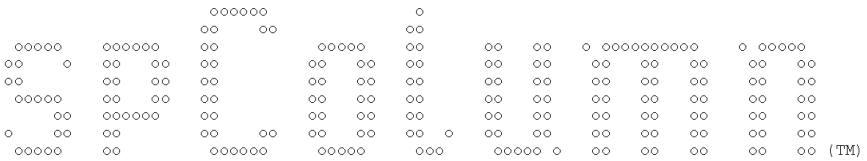
Column: 8D

Engineer: ahm

f'c = 4 ksi	fy = 60 ksi	Ag = 196 in^2	10 #8 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 7.90 in^2	rho = 4.03%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 3201.33 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 3201.33 in^4
Beta1 = 0.85		Min clear spacing = 2.08 in	Clear cover = 1.87 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



==========

spColumn v4.81 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

==========

General Information:
==========
File Name: F:\SPRING\Gravity\Column Design\Frame 8\8D.col
Project: Gravity System
Column: 8D Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 14 in Depth = 14 in

Gross section area, Ag = 196 in^2
Ix = 3201.33 in^4 Iy = 3201.33 in^4
rx = 4.04145 in ry = 4.04145 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 1.96 in^2, Asmax = 0.08 * Ag = 15.68 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area: As = 7.90 in^2 at rho = 4.03%
Minimum clear spacing = 2.08 in

10 #8 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	278.71	0.00	0.00	-18.89	0.00
	Live	131.44	0.00	0.00	-6.58	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	51.76	0.00	0.00	-4.54	0.00
2	Dead	278.71	0.00	0.00	-18.89	0.00
	Live	97.22	0.00	0.00	-10.91	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	51.76	0.00	0.00	-4.54	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow

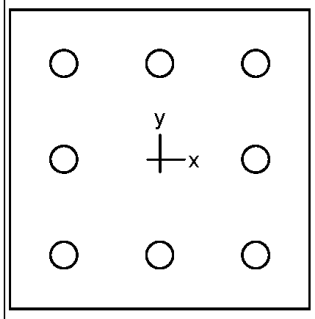
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

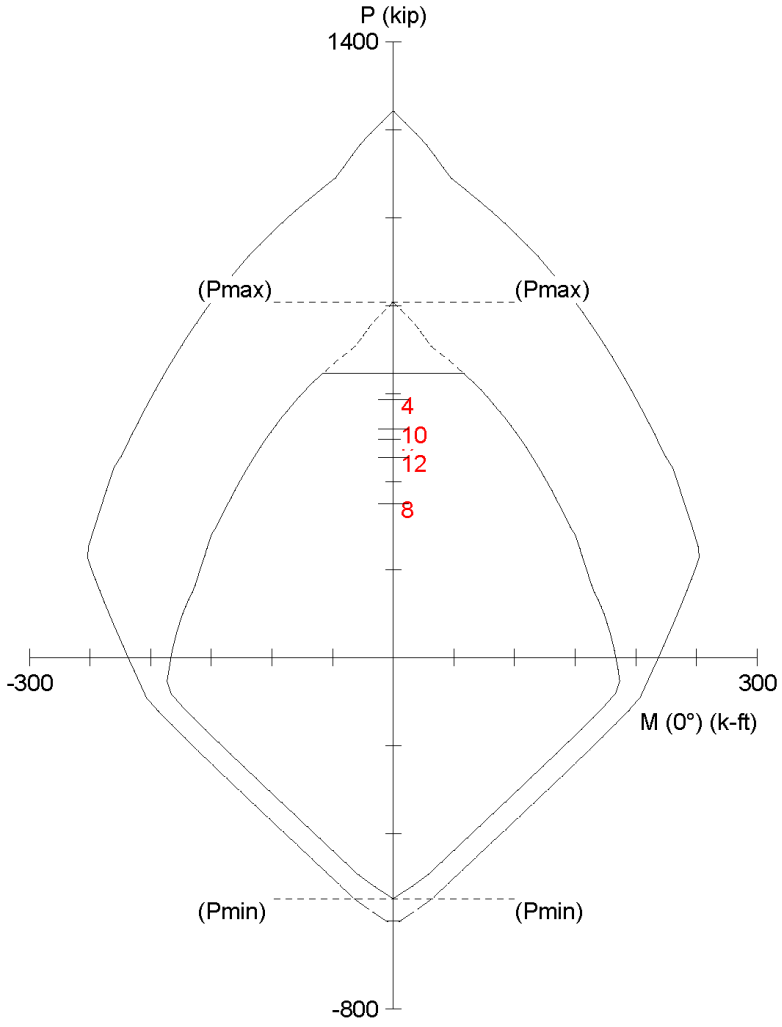
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	390.19	0.00	-26.45	0.00	-112.66	4.260	10.32	11.63	0.00038	0.650
2		390.19	0.00	0.00	103.05	0.00	999.999	10.28	11.63	0.00039	0.650
3	1 U2	570.64	0.00	-35.47	0.00	-59.71	1.684	14.55	11.63	-0.00060	0.650
4		570.64	0.00	0.00	56.15	0.00	999.999	14.38	11.63	-0.00058	0.650
5	1 U3	548.71	0.00	-36.51	0.00	-68.12	1.866	13.99	11.63	-0.00051	0.650
6		548.71	0.00	0.00	63.82	0.00	999.999	13.84	11.63	-0.00048	0.650
7	2 U1	390.19	0.00	-26.45	0.00	-112.66	4.260	10.32	11.63	0.00038	0.650
8		390.19	0.00	0.00	103.05	0.00	999.999	10.28	11.63	0.00039	0.650
9	2 U2	515.88	0.00	-42.39	0.00	-79.18	1.868	13.03	11.63	-0.00032	0.650
10		515.88	0.00	0.00	73.72	0.00	999.999	12.93	11.63	-0.00030	0.650
11	2 U3	514.49	0.00	-40.84	0.00	-79.63	1.950	12.99	11.63	-0.00032	0.650
12		514.49	0.00	0.00	74.13	0.00	999.999	12.90	11.63	-0.00030	0.650

*** End of output ***

Column 8G



14 x 14 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/07/14

Time: 09:43:54

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

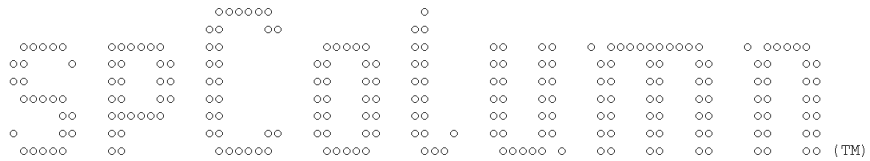
File: F:\SPRING\Gravity\Column Design\Frame 8\8G.col

Project: Gravity System

Column: 8G		Engineer: ahm	
f'c = 4 ksi	fy = 60 ksi	Ag = 196 in^2	8 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 10.16 in^2	rho = 5.18%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 3201.33 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 3201.33 in^4
Beta1 = 0.85		Min clear spacing = 3.22 in	Clear cover = 1.87 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



spColumn v4.81 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

General Information:
==========
File Name: F:\SPRING\Gravity\Column Design\Frame 8\8G.col
Project: Gravity System
Column: 8G Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 14 in Depth = 14 in

Gross section area, Ag = 196 in^2
Ix = 3201.33 in^4 Iy = 3201.33 in^4
rx = 4.04145 in ry = 4.04145 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 1.96 in^2, Asmax = 0.08 * Ag = 15.68 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area: As = 10.16 in^2 at rho = 5.18%
Minimum clear spacing = 3.22 in

8 #10 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	249.62	0.00	0.00	9.39	0.00
	Live	175.12	0.00	0.00	3.42	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	13.66	0.00	0.00	1.28	0.00
2	Dead	249.62	0.00	0.00	9.39	0.00
	Live	132.67	0.00	0.00	8.35	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	13.66	0.00	0.00	1.28	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow

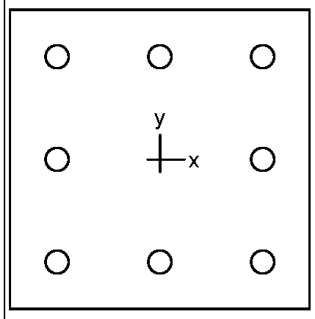
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

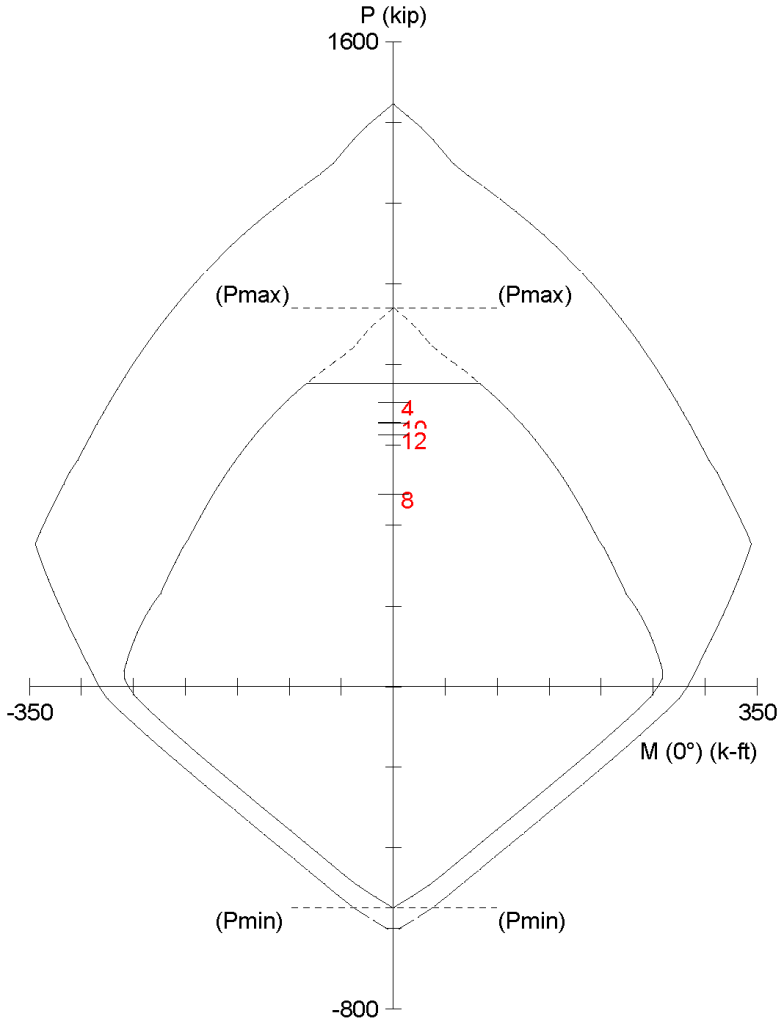
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	349.47	0.00	13.15	-0.00	136.27	10.366	9.09	11.49	0.00079	0.650
2		349.47	0.00	0.00	136.27	0.00	999.999	9.09	11.49	0.00079	0.650
3	1 U2	586.57	0.00	17.38	-0.00	79.58	4.579	13.59	11.49	-0.00046	0.650
4		586.57	0.00	0.00	79.58	0.00	999.999	13.59	11.49	-0.00046	0.650
5	1 U3	496.52	0.00	16.74	-0.00	104.83	6.264	11.56	11.49	-0.00002	0.650
6		496.52	0.00	0.00	104.83	0.00	999.999	11.56	11.49	-0.00002	0.650
7	2 U1	349.47	0.00	13.15	-0.00	136.27	10.366	9.09	11.49	0.00079	0.650
8		349.47	0.00	0.00	136.27	0.00	999.999	9.09	11.49	0.00079	0.650
9	2 U2	518.65	0.00	25.27	-0.00	99.12	3.923	11.99	11.49	-0.00013	0.650
10		518.65	0.00	0.00	99.12	0.00	999.999	11.99	11.49	-0.00013	0.650
11	2 U3	454.07	0.00	21.67	-0.00	114.93	5.305	10.78	11.49	0.00020	0.650
12		454.07	0.00	0.00	114.93	0.00	999.999	10.78	11.49	0.00020	0.650

*** End of output ***

Column 8M



16 x 16 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/07/14

Time: 09:48:33

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

File: F:\SPRING\Gravity\Column Design\Frame 8\8M.col

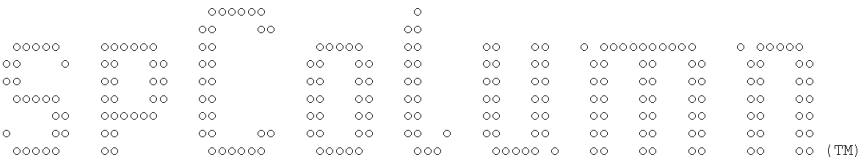
Project: Gravity System

Column: 8M — Engineer: ahm

f'c = 4 ksi	fy = 60 ksi	Ag = 256 in^2	8 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 10.16 in^2	rho = 3.97%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 5461.33 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 5461.33 in^4
Beta1 = 0.85		Min clear spacing = 4.22 in	Clear cover = 1.87 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



General Information:
==========
File Name: F:\SPRING\Gravity\Column Design\Frame 8\8M.col
Project: Gravity System
Column: 8M Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 16 in Depth = 16 in

Gross section area, Ag = 256 in^2
Ix = 5461.33 in^4 Iy = 5461.33 in^4
rx = 4.6188 in ry = 4.6188 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 2.56 in^2, Asmax = 0.08 * Ag = 20.48 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area: As = 10.16 in^2 at rho = 3.97%
Minimum clear spacing = 4.22 in

8 #10 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	340.47	0.00	0.00	-4.39	0.00
	Live	170.19	0.00	0.00	-2.69	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	48.28	0.00	0.00	-0.31	0.00
2	Dead	340.47	0.00	0.00	-4.39	0.00
	Live	138.39	0.00	0.00	-6.69	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	48.28	0.00	0.00	-0.31	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow

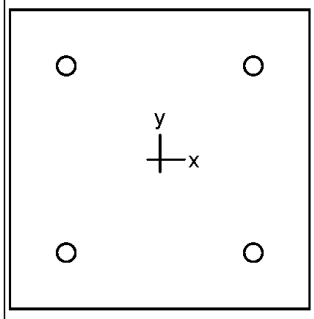
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

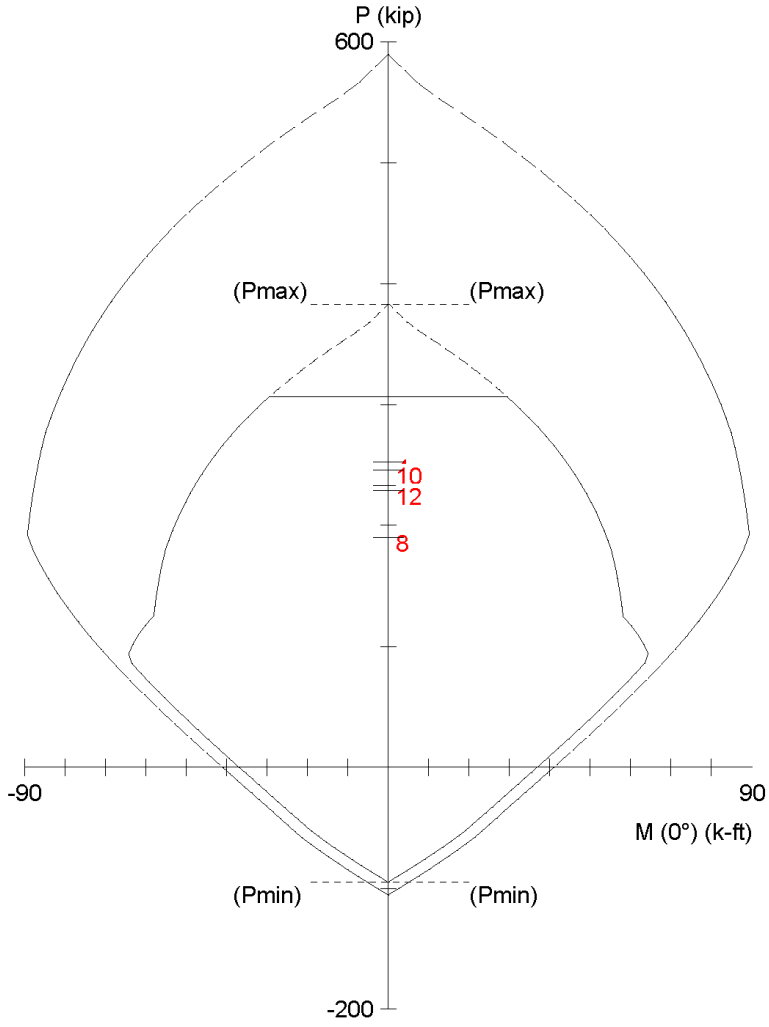
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	476.66	0.00	-6.15	0.00	-173.19	28.179	11.34	13.49	0.00057	0.650
2		476.66	0.00	0.00	173.19	0.00	999.999	11.34	13.49	0.00057	0.650
3	1 U2	705.01	0.00	-9.73	0.00	-103.33	10.623	15.65	13.49	-0.00041	0.650
4		705.01	0.00	0.00	103.33	0.00	999.999	15.65	13.49	-0.00041	0.650
5	1 U3	656.00	0.00	-8.45	0.00	-121.81	14.408	14.63	13.49	-0.00023	0.650
6		656.00	0.00	0.00	121.81	0.00	999.999	14.63	13.49	-0.00023	0.650
7	2 U1	476.66	0.00	-6.15	0.00	-173.19	28.179	11.34	13.49	0.00057	0.650
8		476.66	0.00	0.00	173.19	0.00	999.999	11.34	13.49	0.00057	0.650
9	2 U2	654.13	0.00	-16.13	0.00	-122.47	7.594	14.59	13.49	-0.00023	0.650
10		654.13	0.00	0.00	122.47	0.00	999.999	14.59	13.49	-0.00023	0.650
11	2 U3	624.20	0.00	-12.45	0.00	-132.59	10.647	13.99	13.49	-0.00011	0.650
12		624.20	0.00	0.00	132.59	0.00	999.999	13.99	13.49	-0.00011	0.650

*** End of output ***

Column 8P



12 x 12 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/07/14

Time: 09:51:36

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

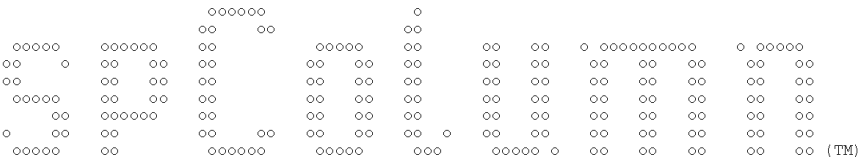
File: F:\SPRING\Gravity\Column Design\Frame 8\8P.col

Project: Gravity System

Column: 8P		Engineer: ahm	
f'c = 4 ksi	fy = 60 ksi	Ag = 144 in^2	4 #6 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 1.76 in^2	rho = 1.22%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 1728 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 1728 in^4
Beta1 = 0.85		Min clear spacing = 6.75 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



spColumn v4.81 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

General Information:
==========
File Name: F:\SPRING\Gravity\Column Design\Frame 8\8P.col
Project: Gravity System
Column: 8P Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 12 in Depth = 12 in

Gross section area, Ag = 144 in^2
Ix = 1728 in^4 Iy = 1728 in^4
rx = 3.4641 in ry = 3.4641 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 1.44 in^2, Asmax = 0.08 * Ag = 11.52 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area: As = 1.76 in^2 at rho = 1.22%
Minimum clear spacing = 6.75 in

4 #6 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	135.60	0.00	0.00	-2.40	0.00
	Live	52.78	0.00	0.00	-4.66	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	11.07	0.00	0.00	0.14	0.00
2	Dead	135.60	0.00	0.00	-2.40	0.00
	Live	48.32	0.00	0.00	-5.09	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	11.07	0.00	0.00	0.14	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow

Factored Loads and Moments with Corresponding Capacities:

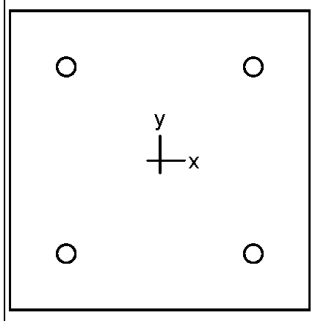
Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	189.84	0.00	-3.36	0.00	-54.04	16.082	7.61	9.75	0.00084	0.650
2		189.84	0.00	0.00	54.04	0.00	999.999	7.61	9.75	0.00084	0.650
3	1 U2	252.70	0.00	-10.27	0.00	-44.00	4.286	9.77	9.75	-0.00001	0.650
4		252.70	0.00	0.00	44.00	0.00	999.999	9.77	9.75	-0.00001	0.650
5	1 U3	233.21	0.00	-7.32	0.00	-47.81	6.534	9.08	9.75	0.00022	0.650
6		233.21	0.00	0.00	47.81	0.00	999.999	9.08	9.75	0.00022	0.650
7	2 U1	189.84	0.00	-3.36	0.00	-54.04	16.082	7.61	9.75	0.00084	0.650
8		189.84	0.00	0.00	54.04	0.00	999.999	7.61	9.75	0.00084	0.650
9	2 U2	245.57	0.00	-10.95	0.00	-45.47	4.151	9.51	9.75	0.00007	0.650
10		245.57	0.00	0.00	45.47	0.00	999.999	9.51	9.75	0.00007	0.650
11	2 U3	228.75	0.00	-7.75	0.00	-48.58	6.272	8.92	9.75	0.00028	0.650
12		228.75	0.00	0.00	48.58	0.00	999.999	8.92	9.75	0.00028	0.650

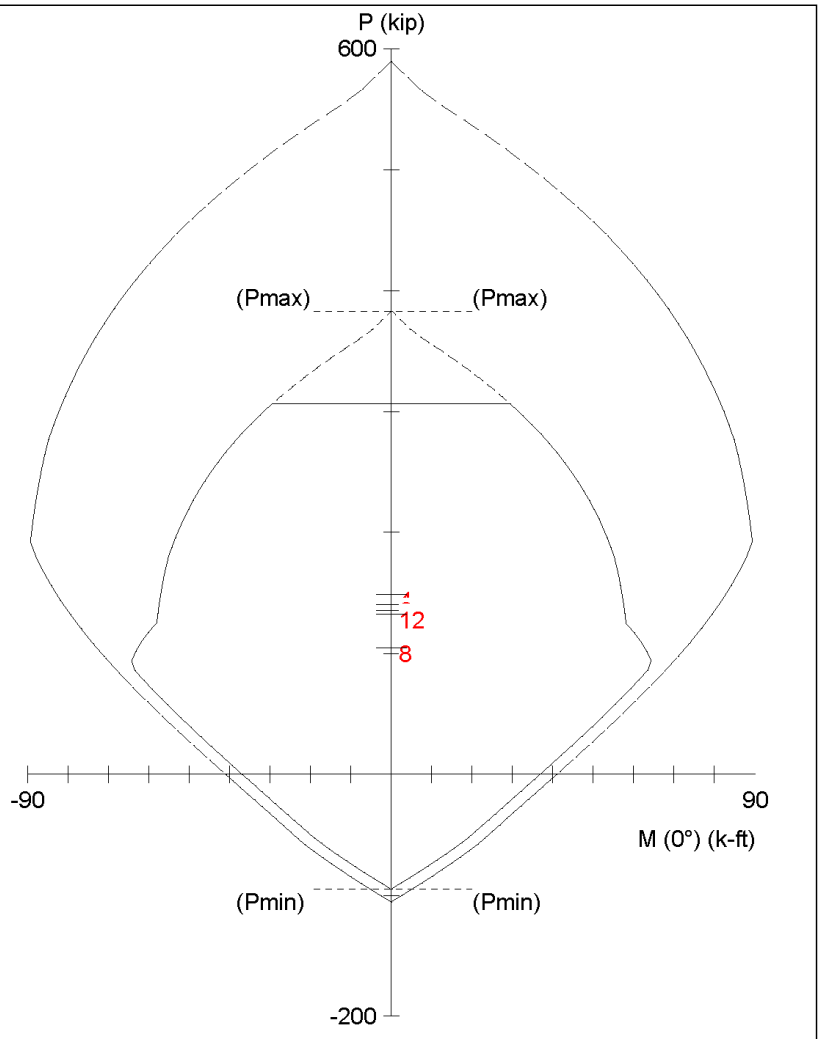
*** End of output ***

Column Line 13 Columns

Column 13A.2



12 x 12 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/06/14

Time: 15:42:22

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

File: E:\SPRING\Gravity\Column Design\Frame 13\13A.2.col

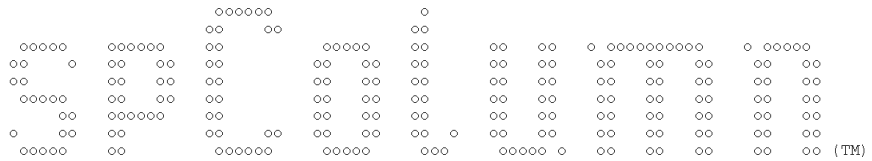
Project: Gravity System

Column: 13A.2 Engineer: ahm

f'c = 4 ksi	fy = 60 ksi	Ag = 144 in^2	4 #6 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 1.76 in^2	rho = 1.22%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 1728 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 1728 in^4
Beta1 = 0.85		Min clear spacing = 6.75 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



General Information:
==========
File Name: E:\SPRING\Gravity\Column Design\Frame 13\13A.2.col
Project: Gravity System
Column: 13A.2 Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 12 in Depth = 12 in

Gross section area, Ag = 144 in^2
Ix = 1728 in^4 Iy = 1728 in^4
rx = 3.4641 in ry = 3.4641 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 1.44 in^2, Asmax = 0.08 * Ag = 11.52 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area: As = 1.76 in^2 at rho = 1.22%
Minimum clear spacing = 6.75 in

4 #6 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	74.75	0.00	0.00	13.26	0.00
	Live	33.42	0.00	0.00	6.94	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	10.89	0.00	0.00	1.86	0.00
2	Dead	74.75	0.00	0.00	13.26	0.00
	Live	25.23	0.00	0.00	7.76	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	10.89	0.00	0.00	1.86	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow

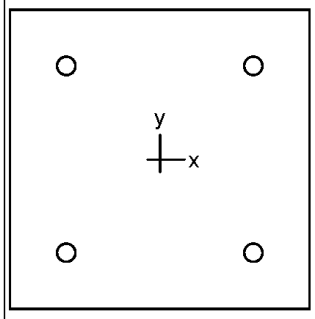
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

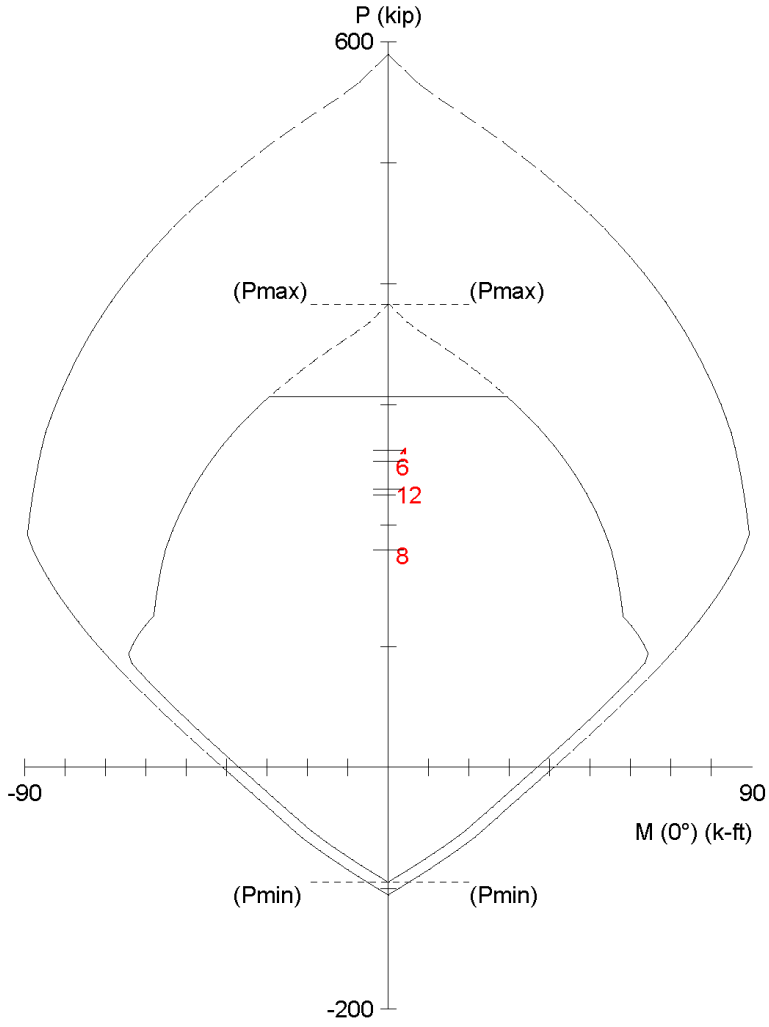
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	104.65	0.00	18.56	-0.00	62.70	3.378	4.36	9.75	0.00370	0.789
2		104.65	0.00	0.00	62.70	0.00	999.999	4.36	9.75	0.00370	0.789
3	1 U2	148.62	0.00	27.95	-0.00	57.04	2.041	6.40	9.75	0.00157	0.650
4		148.62	0.00	0.00	57.04	0.00	999.999	6.40	9.75	0.00157	0.650
5	1 U3	140.54	0.00	25.83	-0.00	57.42	2.223	6.19	9.75	0.00173	0.650
6		140.54	0.00	0.00	57.42	0.00	999.999	6.19	9.75	0.00173	0.650
7	2 U1	104.65	0.00	18.56	-0.00	62.70	3.378	4.36	9.75	0.00370	0.789
8		104.65	0.00	0.00	62.70	0.00	999.999	4.36	9.75	0.00370	0.789
9	2 U2	135.51	0.00	29.26	-0.00	57.63	1.970	6.06	9.75	0.00183	0.650
10		135.51	0.00	0.00	57.63	0.00	999.999	6.06	9.75	0.00183	0.650
11	2 U3	132.35	0.00	26.65	-0.00	57.75	2.167	5.98	9.75	0.00189	0.650
12		132.35	0.00	0.00	57.75	0.00	999.999	5.98	9.75	0.00189	0.650

*** End of output ***

Column 13B



12 x 12 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/06/14

Time: 15:53:13

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

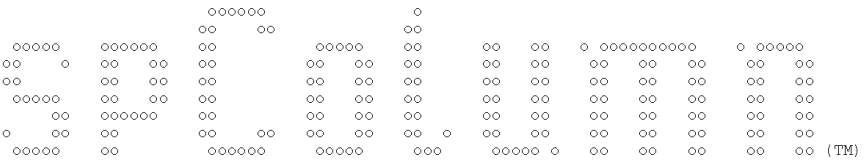
File: E:\SPRING\Gravity\Column Design\Frame 13\13B.col

Project: Gravity System

Column: 13B		Engineer: ahm	
f'c = 4 ksi	fy = 60 ksi	Ag = 144 in^2	4 #6 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 1.76 in^2	rho = 1.22%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 1728 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 1728 in^4
Beta1 = 0.85		Min clear spacing = 6.75 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



General Information:
==========
File Name: E:\SPRING\Gravity\Column Design\Frame 13\13B.col
Project: Gravity System
Column: 13B Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 12 in Depth = 12 in

Gross section area, Ag = 144 in^2
Ix = 1728 in^4 Iy = 1728 in^4
rx = 3.4641 in ry = 3.4641 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 1.44 in^2, Asmax = 0.08 * Ag = 11.52 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area: As = 1.76 in^2 at rho = 1.22%
Minimum clear spacing = 6.75 in

4 #6 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	128.26	0.00	0.00	-5.42	0.00
	Live	60.11	0.00	0.00	-2.50	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	24.47	0.00	0.00	-0.28	0.00
2	Dead	128.26	0.00	0.00	-5.42	0.00
	Live	36.91	0.00	0.00	-4.91	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	24.47	0.00	0.00	-0.28	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow

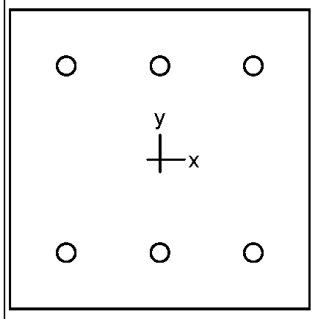
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

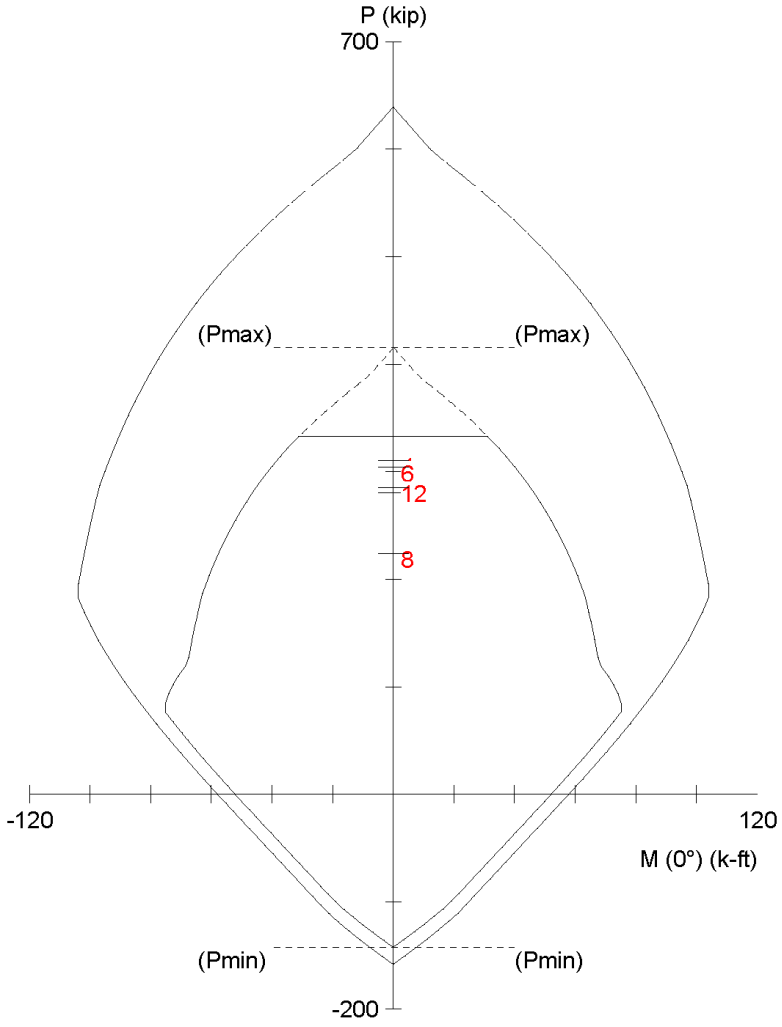
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	179.56	0.00	-7.59	0.00	-55.14	7.266	7.28	9.75	0.00102	0.650
2		179.56	0.00	0.00	55.14	0.00	999.999	7.28	9.75	0.00102	0.650
3	1 U2	262.32	0.00	-10.64	0.00	-41.85	3.931	10.12	9.75	-0.00011	0.650
4		262.32	0.00	0.00	41.85	0.00	999.999	10.12	9.75	-0.00011	0.650
5	1 U3	253.17	0.00	-9.45	0.00	-43.90	4.644	9.79	9.75	-0.00001	0.650
6		253.17	0.00	0.00	43.90	0.00	999.999	9.79	9.75	-0.00001	0.650
7	2 U1	179.56	0.00	-7.59	0.00	-55.14	7.266	7.28	9.75	0.00102	0.650
8		179.56	0.00	0.00	55.14	0.00	999.999	7.28	9.75	0.00102	0.650
9	2 U2	225.20	0.00	-14.50	0.00	-49.18	3.391	8.80	9.75	0.00033	0.650
10		225.20	0.00	0.00	49.18	0.00	999.999	8.80	9.75	0.00033	0.650
11	2 U3	229.97	0.00	-11.86	0.00	-48.37	4.078	8.96	9.75	0.00026	0.650
12		229.97	0.00	0.00	48.37	0.00	999.999	8.96	9.75	0.00026	0.650

*** End of output ***

Column 13C



12 x 12 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/07/14

Time: 10:24:44

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

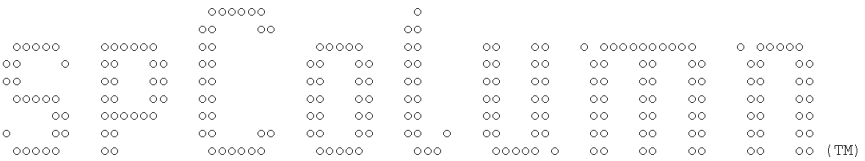
File: F:\SPRING\Gravity\Column Design\Frame 13\13C.col

Project: Gravity System

Column: 13C		Engineer: ahm	
f'c = 4 ksi	fy = 60 ksi	Ag = 144 in^2	6 #6 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 2.64 in^2	rho = 1.83%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 1728 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 1728 in^4
Beta1 = 0.85		Min clear spacing = 3.00 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



General Information:
==========
File Name: F:\SPRING\Gravity\Column Design\Frame 13\13C.col
Project: Gravity System
Column: 13C Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 12 in Depth = 12 in

Gross section area, Ag = 144 in^2
Ix = 1728 in^4 Iy = 1728 in^4
rx = 3.4641 in ry = 3.4641 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 1.44 in^2, Asmax = 0.08 * Ag = 11.52 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area: As = 2.64 in^2 at rho = 1.83%
Minimum clear spacing = 3.00 in

6 #6 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	159.87	0.00	0.00	-0.66	0.00
	Live	64.95	0.00	0.00	-0.80	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	29.39	0.00	0.00	-0.85	0.00
2	Dead	159.87	0.00	0.00	-0.66	0.00
	Live	46.10	0.00	0.00	-2.20	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	29.39	0.00	0.00	-0.85	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow

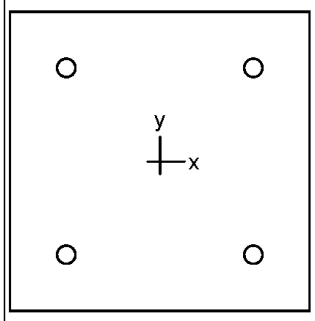
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

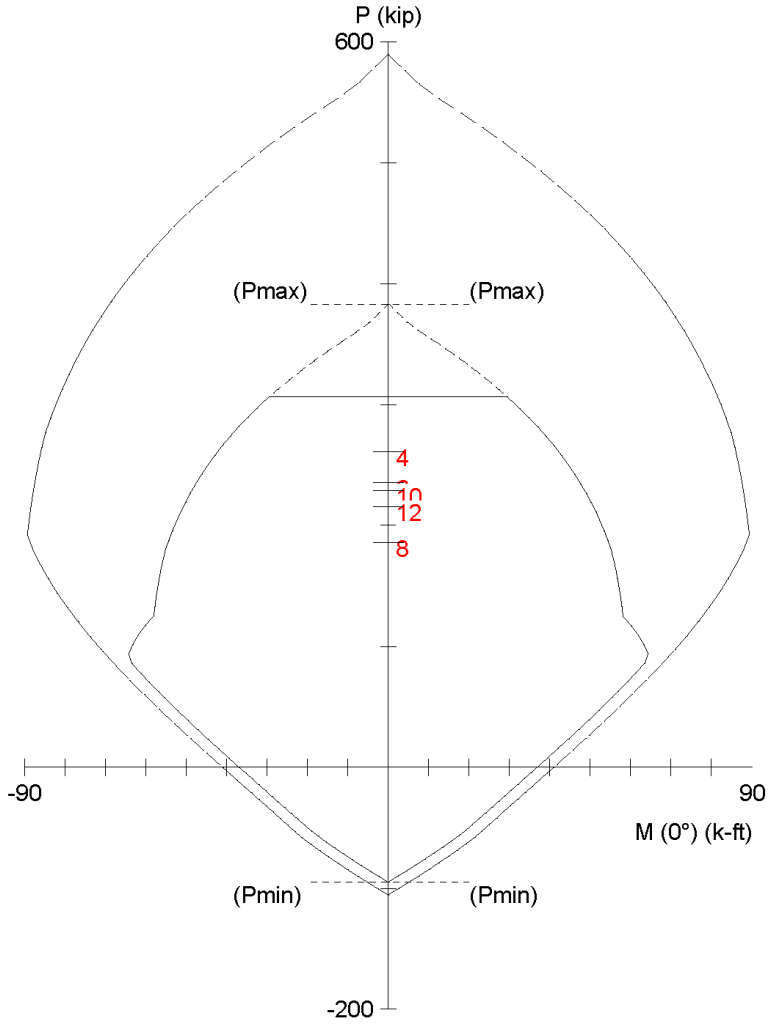
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	223.82	0.00	-0.92	0.00	-51.24	55.450	8.34	9.75	0.00051	0.650
2		223.82	0.00	0.00	57.61	0.00	999.999	8.34	9.75	0.00051	0.650
3	1 U2	310.46	0.00	-2.50	0.00	-34.73	13.908	11.13	9.75	-0.00037	0.650
4		310.46	0.00	0.00	38.31	0.00	999.999	11.19	9.75	-0.00039	0.650
5	1 U3	303.82	0.00	-2.95	0.00	-36.46	12.351	10.90	9.75	-0.00032	0.650
6		303.82	0.00	0.00	40.24	0.00	999.999	10.96	9.75	-0.00033	0.650
7	2 U1	223.82	0.00	-0.92	0.00	-51.24	55.450	8.34	9.75	0.00051	0.650
8		223.82	0.00	0.00	57.61	0.00	999.999	8.34	9.75	0.00051	0.650
9	2 U2	280.30	0.00	-4.74	0.00	-41.92	8.849	10.11	9.75	-0.00011	0.650
10		280.30	0.00	0.00	46.41	0.00	999.999	10.15	9.75	-0.00012	0.650
11	2 U3	284.97	0.00	-4.35	0.00	-40.91	9.401	10.26	9.75	-0.00015	0.650
12		284.97	0.00	0.00	45.26	0.00	999.999	10.31	9.75	-0.00016	0.650

*** End of output ***

Column 13E



12 x 12 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/06/14

Time: 16:11:11

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

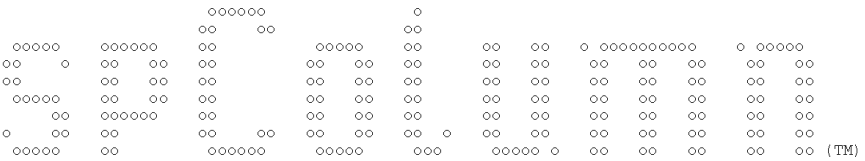
File: E:\SPRING\Gravity\Column Design\Frame 13\13E.col

Project: Gravity System

Column: 13E		Engineer: ahm	
f'c = 4 ksi	fy = 60 ksi	Ag = 144 in^2	4 #6 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 1.76 in^2	rho = 1.22%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 1728 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 1728 in^4
Beta1 = 0.85		Min clear spacing = 6.75 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



General Information:
==========
File Name: E:\SPRING\Gravity\Column Design\Frame 13\13E.col
Project: Gravity System
Column: 13E Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 12 in Depth = 12 in

Gross section area, Ag = 144 in^2
Ix = 1728 in^4 Iy = 1728 in^4
rx = 3.4641 in ry = 3.4641 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 1.44 in^2, Asmax = 0.08 * Ag = 11.52 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area: As = 1.76 in^2 at rho = 1.22%
Minimum clear spacing = 6.75 in

4 #6 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	132.52	0.00	0.00	0.69	0.00
	Live	60.67	0.00	0.00	0.10	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	9.81	0.00	0.00	0.27	0.00
2	Dead	132.52	0.00	0.00	0.69	0.00
	Live	40.63	0.00	0.00	1.72	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	9.81	0.00	0.00	0.27	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow

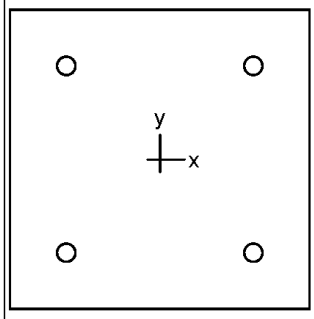
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

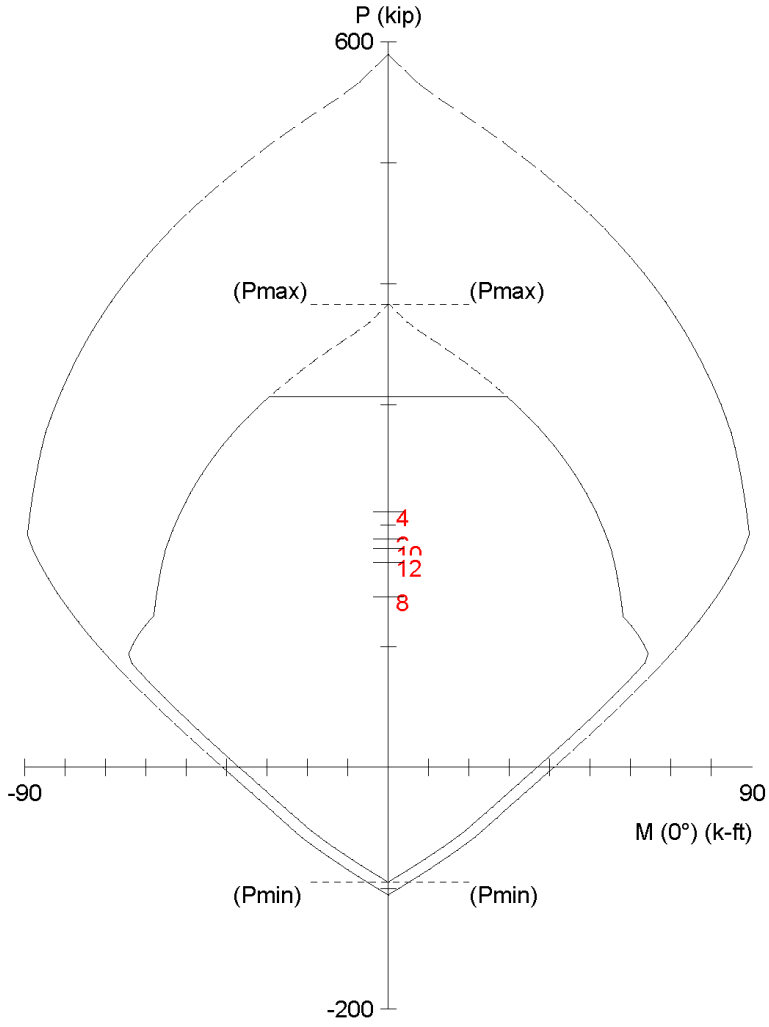
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	185.53	0.00	0.97	-0.00	54.51	56.432	7.47	9.75	0.00092	0.650
2		185.53	0.00	0.00	54.51	0.00	999.999	7.47	9.75	0.00092	0.650
3	1 U2	261.00	0.00	1.12	-0.00	42.15	37.536	10.07	9.75	-0.00010	0.650
4		261.00	0.00	0.00	42.15	0.00	999.999	10.07	9.75	-0.00010	0.650
5	1 U3	235.39	0.00	1.36	-0.00	47.41	34.864	9.15	9.75	0.00020	0.650
6		235.39	0.00	0.00	47.41	0.00	999.999	9.15	9.75	0.00020	0.650
7	2 U1	185.53	0.00	0.97	-0.00	54.51	56.432	7.47	9.75	0.00092	0.650
8		185.53	0.00	0.00	54.51	0.00	999.999	7.47	9.75	0.00092	0.650
9	2 U2	228.94	0.00	3.72	-0.00	48.55	13.069	8.93	9.75	0.00028	0.650
10		228.94	0.00	0.00	48.55	0.00	999.999	8.93	9.75	0.00028	0.650
11	2 U3	215.35	0.00	2.98	-0.00	50.72	17.019	8.46	9.75	0.00046	0.650
12		215.35	0.00	0.00	50.72	0.00	999.999	8.46	9.75	0.00046	0.650

*** End of output ***

Column 13H



12 x 12 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/06/14

Time: 16:30:55

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

File: E:\SPRING\Gravity\Column Design\Frame 13\13H.col

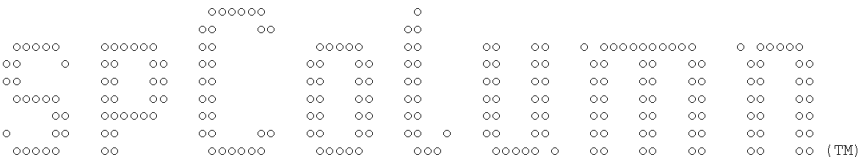
Project: Gravity System

Column: 13H — Engineer: ahm

f'c = 4 ksi	fy = 60 ksi	Ag = 144 in^2	4 #6 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 1.76 in^2	rho = 1.22%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 1728 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 1728 in^4
Beta1 = 0.85		Min clear spacing = 6.75 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



==========

spColumn v4.81 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

==========

General Information:
==========
File Name: E:\SPRING\Gravity\Column Design\Frame 13\13H.col
Project: Gravity System
Column: 13H Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 12 in Depth = 12 in

Gross section area, Ag = 144 in^2
Ix = 1728 in^4 Iy = 1728 in^4
rx = 3.4641 in ry = 3.4641 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 1.44 in^2, Asmax = 0.08 * Ag = 11.52 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area: As = 1.76 in^2 at rho = 1.22%
Minimum clear spacing = 6.75 in

4 #6 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	100.85	0.00	0.00	-1.65	0.00
	Live	53.76	0.00	0.00	-0.64	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	8.77	0.00	0.00	-0.20	0.00
2	Dead	100.85	0.00	0.00	-1.65	0.00
	Live	34.54	0.00	0.00	-1.74	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	8.77	0.00	0.00	-0.20	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow

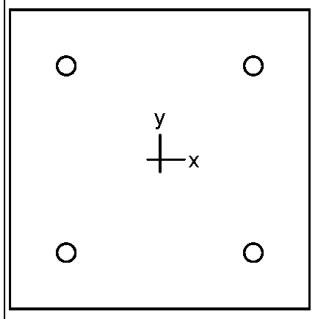
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	141.19	0.00	-2.31	0.00	-57.39	24.843	6.21	9.75	0.00171	0.650
2		141.19	0.00	0.00	57.39	0.00	999.999	6.21	9.75	0.00171	0.650
3	1 U2	211.42	0.00	-3.10	0.00	-51.29	16.523	8.32	9.75	0.00051	0.650
4		211.42	0.00	0.00	51.29	0.00	999.999	8.32	9.75	0.00051	0.650
5	1 U3	188.81	0.00	-2.94	0.00	-54.15	18.419	7.57	9.75	0.00086	0.650
6		188.81	0.00	0.00	54.15	0.00	999.999	7.57	9.75	0.00086	0.650
7	2 U1	141.19	0.00	-2.31	0.00	-57.39	24.843	6.21	9.75	0.00171	0.650
8		141.19	0.00	0.00	57.39	0.00	999.999	6.21	9.75	0.00171	0.650
9	2 U2	180.67	0.00	-4.86	0.00	-55.03	11.313	7.31	9.75	0.00100	0.650
10		180.67	0.00	0.00	55.03	0.00	999.999	7.31	9.75	0.00100	0.650
11	2 U3	169.59	0.00	-4.04	0.00	-55.86	13.827	6.99	9.75	0.00119	0.650
12		169.59	0.00	0.00	55.86	0.00	999.999	6.99	9.75	0.00119	0.650

*** End of output ***

Column 13K



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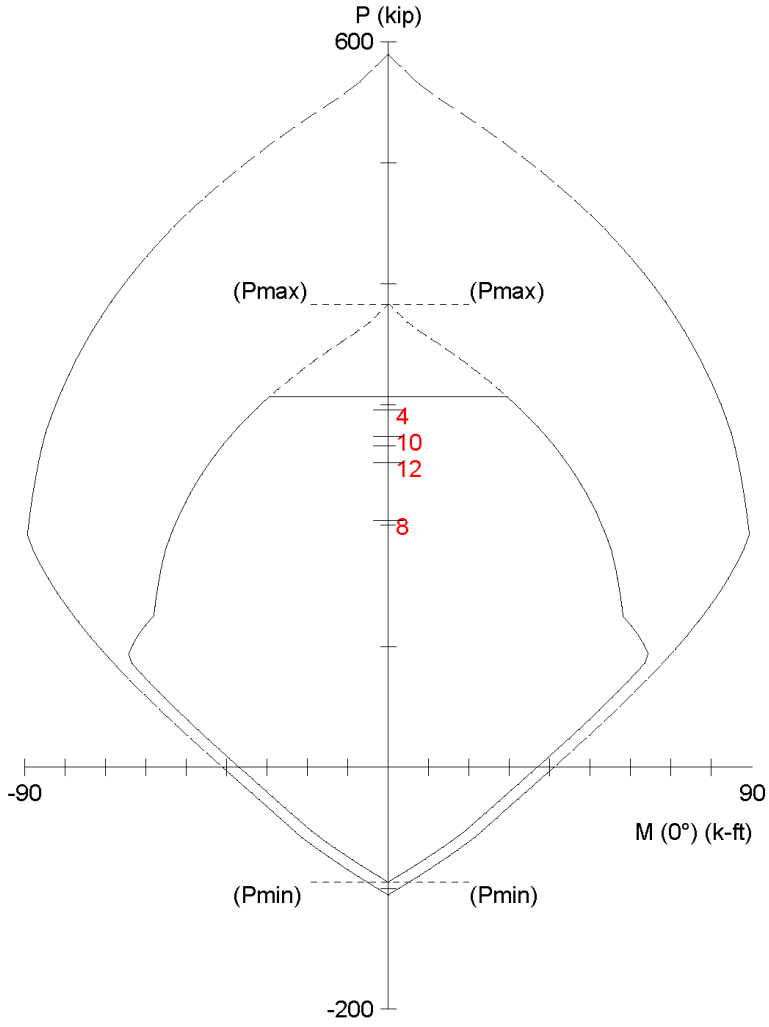

Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/06/14

Time: 16:34:35

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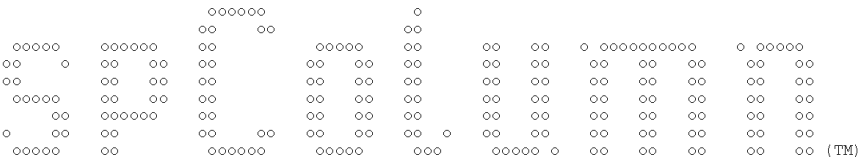
File: E:\SPRING\Gravity\Column Design\Frame 13\13K.col

Project: Gravity System

Column: 13K		Engineer: ahm	
f'c = 4 ksi	fy = 60 ksi	Ag = 144 in^2	4 #6 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 1.76 in^2	rho = 1.22%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 1728 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 1728 in^4
Beta1 = 0.85		Min clear spacing = 6.75 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



General Information:
==========
File Name: E:\SPRING\Gravity\Column Design\Frame 13\13K.col
Project: Gravity System
Column: 13K Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 12 in Depth = 12 in

Gross section area, Ag = 144 in^2
Ix = 1728 in^4 Iy = 1728 in^4
rx = 3.4641 in ry = 3.4641 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 1.44 in^2, Asmax = 0.08 * Ag = 11.52 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area: As = 1.76 in^2 at rho = 1.22%
Minimum clear spacing = 6.75 in

4 #6 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	145.64	0.00	0.00	3.05	0.00
	Live	71.75	0.00	0.00	1.89	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	11.98	0.00	0.00	0.30	0.00
2	Dead	145.64	0.00	0.00	3.05	0.00
	Live	57.91	0.00	0.00	2.60	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	11.98	0.00	0.00	0.30	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow

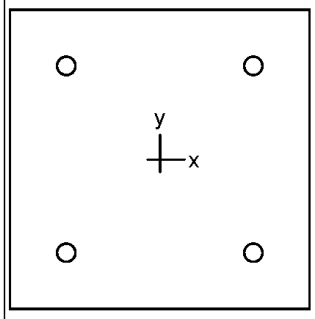
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

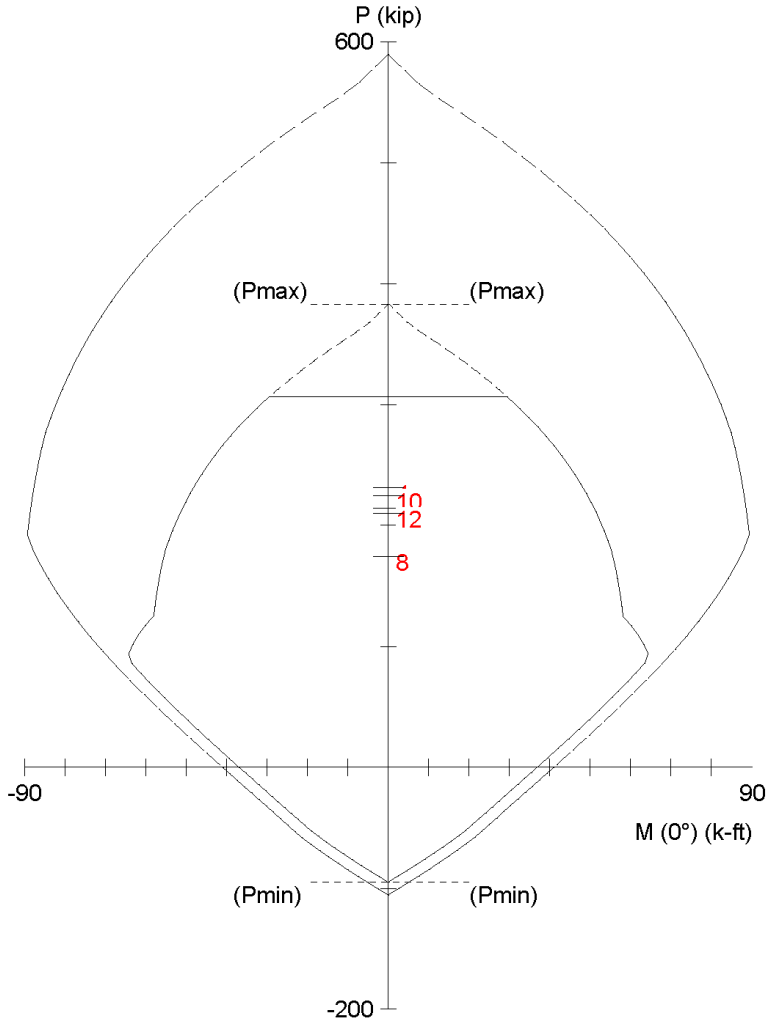
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	203.90	0.00	4.27	-0.00	52.32	12.253	8.07	9.75	0.00062	0.650
2		203.90	0.00	0.00	52.32	0.00	999.999	8.07	9.75	0.00062	0.650
3	1 U2	295.56	0.00	6.83	-0.00	32.89	4.813	11.36	9.75	-0.00043	0.650
4		295.56	0.00	0.00	32.89	0.00	999.999	11.36	9.75	-0.00043	0.650
5	1 U3	265.69	0.00	6.03	-0.00	41.05	6.807	10.24	9.75	-0.00014	0.650
6		265.69	0.00	0.00	41.05	0.00	999.999	10.24	9.75	-0.00014	0.650
7	2 U1	203.90	0.00	4.27	-0.00	52.32	12.253	8.07	9.75	0.00062	0.650
8		203.90	0.00	0.00	52.32	0.00	999.999	8.07	9.75	0.00062	0.650
9	2 U2	273.41	0.00	7.97	-0.00	39.13	4.909	10.53	9.75	-0.00022	0.650
10		273.41	0.00	0.00	39.13	0.00	999.999	10.53	9.75	-0.00022	0.650
11	2 U3	251.85	0.00	6.74	-0.00	44.18	6.555	9.74	9.75	0.00000	0.650
12		251.85	0.00	0.00	44.18	0.00	999.999	9.74	9.75	0.00000	0.650

*** End of output ***

Column 13N



12 x 12 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/06/14

Time: 16:38:35

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File: E:\SPRING\Gravity\Column Design\Frame 13\13N.col

Project: Gravity System

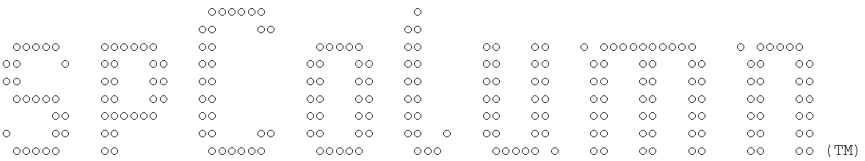
Column: 13N

Engineer: ahm

f'c = 4 ksi	fy = 60 ksi	Ag = 144 in^2	4 #6 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 1.76 in^2	rho = 1.22%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 1728 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 1728 in^4
Beta1 = 0.85		Min clear spacing = 6.75 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



General Information:
==========
File Name: E:\SPRING\Gravity\Column Design\Frame 13\13N.col
Project: Gravity System
Column: 13N Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 12 in Depth = 12 in

Gross section area, Ag = 144 in^2
Ix = 1728 in^4 Iy = 1728 in^4
rx = 3.4641 in ry = 3.4641 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 1.44 in^2, Asmax = 0.08 * Ag = 11.52 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: Equal Bar Spacing (Cover to transverse reinforcement)
Total steel area: As = 1.76 in^2 at rho = 1.22%
Minimum clear spacing = 6.75 in

4 #6 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	124.43	0.00	0.00	-5.74	0.00
	Live	48.01	0.00	0.00	-4.04	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	10.46	0.00	0.00	-0.55	0.00
2	Dead	124.43	0.00	0.00	-5.74	0.00
	Live	43.79	0.00	0.00	-4.41	0.00
	Wind	0.00	0.00	0.00	0.00	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	10.46	0.00	0.00	-0.55	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow

Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	174.20	0.00	-8.04	0.00	-55.55	6.913	7.12	9.75	0.00111	0.650
2		174.20	0.00	0.00	55.55	0.00	999.999	7.12	9.75	0.00111	0.650
3	1 U2	231.36	0.00	-13.63	0.00	-48.13	3.532	9.01	9.75	0.00025	0.650
4		231.36	0.00	0.00	48.13	0.00	999.999	9.01	9.75	0.00025	0.650
5	1 U3	214.06	0.00	-11.81	0.00	-50.91	4.311	8.41	9.75	0.00048	0.650
6		214.06	0.00	0.00	50.91	0.00	999.999	8.41	9.75	0.00048	0.650
7	2 U1	174.20	0.00	-8.04	0.00	-55.55	6.913	7.12	9.75	0.00111	0.650
8		174.20	0.00	0.00	55.55	0.00	999.999	7.12	9.75	0.00111	0.650
9	2 U2	224.61	0.00	-14.22	0.00	-49.27	3.465	8.78	9.75	0.00033	0.650
10		224.61	0.00	0.00	49.27	0.00	999.999	8.78	9.75	0.00033	0.650
11	2 U3	209.84	0.00	-12.18	0.00	-51.51	4.230	8.27	9.75	0.00054	0.650
12		209.84	0.00	0.00	51.51	0.00	999.999	8.27	9.75	0.00054	0.650

*** End of output ***

Appendix B.1: Lateral Load Calculations

Seismic Loads

Seismic Design Values

A. Mincemoyer	Seismic	Final Report	

§ 11.1.2
- seismic design is required

Site Class: B

using usgs.gov: $S_S = 0.124g$ $S_1 = 0.056g$

$S_{MS} = 0.124g$ $S_{M1} = 0.056g$

$S_{DS} = 0.083$ $S_{D1} = 0.037g$

$T_L = 6$ seconds

Table 11.6-1

$S_{DS} = 0.083 < 0.167 \rightarrow$ SDC A

Table 11.6-2

$S_{D1} = 0.037 < 0.067 \rightarrow$ SDC A

→ § 11.7 Design Requirements for seismic design category A pg.68

→ according to § 1.4.3 Lateral Forces

$F_x = 0.01 W_x$ (equation 1.4-1)

Determination of Building Weight

Seismic Load Calculations

	Floor Area			Misc Dead Load		Partition Load		Slab Load		Joist Load		Girder Loads				Beam Loads				Column Loads					Exterior Wall Load (k)	Total Load (k)
	Total Floor Area (sf)	Green Roof Area (sf)	Indoor Floor Area (sf)	Misc Dead (psf)	Misc Dead (k)	Partitions (psf)	Partitions (k)	Slab (psf)	Slab (k)	Joists (psf)	Joists (k)	Girder Width (in)	Girder Length (ft)	Girder Depth (in)	Girder Load (k)	Beam Width (in)	Beam Length (ft)	Beam Depth (in)	Beam Load (k)	Column Qty Per Size	Column Width (in)	Column Depth (in)	Column Length (ft)	Column Load (k)		
Level 1	21292	7369	13923	21	292.4	20	278.5	56.25	1197.7	41.7	887.9	12	54.7	24.5	16.7	32.0	105.0	24.5	85.8	4	14	14	6.67	5.4	193	**4414**
				99	729.5							30	400	24.5	306.3	12.0	254.0	24.5	77.8	29	12	12	13.33	58.0		
												24	356	24.5	218.1					15	14	14	13.33	40.8		
																				5	16	16	13.33	17.8		
																				1	24	24	13.33	8.0		
Level 2	15136	0	15136	21	317.9	20	302.7	56.25	851.4	41.7	631.2	12	55.67	24.5	17.0	12	121	24.5	37.1	7	14	14	6.67	9.5	133.8	**2896**
												30	353	24.5	270.3	30	129	24.5	98.8	16	12	12	13.33	32.0		
												24	198.9	24.5	121.8					20	14	14	13.33	54.4		
																				5	16	16	13.33	17.8		
Level 3	15067	2394	12673	21	266.1	20	253.5	56.25	847.5	41.7	628.3	12	55.67	24.5	17.0	12	151	24.5	46.2	1	14	14	9.58	2.0	169.3	**3002**
				99	237.0							30	351.3	24.5	269.0					16	12	12	16.25	39.0		
												24	209.8	24.5	128.5					23	14	14	16.25	76.3		
																				5	16	16	16.25	21.7		
Roof	15887	0	0	31	492.5	0	0	56.25	893.6	41.7	662.5	12	65	24.5	19.9	12	97.6	24.5	29.9	16	12	12	9.58	23.0	96.4	**2654**
												30	322	24.5	246.5					16	14	14	9.58	31.3		
												24	236.7	24.5	145.0					5	16	16	9.58	12.8		

Summary of Seismic Forces

	Floor Area			Loads								Total Load, W_x (k)	Force at Level, Fx (k)
	Total Floor Area (sf)	Green Roof Area (sf)	Indoor Floor Area (sf)	Misc Dead (k)	Partitions (k)	Slab (k)	Joists (k)	Girder Load (k)	Beam Load (k)	Column Load (k)	Exterior Wall Load (k)		
Level 1	21292	7369	13923	1021.9	278.5	1197.7	887.9	541.0	163.5	130.0	193	**4414**	**45**
Level 2	15136	0	15136	317.9	302.7	851.4	631.2	409.1	135.8	113.7	133.8	**2896**	**29**
Level 3	15067	2394	12673	503.1	253.5	847.5	628.3	414.5	46.2	138.9	169.3	**3002**	**31**
Roof	15887	0	0	492.5	0.0	893.6	662.5	411.4	29.9	67.1	96.4	**2654**	**27**

$Fx = 0.01W_x$

Seismic Load Base Shear			
	Force (k)	Story Shear (k)	Overturning Moment (ft-k)
Level 1	45.0	132.0	599.9
Level 2	29.0	87.0	773.5
Level 3	31.0	58.0	1240
Roof	27.0	27.0	1869.8
Total	132.0		4483.2

Wind Loads

Wind Design Values

Wind Load Calculations Per ASCE7-10

*Using MWFRS Procedule

Risk Category		III	
Basic Wind Speed	V	120	mph
Wind Directionality Factor	K_d	0.85	
Exposure Category		B	
Topographic Factor	K_{zt}	1.0	
Rigid Structure			
n_a = 43.5/(h^0.9)		1.0	Hz
Gust Effect Factor	G	0.85	(conservative)
Internal Pressure Coefficient	GC_{pi}	0.18	
		-0.18	

Determining K_z and q_z						
	Height above ground, z (ft)	z_g	α	K_z	q_z	q_h
Garden Level	0	1200	7.0	0.57	17.86	27.88
Level 1	13.33	1200	7.0	0.57	17.86	27.88
Level 2	26.67	1200	7.0	0.68	21.23	27.88
Level 3	40.00	1200	7.0	0.76	23.83	27.88
Roof	69.25	1200	7.0	0.89	27.88	27.88

Equations Used:

$p = qGC_p - q_i(GC_{pi})$ (psf)

Force = p*Area (k)

North-South Direction

Windward Wall	C_p =	0.80	L =	110 ft
Leeward Wall	C_p =	-0.50	B =	229 ft
			L/B =	0.48

		q	G	C_p	q_i	GC_{pi}	p (psf)	Area (sf)	Force (k)
WINDWARD	Garden Level	17.86	0.85	0.80	-	-	12.15	1527.4	18.6
	Level 1	17.86	0.85	0.80	-	-	12.15	3052.6	37.1
	Level 2	21.23	0.85	0.80	-	-	14.43	3052.6	44.1
	Level 3	23.83	0.85	0.80	-	-	16.21	4875.4	79.0
	Roof	27.88	0.85	0.80	27.88	-0.18	23.98	3349.1	80.3
LEEWARD	Garden Level	27.88	0.85	-0.50	-	-	-11.85	1527.4	-18.1
	Level 1	27.88	0.85	-0.50	-	-	-11.85	3052.6	-36.2
	Level 2	27.88	0.85	-0.50	-	-	-11.85	3052.6	-36.2
	Level 3	27.88	0.85	-0.50	-	-	-11.85	4875.4	-57.8
	Roof	27.88	0.85	-0.50	27.88	0.18	-16.87	3349.1	-56.5

Wind Load Base Shear & Overturning Moment			
	Force (k)	Story Shear (k)	Overturning Moment (ft-k)
Garden Level	36.6	463.7	0.0
Level 1	73.2	427.0	976.4
Level 2	80.2	353.8	2139.8
Level 3	136.8	273.6	5471.3
Roof	136.8	136.8	9472.8
Total	463.7		18060.3

East-West Direction

Windward Wall	C_p =	0.80	L =	229 ft
Leeward Wall	C_p =	-0.30	B =	110 ft
			L/B =	2.08

		q	G	C_p	q_i	GC_{pi}	p (psf)	Area (sf)	Force (k)
WINDWARD	Garden Level	17.86	0.85	0.80	-	-	12.15	733.7	8.9
	Level 1	17.86	0.85	0.80	-	-	12.15	1466.3	17.8
	Level 2	21.23	0.85	0.80	-	-	14.43	1466.3	21.2
	Level 3	23.83	0.85	0.80	-	-	16.21	2341.9	38.0
	Roof	27.88	0.85	0.80	27.88	-0.18	23.98	1608.8	38.6
LEEWARD	Garden Level	27.88	0.85	-0.30	-	-	-7.01	733.7	-5.1
	Level 1	27.88	0.85	-0.30	-	-	-7.01	1466.3	-10.3
	Level 2	27.88	0.85	-0.30	-	-	-7.01	1466.3	-10.3
	Level 3	27.88	0.85	-0.30	-	-	-7.01	2341.9	-16.4
	Roof	27.88	0.85	-0.30	27.88	0.18	-12.03	1608.8	-19.4

Wind Load Base Shear & Overturning Moment			
	Force (k)	Story Shear (k)	Overturning Moment (ft-k)
Garden Level	14.1	185.9	0.0
Level 1	28.1	171.9	374.5
Level 2	31.5	143.8	838.8
Level 3	54.4	112.3	2175.3
Roof	57.9	57.9	4011.7
Total	185.9		7400.3

Appendix B.2: Determination of Frame Stiffness's

Determination of Stiffness				
	Frame	In-Plane		
		P (k)	Δ (in)	k = P/Δ (k/in)
North-South	6	10	0.03	333.33
	8	10	0.031	322.58
	10	10	0.017	588.24
	13	10	0.017	588.24
East-West	D	10	0.042	238.10
	E	10	0.039	256.41
	G	10	0.042	238.10
	K	10	0.041	243.90

Appendix B.3: Center of Mass and Center of Rigidity

Center of Mass

Center of Mass										
	Weight (pcf) [or psf if no thickness]	Thickness (ft)	Width (ft)	Length (ft)	Area (sf)	Weight (k)	Dist in X-dirn from (0,0) (ft)	Dist in Y-dirn from (0,0) (ft)	Weight*Dx	Weight*Dy
Slab	150.0	0.4	-	-	1863.4	104.8	10.1	70.9	1056.9	7428.7
	150.0	0.4	-	-	1651.9	92.9	42.2	63.0	3918.0	5849.8
	150.0	0.4	-	-	7692.2	432.7	101.3	47.4	43845.6	20516.6
	150.0	0.4	-	-	9951.8	559.8	189.5	55.8	106080.0	31231.6
Slab Openings	150.0	0.4	-	-	-70.0	-3.9	50.3	59.3	-197.9	-233.7
	150.0	0.4	-	-	-134.3	-7.6	74.2	53.4	-560.6	-403.6
	150.0	0.4	-	-	-67.8	-3.8	94.0	48.7	-358.7	-185.7
	150.0	0.4	-	-	-387.9	-21.8	158.5	96.7	-3458.2	-2109.8
	150.0	0.4	-	-	-406.9	-22.9	158.5	54.2	-3628.1	-1240.6
	150.0	0.4	-	-	-69.8	-3.9	188.2	18.5	-739.2	-72.7
	150.0	0.4	-	-	-65.1	-3.7	218.3	13.2	-798.6	-48.3
Joists	41.7	-	-	-	1863.4	77.7	10.1	70.9	783.5	5507.1
	41.7	-	-	-	1651.9	68.9	42.2	63.0	2904.5	4336.7
	41.7	-	-	-	7692.2	320.8	101.3	47.4	32504.2	15209.6
	41.7	-	-	-	9951.8	415.0	189.5	55.8	78640.6	23153.0
Joist Openings	41.7	-	-	-	-70.0	-2.9	50.3	59.3	-146.7	-173.2
	41.7	-	-	-	-134.3	-5.6	74.2	53.4	-415.6	-299.2
	41.7	-	-	-	-67.8	-2.8	94.0	48.7	-265.9	-137.7
	41.7	-	-	-	-387.9	-16.2	158.5	96.7	-2563.7	-1564.1
	41.7	-	-	-	-406.9	-17.0	158.5	54.2	-2689.6	-919.7
	41.7	-	-	-	-69.8	-2.9	188.2	18.5	-548.0	-53.9
	41.7	-	-	-	-65.1	-2.7	218.3	13.2	-592.0	-35.8
Columns	150.0	1.5	1.5	6.7	10.0	2.2	1.1	95.8	2.4	215.4
	150.0	1.5	1.5	6.7	10.0	2.2	1.1	83.3	2.4	187.3
	150.0	1.5	1.5	6.7	10.0	2.2	1.1	55.3	2.4	124.5
	150.0	1.5	1.5	13.3	20.0	4.5	6.0	94.4	27.0	424.8
	150.0	1.5	1.5	13.3	20.0	4.5	6.0	81.8	27.0	367.8
	150.0	1.5	1.5	13.3	20.0	4.5	6.0	54	27.0	242.9
	150.0	1.5	1.5	13.3	20.0	4.5	38.3	86.3	172.4	388.4
	150.0	1.5	1.5	13.3	20.0	4.5	33.8	68.3	152.2	307.0
	150.0	1.5	1.5	13.3	20.0	4.5	28.8	48.3	129.7	217.1
	150.0	1.5	1.5	6.7	10.0	2.2	27.3	41.8	61.3	94.1
	150.0	1.5	1.5	13.3	20.0	4.5	71.8	91.2	323.2	410.1
	150.0	1.5	1.5	13.3	20.0	4.5	68.8	78.8	309.3	354.3
	150.0	1.5	1.5	13.3	20.0	4.5	64.3	60.8	289.1	273.3
	150.0	1.5	1.5	13.3	20.0	4.5	57.3	33.4	257.9	150.3
	150.0	1.5	1.5	13.3	20.0	4.5	57.7	22.3	259.5	100.5
	150.0	1.5	1.5	13.3	20.0	4.5	49.9	22.3	224.6	100.5
	150.0	1.5	1.5	13.3	20.0	4.5	101.7	95.4	457.4	429.3
	150.0	1.5	1.5	13.3	20.0	4.5	95.8	72.0	431.1	323.9
	150.0	1.5	1.5	13.3	20.0	4.5	91.3	54.0	410.9	242.9
	150.0	1.5	1.5	13.3	20.0	4.5	84.4	26.7	379.8	120.0
	150.0	1.5	1.5	13.3	20.0	4.5	84.5	1.0	380.2	4.5
	150.0	1.5	1.5	13.3	20.0	4.5	130.0	99.4	584.9	447.3
	150.0	1.5	1.5	13.3	20.0	4.5	121.5	65.5	546.6	294.7
	150.0	1.5	1.5	13.3	20.0	4.5	117.0	47.5	526.4	213.7
	150.0	1.5	1.5	13.3	20.0	4.5	110.1	20.3	495.3	91.1
	150.0	1.5	1.5	13.3	20.0	4.5	110.2	1.0	495.6	4.5
	150.0	1.5	1.5	13.3	20.0	4.5	142.0	60.5	638.8	272.2
	150.0	1.5	1.5	13.3	20.0	4.5	142.0	47.9	638.8	215.6
	150.0	1.5	1.5	13.3	20.0	4.5	142.0	23.4	638.8	105.4
	150.0	1.5	1.5	13.3	20.0	4.5	142.0	12.3	638.8	55.1
	150.0	1.5	1.5	13.3	20.0	4.5	142.0	2.9	638.8	13.1
	150.0	1.5	1.5	13.3	20.0	4.5	174.5	106.0	785.1	476.9
	150.0	1.5	1.5	13.3	20.0	4.5	174.5	80.9	785.1	364.0
	150.0	1.5	1.5	13.3	20.0	4.5	174.5	60.5	785.1	272.2
	150.0	1.5	1.5	13.3	20.0	4.5	174.5	47.9	785.1	215.6
	150.0	1.5	1.5	13.3	20.0	4.5	174.5	32.3	785.1	145.1
	150.0	1.5	1.5	13.3	20.0	4.5	174.5	23.4	785.1	105.4
	150.0	1.5	1.5	13.3	20.0	4.5	174.5	2.3	785.1	10.5
	150.0	1.5	1.5	13.3	20.0	4.5	191.5	106.0	861.5	476.9
	150.0	1.5	1.5	13.3	20.0	4.5	191.5	80.9	861.5	364.0
	150.0	1.5	1.5	13.3	20.0	4.5	191.5	60.5	861.5	272.2
	150.0	1.5	1.5	13.3	20.0	4.5	191.5	47.9	861.5	215.6
	150.0	1.5	1.5	13.3	20.0	4.5	191.5	32.3	861.5	145.1
	150.0	1.5	1.5	13.3	20.0	4.5	191.5	23.4	861.5	105.4
	150.0	1.5	1.5	13.3	20.0	4.5	191.5	2.3	861.5	10.5
	150.0	1.5	1.5	13.3	20.0	4.5	216.5	106.0	974.0	476.9
	150.0	1.5	1.5	13.3	20.0	4.5	216.5	80.9	974.0	364.0
	150.0	1.5	1.5	13.3	20.0	4.5	216.5	60.5	974.0	272.2
	150.0	1.5	1.5	13.3	20.0	4.5	216.5	47.9	974.0	215.6
	150.0	1.5	1.5	13.3	20.0	4.5	216.5	32.3	974.0	145.1
	150.0	1.5	1.5	13.3	20.0	4.5	216.5	23.4	974.0	105.4
	150.0	1.5	1.5	13.3	20.0	4.5	216.5	2.3	974.0	10.5

	150.0	1.5	1.5	13.3	20.0	4.5	237.0	107.8	1066.2	485.1
	150.0	1.5	1.5	13.3	20.0	4.5	237.0	80.9	1066.2	364.0
Beams	150.0	2.0	2.7	39.0	104.0	31.9	19.2	91.2	610.5	2903.7
	150.0	2.0	2.7	36.5	97.3	29.8	17.7	79.0	526.6	2354.9
	150.0	2.0	2.7	29.2	77.8	23.8	14.2	52.0	337.5	1238.6
	150.0	2.0	1.0	104.8	104.8	32.1	90.2	93.8	2894.8	3009.9
	150.0	2.0	1.0	86.8	86.8	26.6	99.5	22.9	2643.4	608.8
	150.0	2.0	1.0	32.0	32.0	9.8	158.3	60.5	1551.6	592.9
	150.0	2.0	1.0	32.0	32.0	9.8	158.3	47.9	1551.6	469.6
Girders	150.0	2.0	1.0	54.6	54.6	16.7	6.0	73.5	100.3	1228.6
	150.0	2.0	2.5	52.8	131.9	40.4	33.3	66.5	1346.1	2685.7
	150.0	2.0	2.5	59.5	148.8	45.6	64.6	62.3	2942.1	2835.8
	150.0	2.0	2.5	11.0	27.5	8.4	57.6	27.9	485.0	235.1
	150.0	2.0	2.5	70.8	177.1	54.2	93.0	61.0	5043.5	3308.1
	150.0	2.0	2.5	25.1	62.7	19.2	84.5	14.0	1622.8	268.9
	150.0	2.0	2.5	81.6	204.0	62.5	120.0	59.8	7495.4	3737.3
	150.0	2.0	2.5	18.8	46.9	14.4	110.2	10.9	1581.5	156.7
	150.0	2.0	2.5	80.2	200.4	61.4	142.0	43.5	8715.7	2669.9
	150.0	2.0	2.0	105.8	211.5	64.8	174.5	55.2	11302.7	3573.3
	150.0	2.0	2.0	105.2	210.3	64.4	191.5	55.4	12335.4	3569.7
	150.0	2.0	2.0	105.8	211.5	64.8	216.5	55.2	14023.1	3573.3
	150.0	2.0	2.0	39.7	79.3	24.3	237.0	87.0	5758.2	2113.8
Exterior Walls										
North Walls										
	13.9	-	-	-	648.7	9.0	20.3	97.9	183.1	882.8
	12.9	-	-	-	639.4	8.2	138.5	99.1	1142.3	817.4
	12.0	-	-	-	1712.0	20.5	138.5	99.1	2845.3	2035.9
	28.0	-	-	-	103.6	2.9	158.2	72.1	458.9	209.2
	176.5	-	-	-	34.3	6.1	232.4	109.4	1406.6	662.1
East Walls										
	12.0	-	-	-	121.9	1.5	236.4	87.9	345.8	128.6
	12.9	-	-	-	341.4	4.4	234.4	55.6	1032.3	244.9
	176.5	-	-	-	178.7	31.5	232.9	32.1	7347.0	1012.6
	28.0	-	-	-	267.8	7.5	232.9	17.1	1746.1	128.2
South Walls										
	12.9	-	-	-	231.2	3.0	202.7	1.4	604.6	4.2
	12.0	-	-	-	193.6	2.3	157.9	1.4	366.9	3.3
	28.0	-	-	-	463.0	13.0	96.2	1.3	1247.1	16.9
	12.0	-	-	-	307.6	3.7	96.2	1.3	355.1	4.8
	12.0	-	-	-	627.8	7.5	27.9	41.0	210.2	308.9
West Walls										
	12.9	-	-	-	482.3	6.2	0.3	65.6	1.9	408.1
	28.0	-	-	-	225.2	6.3	0.3	92.8	1.9	585.1
	28.0	-	-	-	209.3	5.9	49.7	12.2	291.2	71.5
	176.5	-	-	-	120.3	21.2	49.7	12.2	1054.9	258.9
Totals						3054.3			386925.5	167082.0

Center of Mass	
X - Direction	126.7
Y - Direction	54.7

Center of Rigidity

Center of Rigidity						
	Frame	Stiffness, k (k/in)	Dist in X-dirn from (0,0) (ft)	Dist in Y-dirn from (0,0) (ft)	k*Dx	k*Dy
North-South	6	333.3	64.8	-	21583.3	-
	8	322.6	120.2	-	38776.8	-
	10	588.2	174.7	-	102763.5	-
	13	588.2	216.7	-	127469.4	-
East-West	D	238.1	-	75.9	-	18082.9
	E	256.4	-	47.9	-	12286.4
	G	238.1	-	57.9	-	13784.8
	K	243.9	-	23.4	-	5711.5

$\sum k*Dx =$ 290593.0

$\sum k_{NS} =$ 1832.4

$\sum k*Dy =$ 49865.5

$\sum k_{EW} =$ 976.5

Center of Rigidity		
Xr =	158.59	ft
Yr =	51.07	ft

Appendix B.4: Wind Load Cases

Wind Load Input Values

Distribution of Level 1 Story Shear Force				
	N-S		E-W	
Center of Rigidity	158.6	ft	51.1	ft
Center of Mass	126.7	ft	54.7	ft
|CR-CM| =	31.9	ft	3.6	ft
By	229.0	ft		
0.15 By	34.4	ft		
Bx	110.0	ft		
0.15 Bx	16.5	ft		

Wind Case 1

North-South

Wind Case 1: North-South			
F_{NS} (kip)	463.7	e_{NS} (ft)	31.9
F_{EW} (kip)	0.0	e_{EW} (ft)	0.0
M_{NS} (k-ft)	14787.2		
M_{EW} (k-ft)	0.0		

	Frame	k (k/in)	$\sum k_{NS}$ (k/in)	$\sum k_{EW}$ (k/in)	Direct Shear (kip)	d (in)	kd^2	$J = \sum kd^2$	Torsional Shear (kip)	Total Shear (kip)
North-South	6	333.3	1832.4	-	84.4	93.84	2935150.7	5896874.7	78.4	162.8
	8	322.6	1832.4	-	81.6	38.38	475153.6	5896874.7	31.0	112.7
	10	588.2	1832.4	-	148.9	-16.11	152677.9	5896874.7	-23.8	125.1
	13	588.2	1832.4	-	148.9	-58.11	1986379.6	5896874.7	-85.7	63.1
East-West	D	238.1	-	976.5	0.0	24.88	147415.6	5896874.7	14.9	14.9
	E	256.4	-	976.5	0.0	-3.15	2541.6	5896874.7	-2.0	-2.0
	G	238.1	-	976.5	0.0	6.83	11108.9	5896874.7	4.1	4.1
	K	243.9	-	976.5	0.0	-27.65	186446.9	5896874.7	-16.9	-16.9

East-West

Wind Case 1: East-West			
F_{NS} (kip)	0.0	e_{NS} (ft)	0.0
F_{EW} (kip)	185.9	e_{EW} (ft)	3.6
M_{NS} (k-ft)	0.0		
M_{EW} (k-ft)	674.9		

	Frame	k (k/in)	$\sum k_{NS}$ (k/in)	$\sum k_{EW}$ (k/in)	Direct Shear (kip)	d (in)	kd^2	$J = \sum kd^2$	Torsional Shear (kip)	Total Shear (kip)
North-South	6	333.3	1832.4	-	0.0	93.84	2935150.7	5896874.7	3.6	3.6
	8	322.6	1832.4	-	0.0	38.38	475153.6	5896874.7	1.4	1.4
	10	588.2	1832.4	-	0.0	-16.11	152677.9	5896874.7	-1.1	-1.1
	13	588.2	1832.4	-	0.0	-58.11	1986379.6	5896874.7	-3.9	-3.9
East-West	D	238.1	-	976.5	45.3	24.88	147415.6	5896874.7	0.7	46.0
	E	256.4	-	976.5	48.8	-3.15	2541.6	5896874.7	-0.1	48.7
	G	238.1	-	976.5	45.3	6.83	11108.9	5896874.7	0.2	45.5
	K	243.9	-	976.5	46.4	-27.65	186446.9	5896874.7	-0.8	45.7

Wind Case 2

North-South + 0.15By

Wind Case 2: North-South + 0.15 By			
0.75 F_{NS} (kip)	347.8	e_{NS} (ft)	66.2
0.75 F_{EW} (kip)	0.0	e_{EW} (ft)	0.0
M_{NS} (k-ft)	23036.4		
M_{EW} (k-ft)	0.0		

	Frame	k (k/in)	$\sum k_{NS}$ (k/in)	$\sum k_{EW}$ (k/in)	Direct Shear (kip)	d (in)	kd^2	$J = \sum kd^2$	Torsional Shear (kip)	Total Shear (kip)
North-South	6	333.3	1832.4	-	63.3	93.84	2935150.7	5896874.7	122.2	185.5
	8	322.6	1832.4	-	61.2	38.38	475153.6	5896874.7	48.4	109.6
	10	588.2	1832.4	-	111.6	-16.11	152677.9	5896874.7	-37.0	74.6
	13	588.2	1832.4	-	111.6	-58.11	1986379.6	5896874.7	-133.5	-21.9
East-West	D	238.1	-	976.5	0.0	24.88	147415.6	5896874.7	23.1	23.1
	E	256.4	-	976.5	0.0	-3.15	2541.6	5896874.7	-3.2	-3.2
	G	238.1	-	976.5	0.0	6.83	11108.9	5896874.7	6.4	6.4
	K	243.9	-	976.5	0.0	-27.65	186446.9	5896874.7	-26.3	-26.3

North-South - 0.15By

Wind Case 2: North-South - 0.15 By			
0.75 F_{NS} (kip)	347.8	e_{NS} (ft)	-2.5
0.75 F_{EW} (kip)	0.0	e_{EW} (ft)	0.0
M_{NS} (k-ft)	-855.5		
M_{EW} (k-ft)	0.0		

	Frame	k (k/in)	$\sum k_{NS}$ (k/in)	$\sum k_{EW}$ (k/in)	Direct Shear (kip)	d (in)	kd^2	$J = \sum kd^2$	Torsional Shear (kip)	Total Shear (kip)
North-South	6	333.3	1832.4	-	63.3	93.84	2935150.7	5896874.7	-4.5	58.7
	8	322.6	1832.4	-	61.2	38.38	475153.6	5896874.7	-1.8	59.4
	10	588.2	1832.4	-	111.6	-16.11	152677.9	5896874.7	1.4	113.0
	13	588.2	1832.4	-	111.6	-58.11	1986379.6	5896874.7	5.0	116.6
East-West	D	238.1	-	976.5	0.0	24.88	147415.6	5896874.7	-0.9	-0.9
	E	256.4	-	976.5	0.0	-3.15	2541.6	5896874.7	0.1	0.1
	G	238.1	-	976.5	0.0	6.83	11108.9	5896874.7	-0.2	-0.2
	K	243.9	-	976.5	0.0	-27.65	186446.9	5896874.7	1.0	1.0

East-West + 0.15By

Wind Case 2: East-West + 0.15 Bx			
0.75 F_{NS} (kip)	0.0	e_{NS} (ft)	0.0
0.75 F_{EW} (kip)	139.4	e_{EW} (ft)	20.1
M_{NS} (k-ft)	0.0		
M_{EW} (k-ft)	2806.8		

	Frame	k (k/in)	$\sum k_{NS}$ (k/in)	$\sum k_{EW}$ (k/in)	Direct Shear (kip)	d (in)	kd^2	$J = \sum kd^2$	Torsional Shear (kip)	Total Shear (kip)
North-South	6	333.3	1832.4	-	0.0	93.84	2935150.7	5896874.7	14.9	14.9
	8	322.6	1832.4	-	0.0	38.38	475153.6	5896874.7	5.9	5.9
	10	588.2	1832.4	-	0.0	-16.11	152677.9	5896874.7	-4.5	-4.5
	13	588.2	1832.4	-	0.0	-58.11	1986379.6	5896874.7	-16.3	-16.3
East-West	D	238.1	-	976.5	34.0	24.88	147415.6	5896874.7	2.8	36.8
	E	256.4	-	976.5	36.6	-3.15	2541.6	5896874.7	-0.4	36.2
	G	238.1	-	976.5	34.0	6.83	11108.9	5896874.7	0.8	34.8
	K	243.9	-	976.5	34.8	-27.65	186446.9	5896874.7	-3.2	31.6

East-West - 0.15By

Wind Case 2: East-West - 0.15 Bx			
0.75 F_{NS} (kip)	0.0	e_{NS} (ft)	0.0
0.75 F_{EW} (kip)	139.4	e_{EW} (ft)	-12.9
M_{NS} (k-ft)	0.0		
M_{EW} (k-ft)	-1794.5		

	Frame	k (k/in)	$\sum k_{NS}$ (k/in)	$\sum k_{EW}$ (k/in)	Direct Shear (kip)	d (in)	kd^2	$J = \sum kd^2$	Torsional Shear (kip)	Total Shear (kip)
North-South	6	333.3	1832.4	-	0.0	93.84	2935150.7	5896874.7	-9.5	-9.5
	8	322.6	1832.4	-	0.0	38.38	475153.6	5896874.7	-3.8	-3.8
	10	588.2	1832.4	-	0.0	-16.11	152677.9	5896874.7	2.9	2.9
	13	588.2	1832.4	-	0.0	-58.11	1986379.6	5896874.7	10.4	10.4
East-West	D	238.1	-	976.5	34.0	24.88	147415.6	5896874.7	-1.8	32.2
	E	256.4	-	976.5	36.6	-3.15	2541.6	5896874.7	0.2	36.9
	G	238.1	-	976.5	34.0	6.83	11108.9	5896874.7	-0.5	33.5
	K	243.9	-	976.5	34.8	-27.65	186446.9	5896874.7	2.1	36.9

Wind Case 3

North-South and East-West

Wind Case 3: NS + EW			
0.75 F_{NS} (kip)	347.8	e_{NS} (ft)	31.9
0.75 F_{EW} (kip)	139.4	e_{EW} (ft)	3.6
M_{NS} (k-ft)	11090.4		
M_{EW} (k-ft)	506.1		

	Frame	k (k/in)	$\sum k_{NS}$ (k/in)	$\sum k_{EW}$ (k/in)	Direct Shear (kip)	d (in)	kd^2	$J = \sum kd^2$	Torsional Shear (kip)	Total Shear (kip)
North-South	6	333.3	1832.4	-	63.3	93.84	2935150.7	5896874.7	61.5	124.8
	8	322.6	1832.4	-	61.2	38.38	475153.6	5896874.7	24.3	85.6
	10	588.2	1832.4	-	111.6	-16.11	152677.9	5896874.7	-18.6	93.0
	13	588.2	1832.4	-	111.6	-58.11	1986379.6	5896874.7	-67.2	44.4
East-West	D	238.1	-	976.5	34.0	24.88	147415.6	5896874.7	11.7	45.6
	E	256.4	-	976.5	36.6	-3.15	2541.6	5896874.7	-1.6	35.0
	G	238.1	-	976.5	34.0	6.83	11108.9	5896874.7	3.2	37.2
	K	243.9	-	976.5	34.8	-27.65	186446.9	5896874.7	-13.3	21.6

Wind Case 4

(North-South + 0.15By)+(East-West + 0.15Bx)

Wind Case 4: (N-S + 0.15 By) + (E-W + 0.15 Bx)			
0.563 F_{NS} (kip)	261.1	e_{NS} (ft)	66.2
0.563 F_{EW} (kip)	104.7	e_{EW} (ft)	20.1
M_{NS} (k-ft)	17292.6		
M_{EW} (k-ft)	2107.0		

	Frame	k (k/in)	$\sum k_{NS}$ (k/in)	$\sum k_{EW}$ (k/in)	Direct Shear (kip)	d (in)	kd^2	$J = \sum kd^2$	Torsional Shear (kip)	Total Shear (kip)
North-South	6	333.3	1832.4	-	47.5	93.84	2935150.7	5896874.7	102.9	150.4
	8	322.6	1832.4	-	46.0	38.38	475153.6	5896874.7	40.7	86.7
	10	588.2	1832.4	-	83.8	-16.11	152677.9	5896874.7	-31.2	52.6
	13	588.2	1832.4	-	83.8	-58.11	1986379.6	5896874.7	-112.5	-28.6
East-West	D	238.1	-	976.5	25.5	24.88	147415.6	5896874.7	19.5	45.0
	E	256.4	-	976.5	27.5	-3.15	2541.6	5896874.7	-2.7	24.8
	G	238.1	-	976.5	25.5	6.83	11108.9	5896874.7	5.4	30.9
	K	243.9	-	976.5	26.1	-27.65	186446.9	5896874.7	-22.2	4.0

(North-South + 0.15By)+(East-West - 0.15Bx)

Wind Case 4: (N-S + 0.15 By) + (E-W - 0.15 Bx)			
0.563 F_{NS} (kip)	261.1	e_{NS} (ft)	66.2
0.563 F_{EW} (kip)	104.7	e_{EW} (ft)	-12.9
M_{NS} (k-ft)	17292.6		
M_{EW} (k-ft)	-1347.1		

	Frame	k (k/in)	$\sum k_{NS}$ (k/in)	$\sum k_{EW}$ (k/in)	Direct Shear (kip)	d (in)	kd^2	$J = \sum kd^2$	Torsional Shear (kip)	Total Shear (kip)
North-South	6	333.3	1832.4	-	47.5	93.84	2935150.7	5896874.7	84.6	132.1
	8	322.6	1832.4	-	46.0	38.38	475153.6	5896874.7	33.5	79.4
	10	588.2	1832.4	-	83.8	-16.11	152677.9	5896874.7	-25.6	58.2
	13	588.2	1832.4	-	83.8	-58.11	1986379.6	5896874.7	-92.4	-8.6
East-West	D	238.1	-	976.5	25.5	24.88	147415.6	5896874.7	16.0	41.5
	E	256.4	-	976.5	27.5	-3.15	2541.6	5896874.7	-2.2	25.3
	G	238.1	-	976.5	25.5	6.83	11108.9	5896874.7	4.4	29.9
	K	243.9	-	976.5	26.1	-27.65	186446.9	5896874.7	-18.2	7.9

(North-South - 0.15By)+(East-West + 0.15Bx)

Wind Case 4: (N-S - 0.15 By) + (E-W + 0.15 Bx)			
0.563 F_{NS} (kip)	261.1	e_{NS} (ft)	-2.5
0.563 F_{EW} (kip)	104.7	e_{EW} (ft)	20.1
M_{NS} (k-ft)	-642.2		
M_{EW} (k-ft)	2107.0		

	Frame	k (k/in)	$\sum k_{NS}$ (k/in)	$\sum k_{EW}$ (k/in)	Direct Shear (kip)	d (in)	kd^2	$J = \sum kd^2$	Torsional Shear (kip)	Total Shear (kip)
North-South	6	333.3	1832.4	-	47.5	93.84	2935150.7	5896874.7	7.8	55.3
	8	322.6	1832.4	-	46.0	38.38	475153.6	5896874.7	3.1	49.0
	10	588.2	1832.4	-	83.8	-16.11	152677.9	5896874.7	-2.4	81.5
	13	588.2	1832.4	-	83.8	-58.11	1986379.6	5896874.7	-8.5	75.3
East-West	D	238.1	-	976.5	25.5	24.88	147415.6	5896874.7	1.5	27.0
	E	256.4	-	976.5	27.5	-3.15	2541.6	5896874.7	-0.2	27.3
	G	238.1	-	976.5	25.5	6.83	11108.9	5896874.7	0.4	25.9
	K	243.9	-	976.5	26.1	-27.65	186446.9	5896874.7	-1.7	24.5

(North-South - 0.15By)+(East-West - 0.15Bx)

Wind Case 4: (N-S - 0.15 By) + (E-W - 0.15 Bx)			
0.563 F_{NS} (kip)	261.1	e_{NS} (ft)	-2.5
0.563 F_{EW} (kip)	104.7	e_{EW} (ft)	-12.9
M_{NS} (k-ft)	-642.2		
M_{EW} (k-ft)	-1347.1		

	Frame	k (k/in)	$\sum k_{NS}$ (k/in)	$\sum k_{EW}$ (k/in)	Direct Shear (kip)	d (in)	kd^2	$J = \sum kd^2$	Torsional Shear (kip)	Total Shear (kip)
North-South	6	333.3	1832.4	-	47.5	93.84	2935150.7	5896874.7	-10.6	36.9
	8	322.6	1832.4	-	46.0	38.38	475153.6	5896874.7	-4.2	41.8
	10	588.2	1832.4	-	83.8	-16.11	152677.9	5896874.7	3.2	87.0
	13	588.2	1832.4	-	83.8	-58.11	1986379.6	5896874.7	11.5	95.3
East-West	D	238.1	-	976.5	25.5	24.88	147415.6	5896874.7	-2.0	23.5
	E	256.4	-	976.5	27.5	-3.15	2541.6	5896874.7	0.3	27.8
	G	238.1	-	976.5	25.5	6.83	11108.9	5896874.7	-0.5	25.0
	K	243.9	-	976.5	26.1	-27.65	186446.9	5896874.7	2.3	28.4

Appendix B.5: Column Lateral Loadings to be Used in spColumn Analysis

RISA Lateral Results to be Used in spColumn Analysis				
	Column	P (kip)	M (ft-k)	Direction
Frame 8	Z	6.887	-141.789	y
	D	3.532	-197.876	y
	G	-0.857	-203.875	y
	M	-9.563	-159.903	y
Frame 13	A.2	5.524	-80.339	y
	B	-0.201	-106.708	y
	C	2.752	-108.529	y
	E	-1.436	-111.652	y
	H	7.706	-117.023	y
	K	-6.849	-121.915	y
	N	-7.495	-96.467	y
Frame D	8	3.083	-43.415	x
Frame E	13	3.135	-42.596	x
Frame G	8	3.05	-42.943	x
Frame K	13	3.094	-42.275	x

*NOTE: Positive axial forces denote compression.

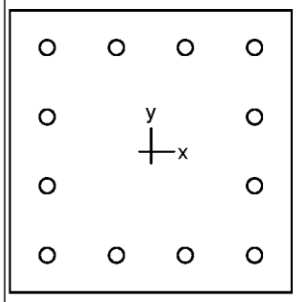
*NOTE: Because negative axial forces denote tension, thus helping to resist some of the compressive forces, these forces will not be considered during analysis of the columns.

*NOTE: Positive moments denote that the left hand face of the upper column is in tension and the right hand face of the bottom column is in tension.

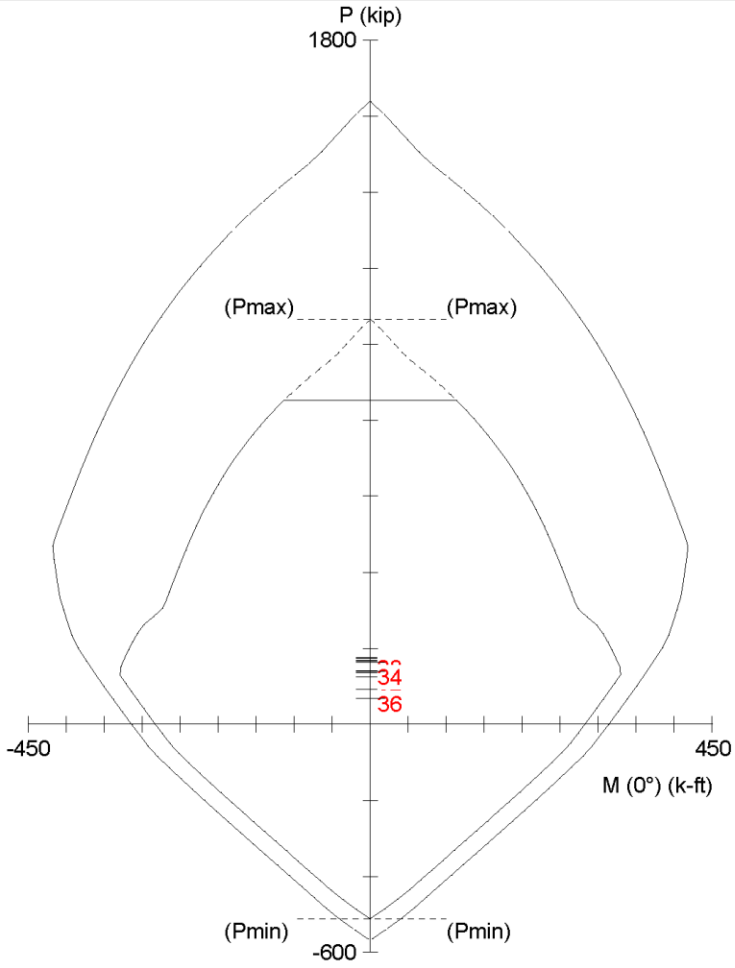
Appendix B.6: spColumn Output for Final Column Designs

Column Line 8 Columns

Column 8Z



18 x 18 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/18/14

Time: 12:33:31

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

File: F:\SPRING\Lateral\Column Designs\Frame 8 - 8Z.col

Project: Lateral System

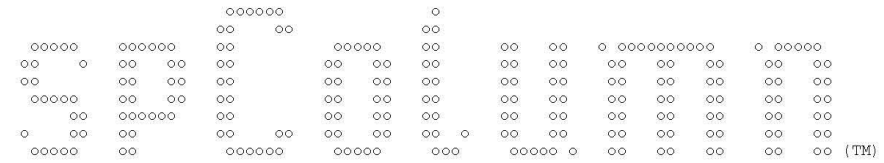
Column: 8Z

Engineer: ahm

f'c = 4 ksi	fy = 60 ksi	Ag = 324 in^2	12 #8 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 9.48 in^2	rho = 2.93%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 8748 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 8748 in^4
Beta1 = 0.85		Min clear spacing = 3.42 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



spColumn v4.81 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

General Information:
==========
File Name: F:\SPRING\Lateral\Column Designs\Frame 8 - 8Z.col
Project: Lateral System
Column: 8Z Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 18 in Depth = 18 in

Gross section area, Ag = 324 in^2
Ix = 8748 in^4 Iy = 8748 in^4
rx = 5.19615 in ry = 5.19615 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 3.24 in^2, Asmax = 0.08 * Ag = 25.92 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 9.48 in^2 at rho = 2.93%
Minimum clear spacing = 3.42 in

12 #8 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	88.83	0.00	0.00	35.40	0.00
	Live	38.36	0.00	0.00	16.15	0.00
	Wind	6.89	0.00	0.00	-141.79	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	14.72	0.00	0.00	6.87	0.00
2	Dead	88.83	0.00	0.00	35.40	0.00
	Live	37.10	0.00	0.00	16.98	0.00
	Wind	6.89	0.00	0.00	-141.79	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	14.72	0.00	0.00	6.87	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.000*Snow
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.000*Snow

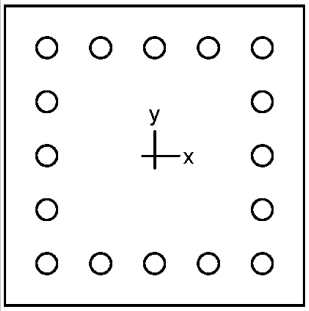
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

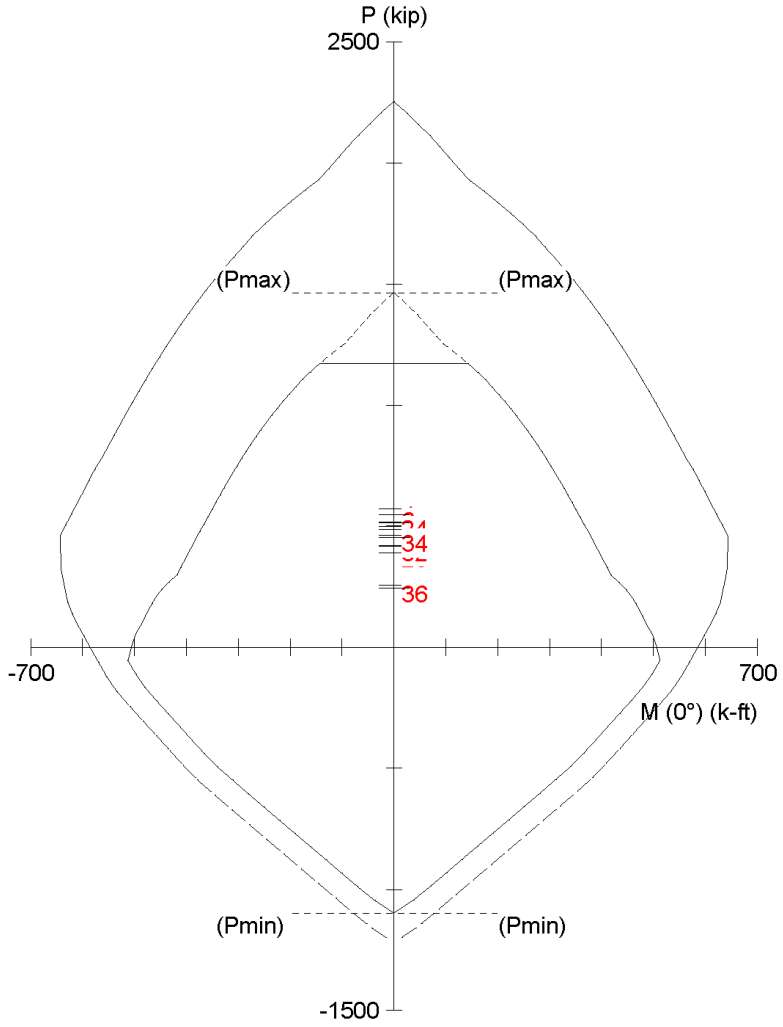
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	124.36	0.00	49.56	-0.00	327.03	6.599	5.73	15.63	0.00518	0.900
2		124.36	0.00	0.00	327.03	0.00	999.999	5.73	15.63	0.00518	0.900
3	1 U2	175.33	0.00	71.76	-0.00	322.53	4.495	6.49	15.63	0.00422	0.834
4		175.33	0.00	0.00	322.53	0.00	999.999	6.49	15.63	0.00422	0.834
5	1 U3	168.51	0.00	69.62	-0.00	324.18	4.656	6.37	15.63	0.00436	0.846
6		168.51	0.00	0.00	324.18	0.00	999.999	6.37	15.63	0.00436	0.846
7	1 U4	135.66	0.00	-59.96	0.00	-330.85	5.518	5.85	15.63	0.00501	0.900
8		135.66	0.00	0.00	330.85	0.00	999.999	5.85	15.63	0.00501	0.900
9	1 U5	163.34	0.00	-164.80	0.00	-325.38	1.974	6.28	15.63	0.00447	0.854
10		163.34	0.00	0.00	325.38	0.00	999.999	6.28	15.63	0.00447	0.854
11	1 U6	90.97	0.00	-195.00	0.00	-315.47	1.618	5.37	15.63	0.00573	0.900
12		90.97	0.00	0.00	315.47	0.00	999.999	5.37	15.63	0.00573	0.900
13	1 U7	124.64	0.00	166.90	-0.00	327.12	1.960	5.73	15.63	0.00518	0.900
14		124.64	0.00	0.00	327.12	0.00	999.999	5.73	15.63	0.00518	0.900
15	1 U8	141.30	0.00	288.93	-0.00	330.01	1.142	5.93	15.63	0.00490	0.891
16		141.30	0.00	0.00	330.01	0.00	999.999	5.93	15.63	0.00490	0.891
17	1 U9	68.93	0.00	258.72	-0.00	307.62	1.189	5.15	15.63	0.00611	0.900
18		68.93	0.00	0.00	307.62	0.00	999.999	5.15	15.63	0.00611	0.900
19	2 U1	124.36	0.00	49.56	-0.00	327.03	6.599	5.73	15.63	0.00518	0.900
20		124.36	0.00	0.00	327.03	0.00	999.999	5.73	15.63	0.00518	0.900
21	2 U2	173.32	0.00	73.08	-0.00	323.03	4.420	6.45	15.63	0.00426	0.837
22		173.32	0.00	0.00	323.03	0.00	999.999	6.45	15.63	0.00426	0.837
23	2 U3	167.25	0.00	70.45	-0.00	324.48	4.606	6.35	15.63	0.00439	0.848
24		167.25	0.00	0.00	324.48	0.00	999.999	6.35	15.63	0.00439	0.848
25	2 U4	135.66	0.00	-59.96	0.00	-330.85	5.518	5.85	15.63	0.00501	0.900
26		135.66	0.00	0.00	330.85	0.00	999.999	5.85	15.63	0.00501	0.900
27	2 U5	162.08	0.00	-163.97	0.00	-325.67	1.986	6.26	15.63	0.00449	0.857
28		162.08	0.00	0.00	325.67	0.00	999.999	6.26	15.63	0.00449	0.857
29	2 U6	90.97	0.00	-195.00	0.00	-315.47	1.618	5.37	15.63	0.00573	0.900
30		90.97	0.00	0.00	315.47	0.00	999.999	5.37	15.63	0.00573	0.900
31	2 U7	124.64	0.00	166.90	-0.00	327.12	1.960	5.73	15.63	0.00518	0.900
32		124.64	0.00	0.00	327.12	0.00	999.999	5.73	15.63	0.00518	0.900
33	2 U8	140.04	0.00	289.76	-0.00	330.25	1.140	5.92	15.63	0.00492	0.894
34		140.04	0.00	0.00	330.25	0.00	999.999	5.92	15.63	0.00492	0.894
35	2 U9	68.93	0.00	258.72	-0.00	307.62	1.189	5.15	15.63	0.00611	0.900
36		68.93	0.00	0.00	307.62	0.00	999.999	5.15	15.63	0.00611	0.900

*** End of output ***

Column 8D



18 x 18 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/18/14

Time: 13:45:44

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

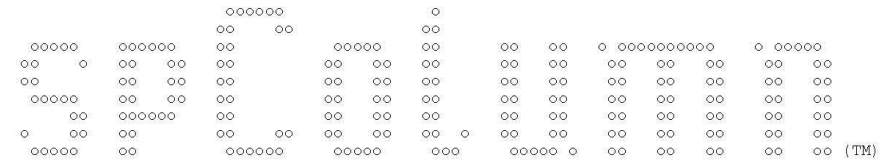
File: F:\SPRING\Lateral\Column Designs\Frame 8 - 8D.col

Project: Lateral System

Column: 8D		Engineer: ahm	
f'c = 4 ksi	fy = 60 ksi	Ag = 324 in^2	16 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 20.32 in^2	rho = 6.27%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 8748 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 8748 in^4
Beta1 = 0.85		Min clear spacing = 1.98 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



==========

spColumn v4.81 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

==========

General Information:
==========
File Name: F:\SPRING\Lateral\Column Designs\Frame 8 - 8D.col
Project: Lateral System
Column: 8D Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 18 in Depth = 18 in

Gross section area, Ag = 324 in^2
Ix = 8748 in^4 Iy = 8748 in^4
rx = 5.19615 in ry = 5.19615 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 3.24 in^2, Asmax = 0.08 * Ag = 25.92 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 20.32 in^2 at rho = 6.27%
Minimum clear spacing = 1.98 in

16 #10 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	278.71	0.00	0.00	-18.89	0.00
	Live	131.44	0.00	0.00	-6.58	0.00
	Wind	3.53	0.00	0.00	-197.88	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	51.76	0.00	0.00	-4.54	0.00
2	Dead	278.71	0.00	0.00	-18.89	0.00
	Live	97.22	0.00	0.00	-10.91	0.00
	Wind	3.53	0.00	0.00	-197.88	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	51.76	0.00	0.00	-4.54	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.000*Snow
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.000*Snow

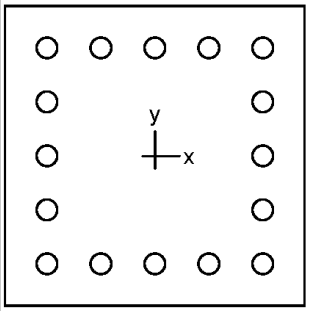
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

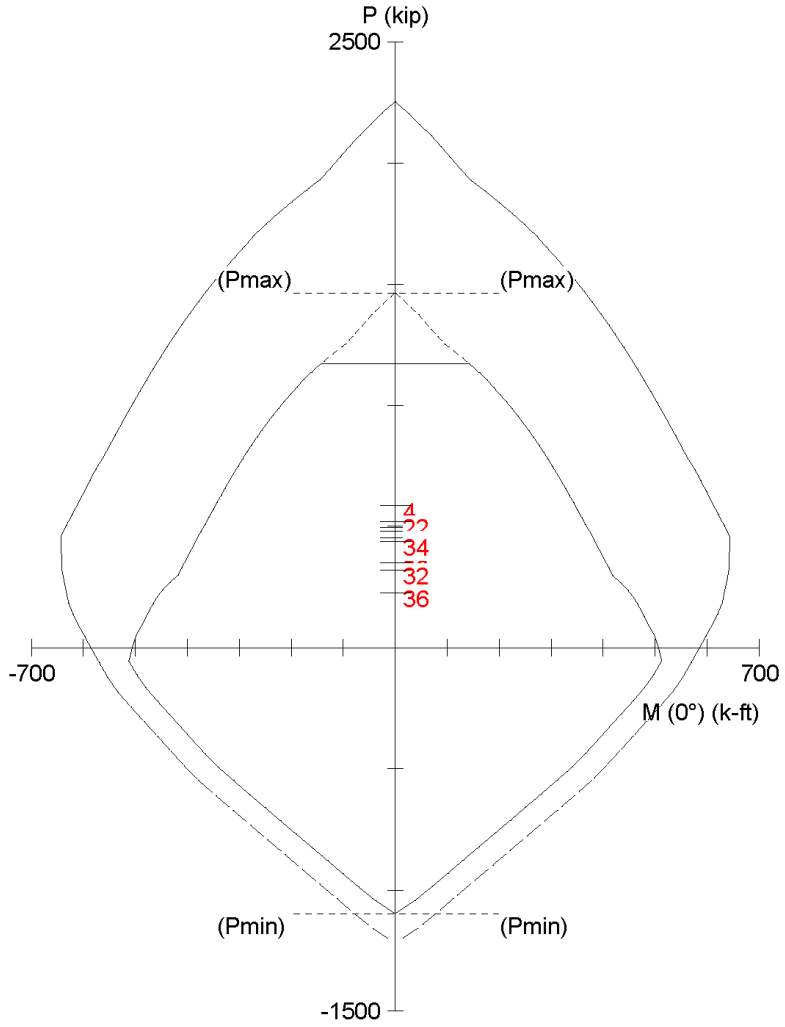
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	390.19	0.00	-26.45	0.00	-395.81	14.967	9.83	15.49	0.00173	0.650
2		390.19	0.00	0.00	395.81	0.00	999.999	9.83	15.49	0.00173	0.650
3	1 U2	570.64	0.00	-35.47	0.00	-349.85	9.865	11.41	15.49	0.00107	0.650
4		570.64	0.00	0.00	349.85	0.00	999.999	11.41	15.49	0.00107	0.650
5	1 U3	548.71	0.00	-36.51	0.00	-355.40	9.734	11.20	15.49	0.00115	0.650
6		548.71	0.00	0.00	355.40	0.00	999.999	11.20	15.49	0.00115	0.650
7	1 U4	420.09	0.00	-188.23	0.00	-388.55	2.064	10.06	15.49	0.00162	0.650
8		420.09	0.00	0.00	388.55	0.00	999.999	10.06	15.49	0.00162	0.650
9	1 U5	497.42	0.00	-348.12	0.00	-368.20	1.058	10.75	15.49	0.00132	0.650
10		497.42	0.00	0.00	368.20	0.00	999.999	10.75	15.49	0.00132	0.650
11	1 U6	256.49	0.00	-333.60	0.00	-438.59	1.315	8.52	15.49	0.00245	0.683
12		256.49	0.00	0.00	438.59	0.00	999.999	8.52	15.49	0.00245	0.683
13	1 U7	414.44	0.00	128.37	-0.00	389.93	3.038	10.02	15.49	0.00164	0.650
14		414.44	0.00	0.00	389.93	0.00	999.999	10.02	15.49	0.00164	0.650
15	1 U8	486.12	0.00	285.08	-0.00	370.99	1.301	10.65	15.49	0.00136	0.650
16		486.12	0.00	0.00	371.00	0.00	999.999	10.65	15.49	0.00136	0.650
17	1 U9	245.19	0.00	299.60	-0.00	443.86	1.482	8.37	15.49	0.00256	0.691
18		245.19	0.00	0.00	443.86	0.00	999.999	8.37	15.49	0.00256	0.691
19	2 U1	390.19	0.00	-26.45	0.00	-395.81	14.967	9.83	15.49	0.00173	0.650
20		390.19	0.00	0.00	395.81	0.00	999.999	9.83	15.49	0.00173	0.650
21	2 U2	515.88	0.00	-42.39	0.00	-363.62	8.577	10.91	15.49	0.00126	0.650
22		515.88	0.00	0.00	363.62	0.00	999.999	10.91	15.49	0.00126	0.650
23	2 U3	514.49	0.00	-40.84	0.00	-363.97	8.912	10.90	15.49	0.00126	0.650
24		514.49	0.00	0.00	363.97	0.00	999.999	10.90	15.49	0.00126	0.650
25	2 U4	420.09	0.00	-188.23	0.00	-388.55	2.064	10.06	15.49	0.00162	0.650
26		420.09	0.00	0.00	388.55	0.00	999.999	10.06	15.49	0.00162	0.650
27	2 U5	463.20	0.00	-352.45	0.00	-378.02	1.073	10.41	15.49	0.00146	0.650
28		463.20	0.00	0.00	378.02	0.00	999.999	10.41	15.49	0.00146	0.650
29	2 U6	256.49	0.00	-333.60	0.00	-438.59	1.315	8.52	15.49	0.00245	0.683
30		256.49	0.00	0.00	438.59	0.00	999.999	8.52	15.49	0.00245	0.683
31	2 U7	414.44	0.00	128.37	-0.00	389.93	3.038	10.02	15.49	0.00164	0.650
32		414.44	0.00	0.00	389.93	0.00	999.999	10.02	15.49	0.00164	0.650
33	2 U8	451.90	0.00	280.75	-0.00	380.79	1.356	10.32	15.49	0.00150	0.650
34		451.90	0.00	0.00	380.79	0.00	999.999	10.32	15.49	0.00150	0.650
35	2 U9	245.19	0.00	299.60	-0.00	443.86	1.482	8.37	15.49	0.00256	0.691
36		245.19	0.00	0.00	443.86	0.00	999.999	8.37	15.49	0.00256	0.691

*** End of output ***

Column 8G



18 x 18 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/18/14

Time: 14:06:03

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

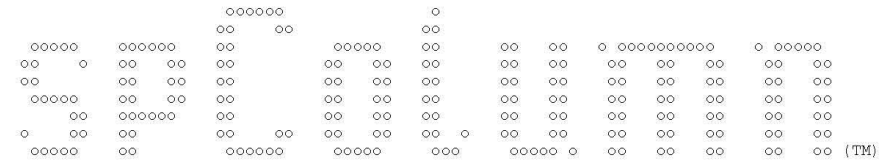
File: F:\SPRING\Lateral\Column Designs\8G\Frame 8 - 8G.col

Project: Lateral System

Column: 8G		Engineer: ahm	
f'c = 4 ksi	fy = 60 ksi	Ag = 324 in^2	16 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 20.32 in^2	rho = 6.27%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 8748 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 8748 in^4
Beta1 = 0.85		Min clear spacing = 1.98 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



spColumn v4.81 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

General Information:
==========
File Name: F:\SPRING\Lateral\Column Designs\8G\Frame 8 - 8G.col
Project: Lateral System
Column: 8G Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 18 in Depth = 18 in

Gross section area, Ag = 324 in^2
Ix = 8748 in^4 Iy = 8748 in^4
rx = 5.19615 in ry = 5.19615 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 3.24 in^2, Asmax = 0.08 * Ag = 25.92 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 20.32 in^2 at rho = 6.27%
Minimum clear spacing = 1.98 in

16 #10 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	249.62	0.00	0.00	9.39	0.00
	Live	175.12	0.00	0.00	3.42	0.00
	Wind	0.00	0.00	0.00	-203.88	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	13.66	0.00	0.00	1.28	0.00
2	Dead	249.62	0.00	0.00	9.39	0.00
	Live	132.67	0.00	0.00	8.35	0.00
	Wind	0.00	0.00	0.00	-203.88	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	13.66	0.00	0.00	1.28	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.000*Snow
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.000*Snow

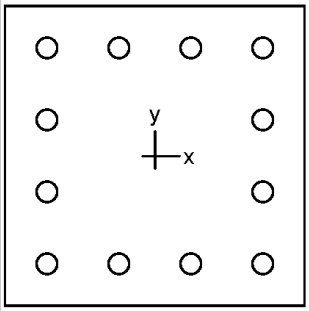
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

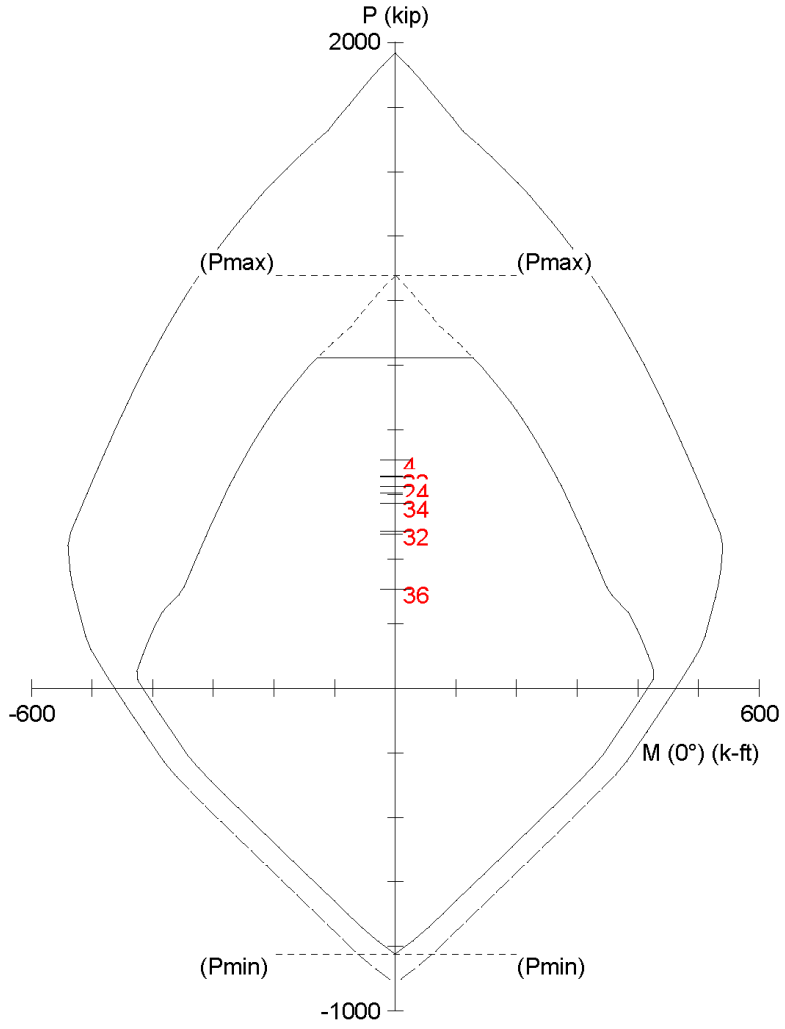
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	349.47	0.00	13.15	-0.00	405.69	30.861	9.53	15.49	0.00188	0.650
2		349.47	0.00	0.00	405.69	0.00	999.999	9.53	15.49	0.00188	0.650
3	1 U2	586.57	0.00	17.38	-0.00	345.80	19.896	11.56	15.49	0.00102	0.650
4		586.57	0.00	0.00	345.80	0.00	999.999	11.56	15.49	0.00102	0.650
5	1 U3	496.52	0.00	16.74	-0.00	368.43	22.014	10.74	15.49	0.00133	0.650
6		496.52	0.00	0.00	368.43	0.00	999.999	10.74	15.49	0.00133	0.650
7	1 U4	321.40	0.00	-149.78	0.00	-412.49	2.754	9.33	15.49	0.00198	0.650
8		321.40	0.00	0.00	412.49	0.00	999.999	9.33	15.49	0.00198	0.650
9	1 U5	481.49	0.00	-310.87	0.00	-372.13	1.197	10.61	15.49	0.00138	0.650
10		481.49	0.00	0.00	372.13	0.00	999.999	10.61	15.49	0.00138	0.650
11	1 U6	224.66	0.00	-317.75	0.00	-453.15	1.426	8.10	15.49	0.00273	0.707
12		224.66	0.00	0.00	453.15	0.00	999.999	8.10	15.49	0.00273	0.707
13	1 U7	321.40	0.00	176.42	-0.00	412.49	2.338	9.33	15.49	0.00198	0.650
14		321.40	0.00	0.00	412.49	0.00	999.999	9.33	15.49	0.00198	0.650
15	1 U8	481.49	0.00	341.53	-0.00	372.13	1.090	10.61	15.49	0.00138	0.650
16		481.49	0.00	0.00	372.13	0.00	999.999	10.61	15.49	0.00138	0.650
17	1 U9	224.66	0.00	334.65	-0.00	453.15	1.354	8.10	15.49	0.00273	0.707
18		224.66	0.00	0.00	453.15	0.00	999.999	8.10	15.49	0.00273	0.707
19	2 U1	349.47	0.00	13.15	-0.00	405.69	30.861	9.53	15.49	0.00188	0.650
20		349.47	0.00	0.00	405.69	0.00	999.999	9.53	15.49	0.00188	0.650
21	2 U2	518.65	0.00	25.27	-0.00	362.93	14.363	10.93	15.49	0.00125	0.650
22		518.65	0.00	0.00	362.93	0.00	999.999	10.93	15.49	0.00125	0.650
23	2 U3	454.07	0.00	21.67	-0.00	380.25	17.551	10.34	15.49	0.00150	0.650
24		454.07	0.00	0.00	380.25	0.00	999.999	10.34	15.49	0.00150	0.650
25	2 U4	321.40	0.00	-149.78	0.00	-412.49	2.754	9.33	15.49	0.00198	0.650
26		321.40	0.00	0.00	412.49	0.00	999.999	9.33	15.49	0.00198	0.650
27	2 U5	439.04	0.00	-305.94	0.00	-383.93	1.255	10.21	15.49	0.00155	0.650
28		439.04	0.00	0.00	383.93	0.00	999.999	10.21	15.49	0.00155	0.650
29	2 U6	224.66	0.00	-317.75	0.00	-453.15	1.426	8.10	15.49	0.00273	0.707
30		224.66	0.00	0.00	453.15	0.00	999.999	8.10	15.49	0.00273	0.707
31	2 U7	321.40	0.00	176.42	-0.00	412.49	2.338	9.33	15.49	0.00198	0.650
32		321.40	0.00	0.00	412.49	0.00	999.999	9.33	15.49	0.00198	0.650
33	2 U8	439.04	0.00	346.46	-0.00	383.93	1.108	10.21	15.49	0.00155	0.650
34		439.04	0.00	0.00	383.93	0.00	999.999	10.21	15.49	0.00155	0.650
35	2 U9	224.66	0.00	334.65	-0.00	453.15	1.354	8.10	15.49	0.00273	0.707
36		224.66	0.00	0.00	453.15	0.00	999.999	8.10	15.49	0.00273	0.707

*** End of output ***

Column 8M



18 x 18 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/18/14

Time: 12:51:32

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

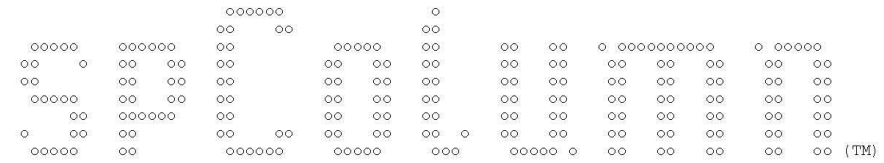
File: F:\SPRING\Lateral\Column Designs\Frame 8 - 8M.col

Project: Lateral System

Column: 8M		Engineer: ahm	
f'c = 4 ksi	fy = 60 ksi	Ag = 324 in^2	12 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 15.24 in^2	rho = 4.70%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 8748 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 8748 in^4
Beta1 = 0.85		Min clear spacing = 3.06 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



spColumn v4.81 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

General Information:
==========
File Name: F:\SPRING\Lateral\Column Designs\Frame 8 - 8M.col
Project: Lateral System
Column: 8M Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 18 in Depth = 18 in

Gross section area, Ag = 324 in^2
Ix = 8748 in^4 Iy = 8748 in^4
rx = 5.19615 in ry = 5.19615 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 3.24 in^2, Asmax = 0.08 * Ag = 25.92 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 15.24 in^2 at rho = 4.70%
Minimum clear spacing = 3.06 in

12 #10 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	340.47	0.00	0.00	-4.39	0.00
	Live	170.19	0.00	0.00	-2.69	0.00
	Wind	0.00	0.00	0.00	-159.90	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	48.28	0.00	0.00	-0.31	0.00
2	Dead	340.47	0.00	0.00	-4.39	0.00
	Live	138.39	0.00	0.00	-6.69	0.00
	Wind	0.00	0.00	0.00	-159.90	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	48.28	0.00	0.00	-0.31	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.000*Snow
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.000*Snow

Factored Loads and Moments with Corresponding Capacities:

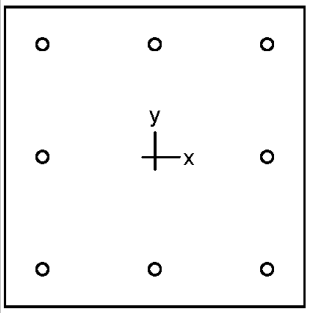
Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	476.66	0.00	-6.15	0.00	-310.45	50.512	10.88	15.49	0.00127	0.650
2		476.66	0.00	0.00	310.45	0.00	999.999	10.88	15.49	0.00127	0.650
3	1 U2	705.01	0.00	-9.73	0.00	-250.71	25.775	13.77	15.49	0.00037	0.650
4		705.01	0.00	0.00	250.71	0.00	999.999	13.77	15.49	0.00037	0.650
5	1 U3	656.00	0.00	-8.45	0.00	-265.24	31.374	13.02	15.49	0.00057	0.650
6		656.00	0.00	0.00	265.24	0.00	999.999	13.02	15.49	0.00057	0.650
7	1 U4	485.81	0.00	-133.69	0.00	-308.29	2.306	10.97	15.49	0.00123	0.650
8		485.81	0.00	0.00	308.29	0.00	999.999	10.97	15.49	0.00123	0.650
9	1 U5	602.89	0.00	-263.96	0.00	-279.40	1.059	12.34	15.49	0.00077	0.650
10		602.89	0.00	0.00	279.40	0.00	999.999	12.34	15.49	0.00077	0.650
11	1 U6	306.42	0.00	-259.80	0.00	-349.46	1.345	9.24	15.49	0.00203	0.650
12		306.42	0.00	0.00	349.46	0.00	999.999	9.24	15.49	0.00203	0.650
13	1 U7	485.81	0.00	122.16	-0.00	308.29	2.524	10.97	15.49	0.00123	0.650
14		485.81	0.00	0.00	308.29	0.00	999.999	10.97	15.49	0.00123	0.650
15	1 U8	602.89	0.00	247.73	-0.00	279.40	1.128	12.34	15.49	0.00077	0.650
16		602.89	0.00	0.00	279.40	0.00	999.999	12.34	15.49	0.00077	0.650
17	1 U9	306.42	0.00	251.89	-0.00	349.46	1.387	9.24	15.49	0.00203	0.650
18		306.42	0.00	0.00	349.46	0.00	999.999	9.24	15.49	0.00203	0.650
19	2 U1	476.66	0.00	-6.15	0.00	-310.45	50.512	10.88	15.49	0.00127	0.650
20		476.66	0.00	0.00	310.45	0.00	999.999	10.88	15.49	0.00127	0.650
21	2 U2	654.13	0.00	-16.13	0.00	-265.75	16.479	13.00	15.49	0.00057	0.650
22		654.13	0.00	0.00	265.75	0.00	999.999	13.00	15.49	0.00057	0.650
23	2 U3	624.20	0.00	-12.45	0.00	-273.81	21.986	12.61	15.49	0.00069	0.650
24		624.20	0.00	0.00	273.81	0.00	999.999	12.61	15.49	0.00069	0.650
25	2 U4	485.81	0.00	-133.69	0.00	-308.29	2.306	10.97	15.49	0.00123	0.650
26		485.81	0.00	0.00	308.29	0.00	999.999	10.97	15.49	0.00123	0.650
27	2 U5	571.09	0.00	-267.96	0.00	-287.52	1.073	11.95	15.49	0.00089	0.650
28		571.09	0.00	0.00	287.52	0.00	999.999	11.95	15.49	0.00089	0.650
29	2 U6	306.42	0.00	-259.80	0.00	-349.46	1.345	9.24	15.49	0.00203	0.650
30		306.42	0.00	0.00	349.46	0.00	999.999	9.24	15.49	0.00203	0.650
31	2 U7	485.81	0.00	122.16	-0.00	308.29	2.524	10.97	15.49	0.00123	0.650
32		485.81	0.00	0.00	308.29	0.00	999.999	10.97	15.49	0.00123	0.650
33	2 U8	571.09	0.00	243.73	-0.00	287.52	1.180	11.95	15.49	0.00089	0.650
34		571.09	0.00	0.00	287.52	0.00	999.999	11.95	15.49	0.00089	0.650
35	2 U9	306.42	0.00	251.89	-0.00	349.46	1.387	9.24	15.49	0.00203	0.650
36		306.42	0.00	0.00	349.46	0.00	999.999	9.24	15.49	0.00203	0.650

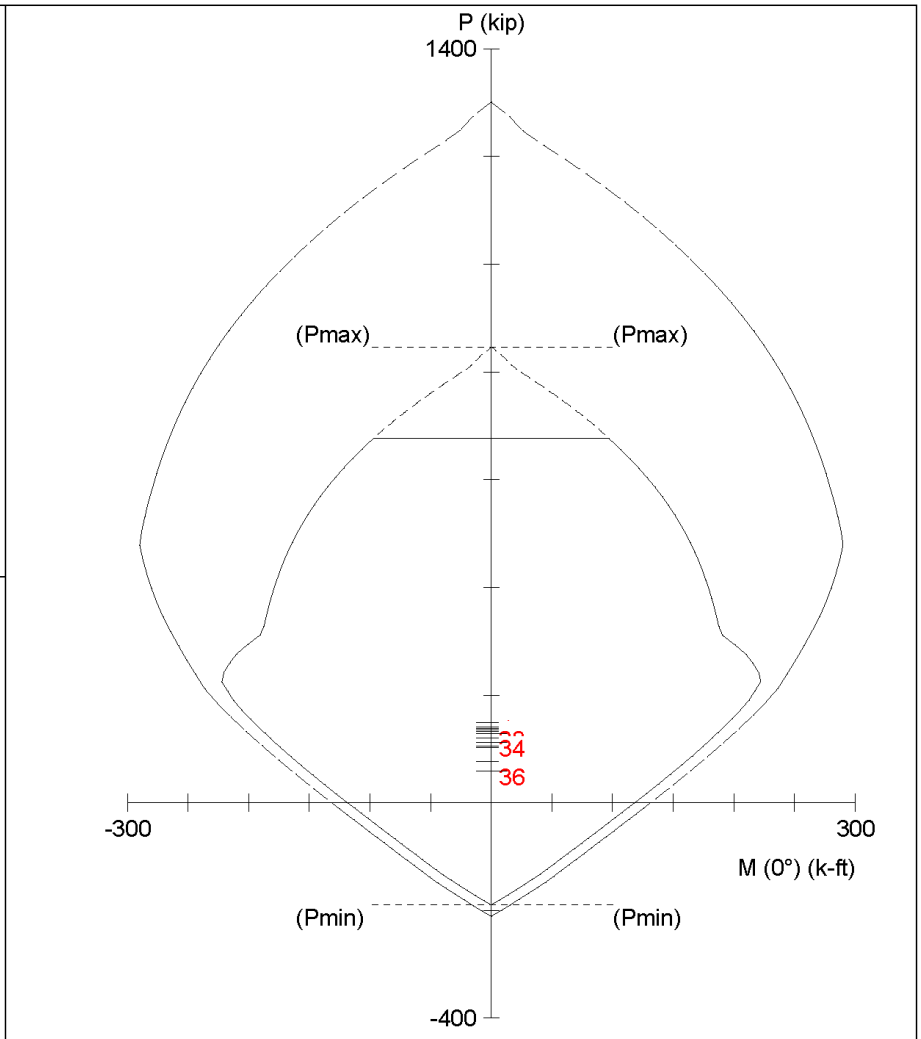
*** End of output ***

Column Line 13 Columns

Column 13A.2



18 x 18 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/18/14

Time: 12:37:17

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

File: F:\SPRING\Lateral\Column Designs\Frame 13 - 13A.2.col

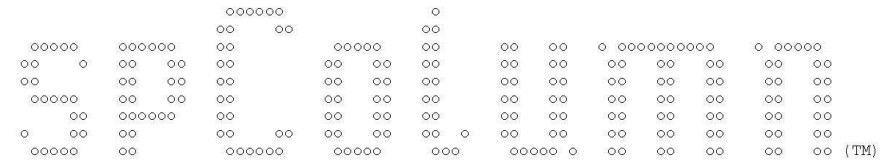
Project: Lateral System

Column: 13A.2 Engineer: ahm

f'c = 4 ksi	fy = 60 ksi	Ag = 324 in^2	8 #6 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 3.52 in^2	rho = 1.09%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 8748 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 8748 in^4
Beta1 = 0.85		Min clear spacing = 6.00 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



spColumn v4.81 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

General Information:
==========
File Name: F:\SPRING\Lateral\Column Designs\Frame 13 - 13A.2.col
Project: Lateral System
Column: 13A.2 Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 18 in Depth = 18 in

Gross section area, Ag = 324 in^2
Ix = 8748 in^4 Iy = 8748 in^4
rx = 5.19615 in ry = 5.19615 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 3.24 in^2, Asmax = 0.08 * Ag = 25.92 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 3.52 in^2 at rho = 1.09%
Minimum clear spacing = 6.00 in

8 #6 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	74.75	0.00	0.00	13.26	0.00
	Live	33.42	0.00	0.00	6.94	0.00
	Wind	5.52	0.00	0.00	-80.34	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	10.89	0.00	0.00	1.86	0.00
2	Dead	74.75	0.00	0.00	13.26	0.00
	Live	25.23	0.00	0.00	7.76	0.00
	Wind	5.52	0.00	0.00	-80.34	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	10.89	0.00	0.00	1.86	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.000*Snow
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.000*Snow

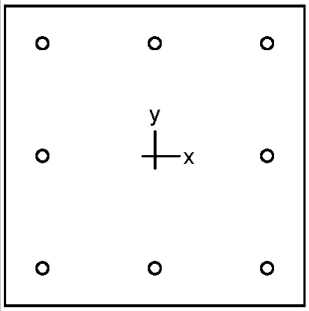
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

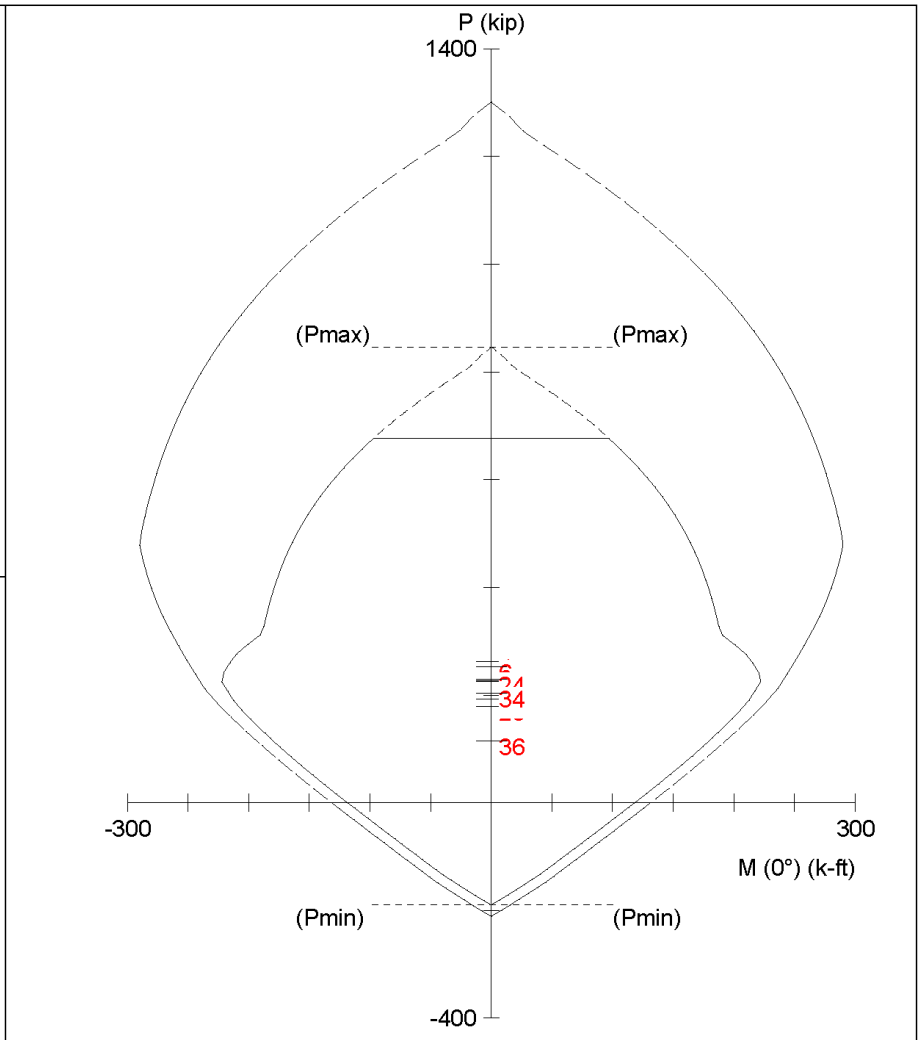
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	104.65	0.00	18.56	-0.00	174.74	9.413	3.92	15.75	0.00905	0.900
2		104.65	0.00	0.00	174.74	0.00	999.999	3.92	15.75	0.00905	0.900
3	1 U2	148.62	0.00	27.95	-0.00	195.45	6.994	4.66	15.75	0.00714	0.900
4		148.62	0.00	0.00	195.45	0.00	999.999	4.66	15.75	0.00714	0.900
5	1 U3	140.54	0.00	25.83	-0.00	191.80	7.426	4.52	15.75	0.00746	0.900
6		140.54	0.00	0.00	191.80	0.00	999.999	4.52	15.75	0.00746	0.900
7	1 U4	111.54	0.00	-45.38	0.00	-178.11	3.925	4.03	15.75	0.00872	0.900
8		111.54	0.00	0.00	178.11	0.00	999.999	4.03	15.75	0.00872	0.900
9	1 U5	137.40	0.00	-104.76	0.00	-190.36	1.817	4.46	15.75	0.00758	0.900
10		137.40	0.00	0.00	190.36	0.00	999.999	4.46	15.75	0.00758	0.900
11	1 U6	76.11	0.00	-116.61	0.00	-160.23	1.374	3.47	15.75	0.01061	0.900
12		76.11	0.00	0.00	160.23	0.00	999.999	3.47	15.75	0.01061	0.900
13	1 U7	102.70	0.00	83.16	-0.00	173.78	2.090	3.89	15.75	0.00915	0.900
14		102.70	0.00	0.00	173.78	0.00	999.999	3.89	15.75	0.00915	0.900
15	1 U8	119.73	0.00	152.32	-0.00	182.06	1.195	4.17	15.75	0.00834	0.900
16		119.73	0.00	0.00	182.06	0.00	999.999	4.17	15.75	0.00834	0.900
17	1 U9	58.44	0.00	140.48	-0.00	150.88	1.074	3.21	15.75	0.01171	0.900
18		58.44	0.00	0.00	150.88	0.00	999.999	3.21	15.75	0.01171	0.900
19	2 U1	104.65	0.00	18.56	-0.00	174.74	9.413	3.92	15.75	0.00905	0.900
20		104.65	0.00	0.00	174.74	0.00	999.999	3.92	15.75	0.00905	0.900
21	2 U2	135.51	0.00	29.26	-0.00	189.49	6.476	4.43	15.75	0.00766	0.900
22		135.51	0.00	0.00	189.49	0.00	999.999	4.43	15.75	0.00766	0.900
23	2 U3	132.35	0.00	26.65	-0.00	188.03	7.056	4.38	15.75	0.00779	0.900
24		132.35	0.00	0.00	188.03	0.00	999.999	4.38	15.75	0.00779	0.900
25	2 U4	111.54	0.00	-45.38	0.00	-178.11	3.925	4.03	15.75	0.00872	0.900
26		111.54	0.00	0.00	178.11	0.00	999.999	4.03	15.75	0.00872	0.900
27	2 U5	129.21	0.00	-103.94	0.00	-186.56	1.795	4.32	15.75	0.00793	0.900
28		129.21	0.00	0.00	186.56	0.00	999.999	4.32	15.75	0.00793	0.900
29	2 U6	76.11	0.00	-116.61	0.00	-160.23	1.374	3.47	15.75	0.01061	0.900
30		76.11	0.00	0.00	160.23	0.00	999.999	3.47	15.75	0.01061	0.900
31	2 U7	102.70	0.00	83.16	-0.00	173.78	2.090	3.89	15.75	0.00915	0.900
32		102.70	0.00	0.00	173.78	0.00	999.999	3.89	15.75	0.00915	0.900
33	2 U8	111.54	0.00	153.14	-0.00	178.11	1.163	4.03	15.75	0.00872	0.900
34		111.54	0.00	0.00	178.11	0.00	999.999	4.03	15.75	0.00872	0.900
35	2 U9	58.44	0.00	140.48	-0.00	150.88	1.074	3.21	15.75	0.01171	0.900
36		58.44	0.00	0.00	150.88	0.00	999.999	3.21	15.75	0.01171	0.900

*** End of output ***

Column 13B



18 x 18 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/18/14

Time: 13:16:58

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

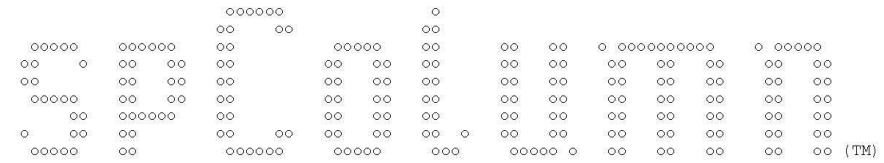
File: F:\SPRING\Lateral\Column Designs\Frame 13 - 13B.col

Project: Lateral System

Column: 13B		Engineer: ahm	
f'c = 4 ksi	fy = 60 ksi	Ag = 324 in^2	8 #6 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 3.52 in^2	rho = 1.09%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 8748 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 8748 in^4
Beta1 = 0.85		Min clear spacing = 6.00 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



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spColumn v4.81 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

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General Information:
==========
File Name: F:\SPRING\Lateral\Column Designs\Frame 13 - 13B.col
Project: Lateral System
Column: 13B Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 18 in Depth = 18 in

Gross section area, Ag = 324 in^2
Ix = 8748 in^4 Iy = 8748 in^4
rx = 5.19615 in ry = 5.19615 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 3.24 in^2, Asmax = 0.08 * Ag = 25.92 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 3.52 in^2 at rho = 1.09%
Minimum clear spacing = 6.00 in

8 #6 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	128.26	0.00	0.00	-5.42	0.00
	Live	60.11	0.00	0.00	-2.50	0.00
	Wind	0.00	0.00	0.00	-106.71	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	24.47	0.00	0.00	-0.28	0.00
2	Dead	128.26	0.00	0.00	-5.42	0.00
	Live	36.91	0.00	0.00	-4.91	0.00
	Wind	0.00	0.00	0.00	-106.71	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	24.47	0.00	0.00	-0.28	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.000*Snow
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.000*Snow

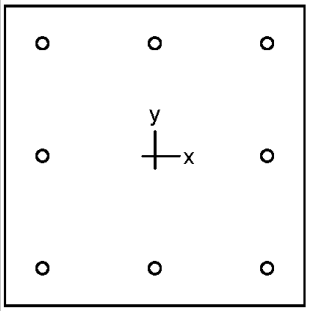
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

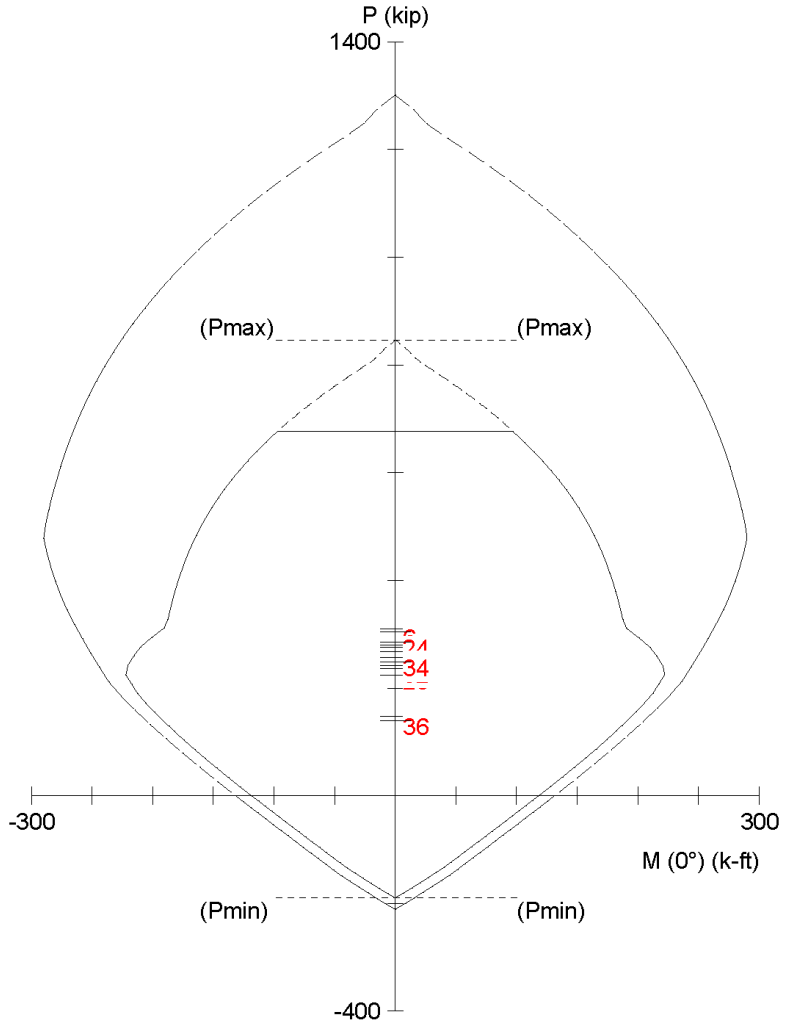
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	179.56	0.00	-7.59	0.00	-208.69	27.503	5.21	15.75	0.00608	0.900
2		179.56	0.00	0.00	208.69	0.00	999.999	5.21	15.75	0.00608	0.900
3	1 U2	262.32	0.00	-10.64	0.00	-214.62	20.163	6.84	15.75	0.00390	0.807
4		262.32	0.00	0.00	214.62	0.00	999.999	6.84	15.75	0.00390	0.807
5	1 U3	253.17	0.00	-9.45	0.00	-217.30	22.989	6.56	15.75	0.00421	0.832
6		253.17	0.00	0.00	217.30	0.00	999.999	6.56	15.75	0.00421	0.832
7	1 U4	193.06	0.00	-92.32	0.00	-213.35	2.311	5.42	15.75	0.00572	0.900
8		193.06	0.00	0.00	213.35	0.00	999.999	5.42	15.75	0.00572	0.900
9	1 U5	226.26	0.00	-179.88	0.00	-222.59	1.237	5.87	15.75	0.00505	0.900
10		226.26	0.00	0.00	222.59	0.00	999.999	5.87	15.75	0.00505	0.900
11	1 U6	115.43	0.00	-175.61	0.00	-180.00	1.025	4.09	15.75	0.00854	0.900
12		115.43	0.00	0.00	180.00	0.00	999.999	4.09	15.75	0.00854	0.900
13	1 U7	193.06	0.00	78.41	-0.00	213.35	2.721	5.42	15.75	0.00572	0.900
14		193.06	0.00	0.00	213.35	0.00	999.999	5.42	15.75	0.00572	0.900
15	1 U8	226.26	0.00	161.59	-0.00	222.59	1.377	5.87	15.75	0.00505	0.900
16		226.26	0.00	0.00	222.59	0.00	999.999	5.87	15.75	0.00505	0.900
17	1 U9	115.43	0.00	165.85	-0.00	180.00	1.085	4.09	15.75	0.00854	0.900
18		115.43	0.00	0.00	180.00	0.00	999.999	4.09	15.75	0.00854	0.900
19	2 U1	179.56	0.00	-7.59	0.00	-208.69	27.503	5.21	15.75	0.00608	0.900
20		179.56	0.00	0.00	208.69	0.00	999.999	5.21	15.75	0.00608	0.900
21	2 U2	225.20	0.00	-14.50	0.00	-222.31	15.331	5.85	15.75	0.00507	0.900
22		225.20	0.00	0.00	222.31	0.00	999.999	5.85	15.75	0.00507	0.900
23	2 U3	229.97	0.00	-11.86	0.00	-223.15	18.813	5.93	15.75	0.00497	0.897
24		229.97	0.00	0.00	223.15	0.00	999.999	5.93	15.75	0.00497	0.897
25	2 U4	193.06	0.00	-92.32	0.00	-213.35	2.311	5.42	15.75	0.00572	0.900
26		193.06	0.00	0.00	213.35	0.00	999.999	5.42	15.75	0.00572	0.900
27	2 U5	203.06	0.00	-182.29	0.00	-216.17	1.186	5.55	15.75	0.00552	0.900
28		203.06	0.00	0.00	216.17	0.00	999.999	5.55	15.75	0.00552	0.900
29	2 U6	115.43	0.00	-175.61	0.00	-180.00	1.025	4.09	15.75	0.00854	0.900
30		115.43	0.00	0.00	180.00	0.00	999.999	4.09	15.75	0.00854	0.900
31	2 U7	193.06	0.00	78.41	-0.00	213.35	2.721	5.42	15.75	0.00572	0.900
32		193.06	0.00	0.00	213.35	0.00	999.999	5.42	15.75	0.00572	0.900
33	2 U8	203.06	0.00	159.18	-0.00	216.17	1.358	5.55	15.75	0.00552	0.900
34		203.06	0.00	0.00	216.17	0.00	999.999	5.55	15.75	0.00552	0.900
35	2 U9	115.43	0.00	165.85	-0.00	180.00	1.085	4.09	15.75	0.00854	0.900
36		115.43	0.00	0.00	180.00	0.00	999.999	4.09	15.75	0.00854	0.900

*** End of output ***

Column 13C



18 x 18 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/18/14

Time: 13:34:01

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

File: F:\SPRING\Lateral\Column Designs\Frame 13 - 13C.col

Project: Lateral System

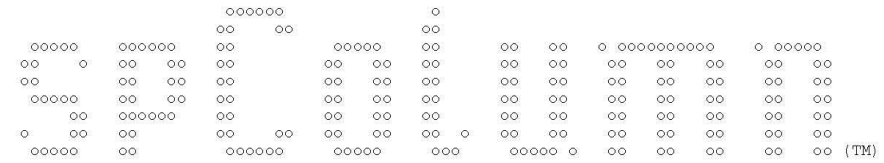
Column: 13C

Engineer: ahm

f'c = 4 ksi	fy = 60 ksi	Ag = 324 in^2	8 #6 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 3.52 in^2	rho = 1.09%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 8748 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 8748 in^4
Beta1 = 0.85		Min clear spacing = 6.00 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



==========

spColumn v4.81 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

==========

General Information:
==========
File Name: F:\SPRING\Lateral\Column Designs\Frame 13 - 13C.col
Project: Lateral System
Column: 13C Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 18 in Depth = 18 in

Gross section area, Ag = 324 in^2
Ix = 8748 in^4 Iy = 8748 in^4
rx = 5.19615 in ry = 5.19615 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 3.24 in^2, Asmax = 0.08 * Ag = 25.92 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 3.52 in^2 at rho = 1.09%
Minimum clear spacing = 6.00 in

8 #6 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	159.87	0.00	0.00	-0.66	0.00
	Live	64.95	0.00	0.00	-0.80	0.00
	Wind	2.75	0.00	0.00	-108.53	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	29.39	0.00	0.00	-0.85	0.00
2	Dead	159.87	0.00	0.00	-0.66	0.00
	Live	46.10	0.00	0.00	-2.20	0.00
	Wind	2.75	0.00	0.00	-108.53	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	29.39	0.00	0.00	-0.85	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.000*Snow
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.000*Snow

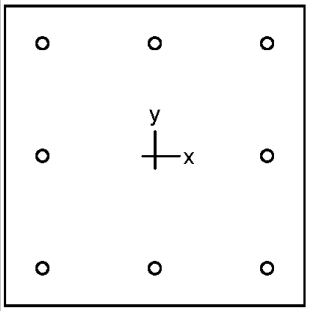
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

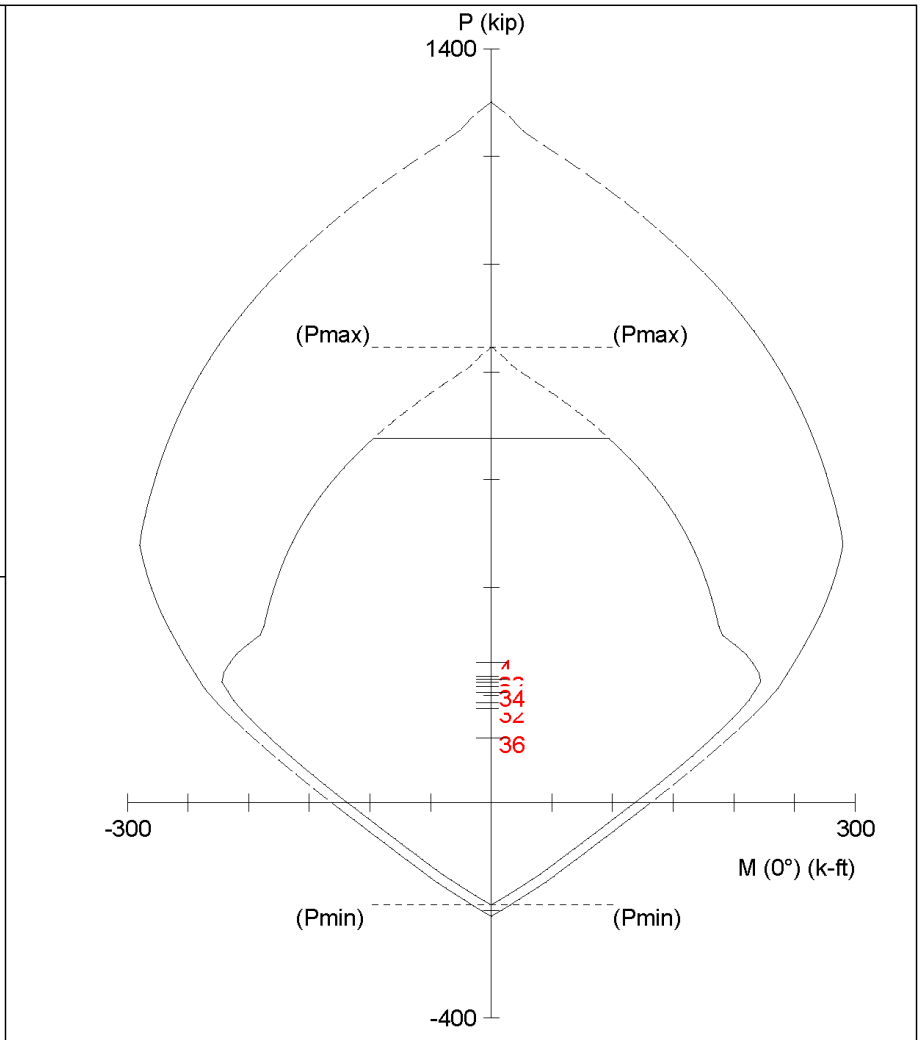
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	223.82	0.00	-0.92	0.00	-221.93	240.181	5.83	15.75	0.00510	0.900
2		223.82	0.00	0.00	221.93	0.00	999.999	5.83	15.75	0.00510	0.900
3	1 U2	310.46	0.00	-2.50	0.00	-190.78	76.404	9.11	15.75	0.00218	0.660
4		310.46	0.00	0.00	190.78	0.00	999.999	9.11	15.75	0.00218	0.660
5	1 U3	303.82	0.00	-2.95	0.00	-194.78	65.983	8.73	15.75	0.00241	0.679
6		303.82	0.00	0.00	194.78	0.00	999.999	8.73	15.75	0.00241	0.679
7	1 U4	241.07	0.00	-88.98	0.00	-220.51	2.478	6.21	15.75	0.00461	0.867
8		241.07	0.00	0.00	220.51	0.00	999.999	6.21	15.75	0.00461	0.867
9	1 U5	275.89	0.00	-175.66	0.00	-209.89	1.195	7.34	15.75	0.00344	0.767
10		275.89	0.00	0.00	209.89	0.00	999.999	7.34	15.75	0.00344	0.767
11	1 U6	148.29	0.00	-174.24	0.00	-195.30	1.121	4.65	15.75	0.00716	0.900
12		148.29	0.00	0.00	195.30	0.00	999.999	4.65	15.75	0.00716	0.900
13	1 U7	236.67	0.00	84.67	-0.00	221.59	2.617	6.10	15.75	0.00475	0.879
14		236.67	0.00	0.00	221.59	0.00	999.999	6.10	15.75	0.00475	0.879
15	1 U8	267.09	0.00	171.63	-0.00	213.12	1.242	7.01	15.75	0.00374	0.793
16		267.09	0.00	0.00	213.12	0.00	999.999	7.01	15.75	0.00374	0.793
17	1 U9	139.48	0.00	173.05	-0.00	191.31	1.106	4.50	15.75	0.00750	0.900
18		139.48	0.00	0.00	191.31	0.00	999.999	4.50	15.75	0.00750	0.900
19	2 U1	223.82	0.00	-0.92	0.00	-221.93	240.181	5.83	15.75	0.00510	0.900
20		223.82	0.00	0.00	221.93	0.00	999.999	5.83	15.75	0.00510	0.900
21	2 U2	280.30	0.00	-4.74	0.00	-207.67	43.840	7.53	15.75	0.00327	0.753
22		280.30	0.00	0.00	207.67	0.00	999.999	7.53	15.75	0.00327	0.753
23	2 U3	284.97	0.00	-4.35	0.00	-205.26	47.164	7.75	15.75	0.00310	0.738
24		284.97	0.00	0.00	205.26	0.00	999.999	7.75	15.75	0.00310	0.738
25	2 U4	241.07	0.00	-88.98	0.00	-220.51	2.478	6.21	15.75	0.00461	0.867
26		241.07	0.00	0.00	220.51	0.00	999.999	6.21	15.75	0.00461	0.867
27	2 U5	257.04	0.00	-177.06	0.00	-216.20	1.221	6.67	15.75	0.00408	0.822
28		257.04	0.00	0.00	216.20	0.00	999.999	6.67	15.75	0.00408	0.822
29	2 U6	148.29	0.00	-174.24	0.00	-195.30	1.121	4.65	15.75	0.00716	0.900
30		148.29	0.00	0.00	195.30	0.00	999.999	4.65	15.75	0.00716	0.900
31	2 U7	236.67	0.00	84.67	-0.00	221.59	2.617	6.10	15.75	0.00475	0.879
32		236.67	0.00	0.00	221.59	0.00	999.999	6.10	15.75	0.00475	0.879
33	2 U8	248.24	0.00	170.23	-0.00	218.65	1.284	6.41	15.75	0.00437	0.846
34		248.24	0.00	0.00	218.65	0.00	999.999	6.41	15.75	0.00437	0.846
35	2 U9	139.48	0.00	173.05	-0.00	191.31	1.106	4.50	15.75	0.00750	0.900
36		139.48	0.00	0.00	191.31	0.00	999.999	4.50	15.75	0.00750	0.900

*** End of output ***

Column 13E



18 x 18 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/18/14

Time: 14:18:35

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

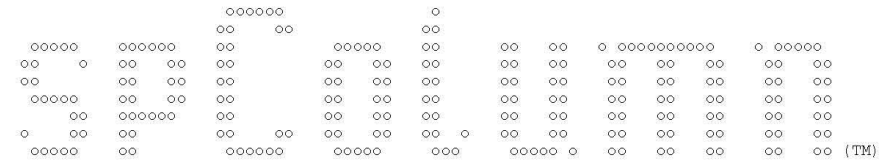
File: F:\SPRING\Lateral\Column Designs\13E\Frame 13 - 13E.col

Project: Lateral System

Column: 13E		Engineer: ahm	
f'c = 4 ksi	fy = 60 ksi	Ag = 324 in^2	8 #6 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 3.52 in^2	rho = 1.09%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 8748 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 8748 in^4
Beta1 = 0.85		Min clear spacing = 6.00 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



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spColumn v4.81 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

==========

General Information:
==========
File Name: F:\SPRING\Lateral\Column Designs\13E\Frame 13 - 13E.col
Project: Lateral System
Column: 13E Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 18 in Depth = 18 in

Gross section area, Ag = 324 in^2
Ix = 8748 in^4 Iy = 8748 in^4
rx = 5.19615 in ry = 5.19615 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 3.24 in^2, Asmax = 0.08 * Ag = 25.92 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 3.52 in^2 at rho = 1.09%
Minimum clear spacing = 6.00 in

8 #6 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	132.52	0.00	0.00	0.69	0.00
	Live	60.67	0.00	0.00	0.10	0.00
	Wind	0.00	0.00	0.00	-111.65	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	9.81	0.00	0.00	0.27	0.00
2	Dead	132.52	0.00	0.00	0.69	0.00
	Live	40.63	0.00	0.00	1.72	0.00
	Wind	0.00	0.00	0.00	-111.65	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	9.81	0.00	0.00	0.27	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.000*Snow
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.000*Snow

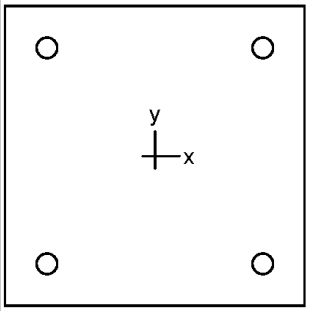
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

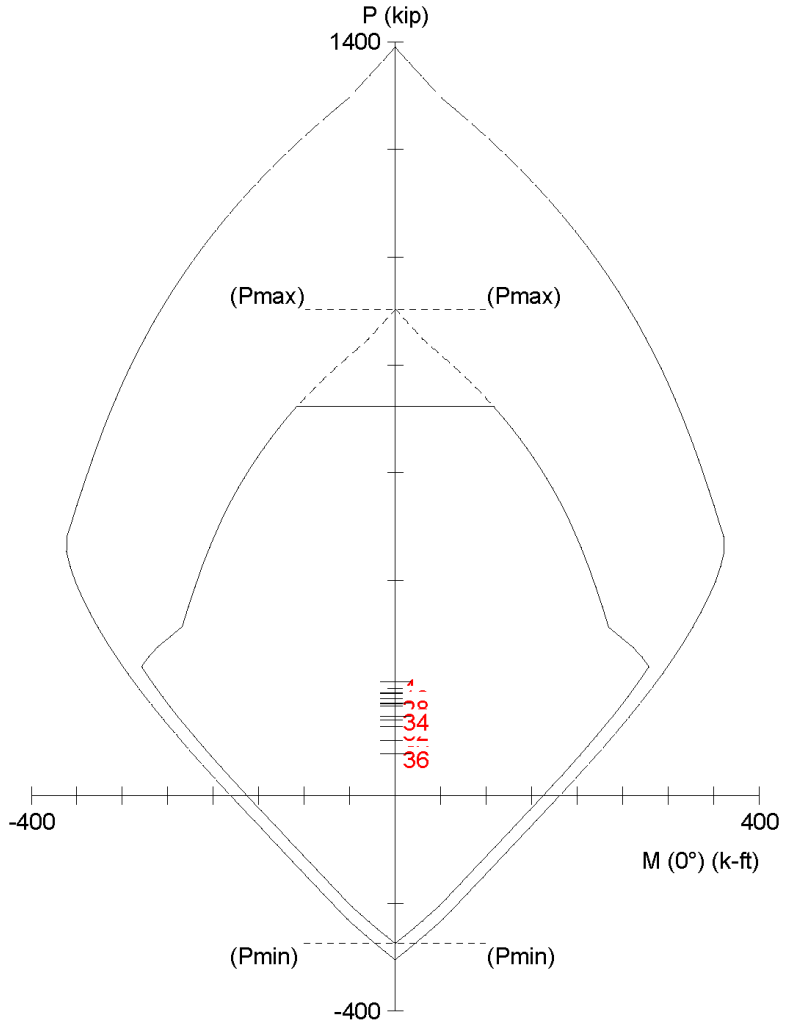
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	185.53	0.00	0.97	-0.00	211.10	218.532	5.31	15.75	0.00589	0.900
2		185.53	0.00	0.00	211.10	0.00	999.999	5.31	15.75	0.00589	0.900
3	1 U2	261.00	0.00	1.12	-0.00	215.02	191.469	6.80	15.75	0.00395	0.810
4		261.00	0.00	0.00	215.02	0.00	999.999	6.80	15.75	0.00395	0.810
5	1 U3	235.39	0.00	1.36	-0.00	221.89	163.158	6.06	15.75	0.00479	0.882
6		235.39	0.00	0.00	221.89	0.00	999.999	6.06	15.75	0.00479	0.882
7	1 U4	174.72	0.00	-88.06	0.00	-206.69	2.347	5.12	15.75	0.00623	0.900
8		174.72	0.00	0.00	206.69	0.00	999.999	5.12	15.75	0.00623	0.900
9	1 U5	224.60	0.00	-177.58	0.00	-222.14	1.251	5.84	15.75	0.00509	0.900
10		224.60	0.00	0.00	222.14	0.00	999.999	5.84	15.75	0.00509	0.900
11	1 U6	119.27	0.00	-178.02	0.00	-181.84	1.021	4.16	15.75	0.00836	0.900
12		119.27	0.00	0.00	181.84	0.00	999.999	4.16	15.75	0.00836	0.900
13	1 U7	174.72	0.00	90.58	-0.00	206.69	2.282	5.12	15.75	0.00623	0.900
14		174.72	0.00	0.00	206.69	0.00	999.999	5.12	15.75	0.00623	0.900
15	1 U8	224.60	0.00	179.71	-0.00	222.14	1.236	5.84	15.75	0.00509	0.900
16		224.60	0.00	0.00	222.14	0.00	999.999	5.84	15.75	0.00509	0.900
17	1 U9	119.27	0.00	179.26	-0.00	181.84	1.014	4.16	15.75	0.00836	0.900
18		119.27	0.00	0.00	181.84	0.00	999.999	4.16	15.75	0.00836	0.900
19	2 U1	185.53	0.00	0.97	-0.00	211.10	218.532	5.31	15.75	0.00589	0.900
20		185.53	0.00	0.00	211.10	0.00	999.999	5.31	15.75	0.00589	0.900
21	2 U2	228.94	0.00	3.72	-0.00	223.32	60.113	5.90	15.75	0.00500	0.900
22		228.94	0.00	0.00	223.32	0.00	999.999	5.90	15.75	0.00500	0.900
23	2 U3	215.35	0.00	2.98	-0.00	219.60	73.692	5.72	15.75	0.00527	0.900
24		215.35	0.00	0.00	219.60	0.00	999.999	5.72	15.75	0.00527	0.900
25	2 U4	174.72	0.00	-88.06	0.00	-206.69	2.347	5.12	15.75	0.00623	0.900
26		174.72	0.00	0.00	206.69	0.00	999.999	5.12	15.75	0.00623	0.900
27	2 U5	204.56	0.00	-175.96	0.00	-216.59	1.231	5.57	15.75	0.00548	0.900
28		204.56	0.00	0.00	216.59	0.00	999.999	5.57	15.75	0.00548	0.900
29	2 U6	119.27	0.00	-178.02	0.00	-181.84	1.021	4.16	15.75	0.00836	0.900
30		119.27	0.00	0.00	181.84	0.00	999.999	4.16	15.75	0.00836	0.900
31	2 U7	174.72	0.00	90.58	-0.00	206.69	2.282	5.12	15.75	0.00623	0.900
32		174.72	0.00	0.00	206.69	0.00	999.999	5.12	15.75	0.00623	0.900
33	2 U8	204.56	0.00	181.33	-0.00	216.59	1.195	5.57	15.75	0.00548	0.900
34		204.56	0.00	0.00	216.59	0.00	999.999	5.57	15.75	0.00548	0.900
35	2 U9	119.27	0.00	179.26	-0.00	181.84	1.014	4.16	15.75	0.00836	0.900
36		119.27	0.00	0.00	181.84	0.00	999.999	4.16	15.75	0.00836	0.900

*** End of output ***

Column 13H



18 x 18 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/18/14

Time: 13:21:24

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

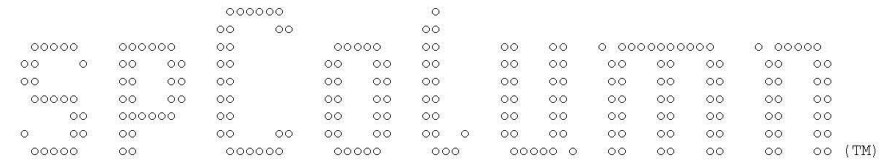
File: F:\SPRING\Lateral\Column Designs\Frame 13 - 13H.col

Project: Lateral System

Column: 13H		Engineer: ahm	
f'c = 4 ksi	fy = 60 ksi	Ag = 324 in^2	4 #10 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 5.08 in^2	rho = 1.57%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 8748 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 8748 in^4
Beta1 = 0.85		Min clear spacing = 11.71 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



==========

spColumn v4.81 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

==========

General Information:
==========
File Name: F:\SPRING\Lateral\Column Designs\Frame 13 - 13H.col
Project: Lateral System
Column: 13H Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 18 in Depth = 18 in

Gross section area, Ag = 324 in^2
Ix = 8748 in^4 Iy = 8748 in^4
rx = 5.19615 in ry = 5.19615 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 3.24 in^2, Asmax = 0.08 * Ag = 25.92 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 5.08 in^2 at rho = 1.57%
Minimum clear spacing = 11.71 in

4 #10 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	100.85	0.00	0.00	-1.65	0.00
	Live	53.76	0.00	0.00	-0.64	0.00
	Wind	7.71	0.00	0.00	-117.02	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	8.77	0.00	0.00	-0.20	0.00
2	Dead	100.85	0.00	0.00	-1.65	0.00
	Live	34.54	0.00	0.00	-1.74	0.00
	Wind	7.71	0.00	0.00	-117.02	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	8.77	0.00	0.00	-0.20	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.000*Snow
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.000*Snow

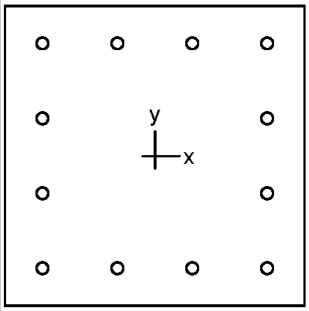
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

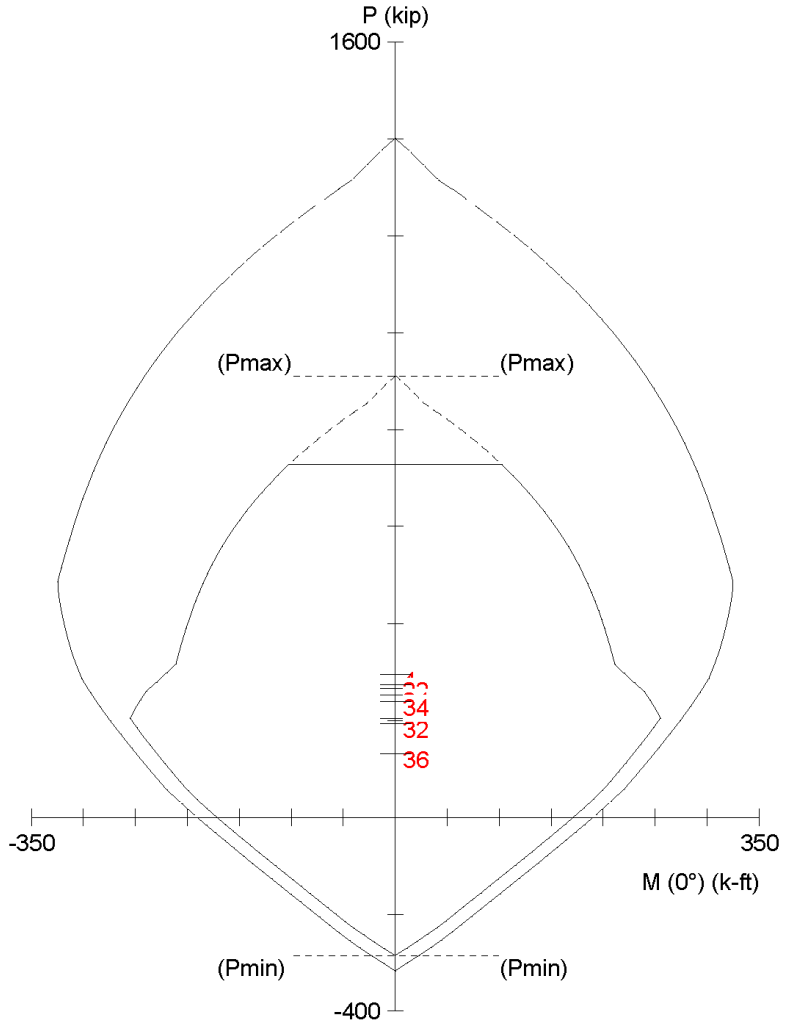
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	141.19	0.00	-2.31	0.00	-236.06	102.192	4.33	15.49	0.00774	0.900
2		141.19	0.00	0.00	236.06	0.00	999.999	4.33	15.49	0.00774	0.900
3	1 U2	211.42	0.00	-3.10	0.00	-267.61	86.213	5.36	15.49	0.00568	0.900
4		211.42	0.00	0.00	267.61	0.00	999.999	5.36	15.49	0.00568	0.900
5	1 U3	188.81	0.00	-2.94	0.00	-257.94	87.734	5.01	15.49	0.00628	0.900
6		188.81	0.00	0.00	257.94	0.00	999.999	5.01	15.49	0.00628	0.900
7	1 U4	141.22	0.00	-95.92	0.00	-236.08	2.461	4.33	15.49	0.00774	0.900
8		141.22	0.00	0.00	236.08	0.00	999.999	4.33	15.49	0.00774	0.900
9	1 U5	191.49	0.00	-189.96	0.00	-259.11	1.364	5.05	15.49	0.00620	0.900
10		191.49	0.00	0.00	259.11	0.00	999.999	5.05	15.49	0.00620	0.900
11	1 U6	103.09	0.00	-188.72	0.00	-217.30	1.151	3.83	15.49	0.00913	0.900
12		103.09	0.00	0.00	217.30	0.00	999.999	3.83	15.49	0.00913	0.900
13	1 U7	128.89	0.00	91.32	-0.00	230.11	2.520	4.16	15.49	0.00816	0.900
14		128.89	0.00	0.00	230.11	0.00	999.999	4.16	15.49	0.00816	0.900
15	1 U8	166.84	0.00	184.52	-0.00	248.07	1.344	4.69	15.49	0.00692	0.900
16		166.84	0.00	0.00	248.07	0.00	999.999	4.69	15.49	0.00692	0.900
17	1 U9	78.44	0.00	185.75	-0.00	204.68	1.102	3.54	15.49	0.01014	0.900
18		78.44	0.00	0.00	204.68	0.00	999.999	3.54	15.49	0.01014	0.900
19	2 U1	141.19	0.00	-2.31	0.00	-236.06	102.192	4.33	15.49	0.00774	0.900
20		141.19	0.00	0.00	236.06	0.00	999.999	4.33	15.49	0.00774	0.900
21	2 U2	180.67	0.00	-4.86	0.00	-254.33	52.289	4.89	15.49	0.00651	0.900
22		180.67	0.00	0.00	254.33	0.00	999.999	4.89	15.49	0.00651	0.900
23	2 U3	169.59	0.00	-4.04	0.00	-249.34	61.717	4.73	15.49	0.00683	0.900
24		169.59	0.00	0.00	249.34	0.00	999.999	4.73	15.49	0.00683	0.900
25	2 U4	141.22	0.00	-95.92	0.00	-236.08	2.461	4.33	15.49	0.00774	0.900
26		141.22	0.00	0.00	236.08	0.00	999.999	4.33	15.49	0.00774	0.900
27	2 U5	172.27	0.00	-191.06	0.00	-250.56	1.311	4.77	15.49	0.00675	0.900
28		172.27	0.00	0.00	250.56	0.00	999.999	4.77	15.49	0.00675	0.900
29	2 U6	103.09	0.00	-188.72	0.00	-217.30	1.151	3.83	15.49	0.00913	0.900
30		103.09	0.00	0.00	217.30	0.00	999.999	3.83	15.49	0.00913	0.900
31	2 U7	128.89	0.00	91.32	-0.00	230.11	2.520	4.16	15.49	0.00816	0.900
32		128.89	0.00	0.00	230.11	0.00	999.999	4.16	15.49	0.00816	0.900
33	2 U8	147.62	0.00	183.42	-0.00	239.13	1.304	4.42	15.49	0.00752	0.900
34		147.62	0.00	0.00	239.13	0.00	999.999	4.42	15.49	0.00752	0.900
35	2 U9	78.44	0.00	185.75	-0.00	204.68	1.102	3.54	15.49	0.01014	0.900
36		78.44	0.00	0.00	204.68	0.00	999.999	3.54	15.49	0.01014	0.900

*** End of output ***

Column 13K



18 x 18 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/18/14

Time: 14:33:41

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

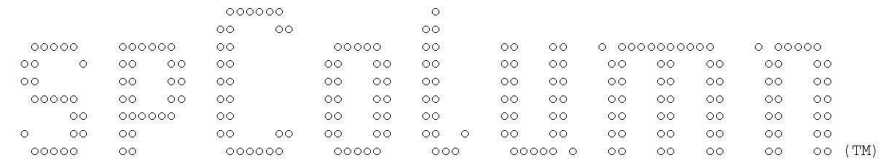
File: F:\SPRING\Lateral\Column Designs\13K\Frame 13 - 13K.col

Project: Lateral System

Column: 13K		Engineer: ahm	
f'c = 4 ksi	fy = 60 ksi	Ag = 324 in^2	12 #6 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 5.28 in^2	rho = 1.63%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 8748 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 8748 in^4
Beta1 = 0.85		Min clear spacing = 3.75 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



spColumn v4.81 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

General Information:
==========
File Name: F:\SPRING\Lateral\Column Designs\13K\Frame 13 - 13K.col
Project: Lateral System
Column: 13K Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 18 in Depth = 18 in

Gross section area, Ag = 324 in^2
Ix = 8748 in^4 Iy = 8748 in^4
rx = 5.19615 in ry = 5.19615 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 3.24 in^2, Asmax = 0.08 * Ag = 25.92 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 5.28 in^2 at rho = 1.63%
Minimum clear spacing = 3.75 in

12 #6 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	145.64	0.00	0.00	3.05	0.00
	Live	71.75	0.00	0.00	1.89	0.00
	Wind	0.00	0.00	0.00	-121.92	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	11.98	0.00	0.00	0.30	0.00
2	Dead	145.64	0.00	0.00	3.05	0.00
	Live	57.91	0.00	0.00	2.60	0.00
	Wind	0.00	0.00	0.00	-121.92	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	11.98	0.00	0.00	0.30	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.000*Snow
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.000*Snow

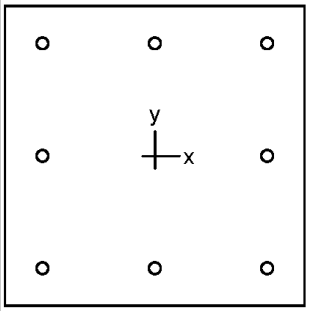
Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

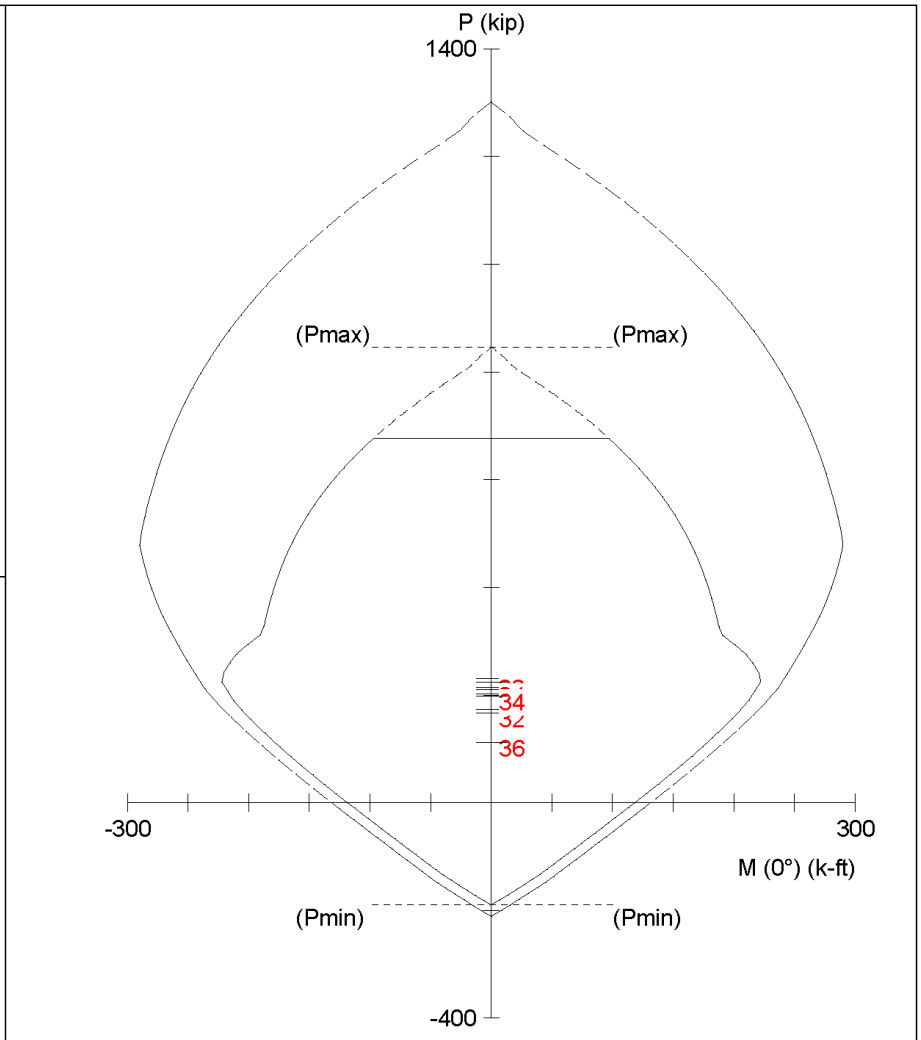
No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	203.90	0.00	4.27	-0.00	254.99	59.717	5.90	15.75	0.00500	0.900
2		203.90	0.00	0.00	254.99	0.00	999.999	5.90	15.75	0.00500	0.900
3	1 U2	295.56	0.00	6.83	-0.00	220.93	32.328	8.59	15.75	0.00250	0.687
4		295.56	0.00	0.00	220.93	0.00	999.999	8.59	15.75	0.00250	0.687
5	1 U3	265.69	0.00	6.03	-0.00	236.88	39.284	7.46	15.75	0.00333	0.758
6		265.69	0.00	0.00	236.88	0.00	999.999	7.46	15.75	0.00333	0.758
7	1 U4	193.94	0.00	-93.39	0.00	-251.63	2.694	5.76	15.75	0.00520	0.900
8		193.94	0.00	0.00	251.63	0.00	999.999	5.76	15.75	0.00520	0.900
9	1 U5	252.51	0.00	-189.36	0.00	-241.89	1.277	7.10	15.75	0.00365	0.785
10		252.51	0.00	0.00	241.89	0.00	999.999	7.10	15.75	0.00365	0.785
11	1 U6	131.08	0.00	-192.32	0.00	-229.05	1.191	4.91	15.75	0.00661	0.900
12		131.08	0.00	0.00	229.05	0.00	999.999	4.91	15.75	0.00661	0.900
13	1 U7	193.94	0.00	101.67	-0.00	251.63	2.475	5.76	15.75	0.00520	0.900
14		193.94	0.00	0.00	251.63	0.00	999.999	5.76	15.75	0.00520	0.900
15	1 U8	252.51	0.00	200.76	-0.00	241.89	1.205	7.10	15.75	0.00365	0.785
16		252.51	0.00	0.00	241.89	0.00	999.999	7.10	15.75	0.00365	0.785
17	1 U9	131.08	0.00	197.81	-0.00	229.05	1.158	4.91	15.75	0.00661	0.900
18		131.08	0.00	0.00	229.05	0.00	999.999	4.91	15.75	0.00661	0.900
19	2 U1	203.90	0.00	4.27	-0.00	254.99	59.717	5.90	15.75	0.00500	0.900
20		203.90	0.00	0.00	254.99	0.00	999.999	5.90	15.75	0.00500	0.900
21	2 U2	273.41	0.00	7.97	-0.00	233.33	29.276	7.71	15.75	0.00313	0.741
22		273.41	0.00	0.00	233.33	0.00	999.999	7.71	15.75	0.00313	0.741
23	2 U3	251.85	0.00	6.74	-0.00	242.09	35.919	7.09	15.75	0.00367	0.786
24		251.85	0.00	0.00	242.09	0.00	999.999	7.09	15.75	0.00367	0.786
25	2 U4	193.94	0.00	-93.39	0.00	-251.63	2.694	5.76	15.75	0.00520	0.900
26		193.94	0.00	0.00	251.63	0.00	999.999	5.76	15.75	0.00520	0.900
27	2 U5	238.67	0.00	-188.65	0.00	-245.86	1.303	6.79	15.75	0.00396	0.811
28		238.67	0.00	0.00	245.86	0.00	999.999	6.79	15.75	0.00396	0.811
29	2 U6	131.08	0.00	-192.32	0.00	-229.05	1.191	4.91	15.75	0.00661	0.900
30		131.08	0.00	0.00	229.05	0.00	999.999	4.91	15.75	0.00661	0.900
31	2 U7	193.94	0.00	101.67	-0.00	251.63	2.475	5.76	15.75	0.00520	0.900
32		193.94	0.00	0.00	251.63	0.00	999.999	5.76	15.75	0.00520	0.900
33	2 U8	238.67	0.00	201.47	-0.00	245.86	1.220	6.79	15.75	0.00396	0.811
34		238.67	0.00	0.00	245.86	0.00	999.999	6.79	15.75	0.00396	0.811
35	2 U9	131.08	0.00	197.81	-0.00	229.05	1.158	4.91	15.75	0.00661	0.900
36		131.08	0.00	0.00	229.05	0.00	999.999	4.91	15.75	0.00661	0.900

*** End of output ***

Column 13N



18 x 18 in



Code: ACI 318-11

Units: English

Run axis: Biaxial

Run option: Design

Slenderness: Not considered

Column type: Structural

Bars: ASTM A615

Date: 02/18/14

Time: 13:28:29

spColumn v4.81. Licensed to: Penn State University Park. License ID: 59919-1033951-4-22545-2CF68

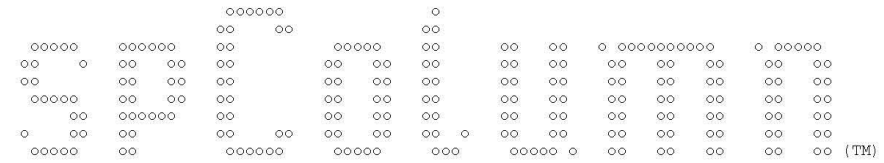
File: F:\SPRING\Lateral\Column Designs\Frame 13 - 13N.col

Project: Lateral System

Column: 13N		Engineer: ahm	
f'c = 4 ksi	fy = 60 ksi	Ag = 324 in^2	8 #6 bars
Ec = 3605 ksi	Es = 29000 ksi	As = 3.52 in^2	rho = 1.09%
fc = 3.4 ksi		Xo = 0.00 in	Ix = 8748 in^4
e_u = 0.003 in/in		Yo = 0.00 in	Iy = 8748 in^4
Beta1 = 0.85		Min clear spacing = 6.00 in	Clear cover = 1.88 in

Confinement: Tied

phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65



==========

spColumn v4.81 (TM)
Computer program for the Strength Design of Reinforced Concrete Sections

==========

General Information:
==========
File Name: F:\SPRING\Lateral\Column Designs\Frame 13 - 13N.col
Project: Lateral System
Column: 13N Engineer: ahm
Code: ACI 318-11 Units: English

Run Option: Design Slenderness: Not considered
Run Axis: Biaxial Column Type: Structural

Material Properties:
==========
f'c = 4 ksi fy = 60 ksi
Ec = 3605 ksi Es = 29000 ksi
Ultimate strain = 0.003 in/in
Betal = 0.85

Section:
==========
Rectangular: Width = 18 in Depth = 18 in

Gross section area, Ag = 324 in^2
Ix = 8748 in^4 Iy = 8748 in^4
rx = 5.19615 in ry = 5.19615 in
Xo = 0 in Yo = 0 in

Reinforcement:
==========
Bar Set: ASTM A615

Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)	Size	Diam (in)	Area (in^2)
# 3	0.38	0.11	# 4	0.50	0.20	# 5	0.63	0.31
# 6	0.75	0.44	# 7	0.88	0.60	# 8	1.00	0.79
# 9	1.13	1.00	# 10	1.27	1.27	# 11	1.41	1.56
# 14	1.69	2.25	# 18	2.26	4.00			

Bar selection: Minimum number of bars
Asmin = 0.01 * Ag = 3.24 in^2, Asmax = 0.08 * Ag = 25.92 in^2

Confinement: Tied; #3 ties with #10 bars, #4 with larger bars.
phi(a) = 0.8, phi(b) = 0.9, phi(c) = 0.65

Layout: Rectangular
Pattern: All Sides Equal (Cover to transverse reinforcement)
Total steel area: As = 3.52 in^2 at rho = 1.09%
Minimum clear spacing = 6.00 in

8 #6 Cover = 1.5 in

Service Loads:
==========

No.	Load Case	Axial Load kip	Mx @ Top k-ft	Mx @ Bot k-ft	My @ Top k-ft	My @ Bot k-ft
1	Dead	124.43	0.00	0.00	-5.74	0.00
	Live	48.01	0.00	0.00	-4.04	0.00
	Wind	0.00	0.00	0.00	-96.47	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	10.46	0.00	0.00	-0.55	0.00
2	Dead	124.43	0.00	0.00	-5.74	0.00
	Live	43.79	0.00	0.00	-4.41	0.00
	Wind	0.00	0.00	0.00	-96.47	0.00
	EQ	0.00	0.00	0.00	0.00	0.00
	Snow	10.46	0.00	0.00	-0.55	0.00

Sustained Load Factors:
==========

Load Case	Factor (%)
Dead	100
Live	0
Wind	0
EQ	0
Snow	0

Load Combinations:
==========
U1 = 1.400*Dead + 0.000*Live + 0.000*Wind + 0.000*EarthQuake + 0.000*Snow
U2 = 1.200*Dead + 1.600*Live + 0.000*Wind + 0.000*EarthQuake + 0.500*Snow

U3 = 1.200*Dead + 1.000*Live + 0.000*Wind + 0.000*EarthQuake + 1.600*Snow
U4 = 1.200*Dead + 0.000*Live + 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U5 = 1.200*Dead + 1.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U6 = 0.900*Dead + 0.000*Live + 1.600*Wind + 0.000*EarthQuake + 0.000*Snow
U7 = 1.200*Dead + 0.000*Live - 0.800*Wind + 0.000*EarthQuake + 1.600*Snow
U8 = 1.200*Dead + 1.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.500*Snow
U9 = 0.900*Dead + 0.000*Live - 1.600*Wind + 0.000*EarthQuake + 0.000*Snow

Factored Loads and Moments with Corresponding Capacities:

Design/Required ratio PhiMn/Mu >= 1.00
NOTE: Each loading combination includes the following cases:
First line - at column top
Second line - at column bottom

No.	Load Combo	Pu kip	Mux k-ft	Muy k-ft	PhiMnx k-ft	PhiMny k-ft	PhiMn/Mu	NA depth in	Dt depth in	eps_t	Phi
1	1 U1	174.20	0.00	-8.04	0.00	-206.48	25.694	5.11	15.75	0.00625	0.900
2		174.20	0.00	0.00	206.48	0.00	999.999	5.11	15.75	0.00625	0.900
3	1 U2	231.36	0.00	-13.63	0.00	-222.84	16.353	5.96	15.75	0.00493	0.894
4		231.36	0.00	0.00	222.84	0.00	999.999	5.96	15.75	0.00493	0.894
5	1 U3	214.06	0.00	-11.81	0.00	-219.25	18.568	5.70	15.75	0.00529	0.900
6		214.06	0.00	0.00	219.25	0.00	999.999	5.70	15.75	0.00529	0.900
7	1 U4	166.05	0.00	-84.94	0.00	-203.05	2.390	4.96	15.75	0.00652	0.900
8		166.05	0.00	0.00	203.05	0.00	999.999	4.96	15.75	0.00652	0.900
9	1 U5	202.56	0.00	-165.55	0.00	-216.03	1.305	5.54	15.75	0.00553	0.900
10		202.56	0.00	0.00	216.03	0.00	999.999	5.54	15.75	0.00553	0.900
11	1 U6	111.99	0.00	-159.51	0.00	-178.33	1.118	4.04	15.75	0.00870	0.900
12		111.99	0.00	0.00	178.33	0.00	999.999	4.04	15.75	0.00870	0.900
13	1 U7	166.05	0.00	69.41	-0.00	203.05	2.926	4.96	15.75	0.00652	0.900
14		166.05	0.00	0.00	203.05	0.00	999.999	4.96	15.75	0.00652	0.900
15	1 U8	202.56	0.00	143.14	-0.00	216.03	1.509	5.54	15.75	0.00553	0.900
16		202.56	0.00	0.00	216.03	0.00	999.999	5.54	15.75	0.00553	0.900
17	1 U9	111.99	0.00	149.18	-0.00	178.33	1.195	4.04	15.75	0.00870	0.900
18		111.99	0.00	0.00	178.33	0.00	999.999	4.04	15.75	0.00870	0.900
19	2 U1	174.20	0.00	-8.04	0.00	-206.48	25.694	5.11	15.75	0.00625	0.900
20		174.20	0.00	0.00	206.48	0.00	999.999	5.11	15.75	0.00625	0.900
21	2 U2	224.61	0.00	-14.22	0.00	-222.14	15.623	5.84	15.75	0.00509	0.900
22		224.61	0.00	0.00	222.14	0.00	999.999	5.84	15.75	0.00509	0.900
23	2 U3	209.84	0.00	-12.18	0.00	-218.07	17.907	5.64	15.75	0.00538	0.900
24		209.84	0.00	0.00	218.07	0.00	999.999	5.64	15.75	0.00538	0.900
25	2 U4	166.05	0.00	-84.94	0.00	-203.05	2.390	4.96	15.75	0.00652	0.900
26		166.05	0.00	0.00	203.05	0.00	999.999	4.96	15.75	0.00652	0.900
27	2 U5	198.34	0.00	-165.92	0.00	-214.85	1.295	5.49	15.75	0.00561	0.900
28		198.34	0.00	0.00	214.85	0.00	999.999	5.49	15.75	0.00561	0.900
29	2 U6	111.99	0.00	-159.51	0.00	-178.33	1.118	4.04	15.75	0.00870	0.900
30		111.99	0.00	0.00	178.33	0.00	999.999	4.04	15.75	0.00870	0.900
31	2 U7	166.05	0.00	69.41	-0.00	203.05	2.926	4.96	15.75	0.00652	0.900
32		166.05	0.00	0.00	203.05	0.00	999.999	4.96	15.75	0.00652	0.900
33	2 U8	198.34	0.00	142.77	-0.00	214.85	1.505	5.49	15.75	0.00561	0.900
34		198.34	0.00	0.00	214.85	0.00	999.999	5.49	15.75	0.00561	0.900
35	2 U9	111.99	0.00	149.18	-0.00	178.33	1.195	4.04	15.75	0.00870	0.900
36		111.99	0.00	0.00	178.33	0.00	999.999	4.04	15.75	0.00870	0.900

*** End of output ***

Appendix B.7: Beam-Column Interaction Calculations

Girder Interaction

A. Mincemoyer | Lateral | Final Report

Check Girder Strength Adequacy for Interaction:

- worst case loading was found to be on Girder 8, span 5. (at midspan)

from spBeam:

$M_u = 1077.7'^k$
$\phi M_n = 1130.9'^k$

$f'_c = 4$ ksi
$\beta_1 = 0.85$
$b = 30"$

$f_y = 60$ ksi
(15) #8 bars
#3 ties

$\phi P_n = \phi\, 0.85 f'_c \cdot \beta_1 \cdot c \cdot b + \sum A_{si} f_{si}$ *it is conservative to not include reinforcement

$a = \frac{A_s f_y}{.85 f'_c b} = \frac{15(0.79)(60)}{0.85(4)(30)} \rightarrow a = 6.97"$

$c = a/\beta_1 = 6.97/0.85 \rightarrow c = 8.2"$

$\varepsilon_t = \frac{\varepsilon_u}{c}(d_t - c) = \frac{.003}{8.2}\left[(24.5 - 1.5 - .375 - .5) - 8.2\right]$

$\rightarrow \varepsilon_t = 0.0051 \geq .005 \rightarrow \phi = 0.90$

$\phi P_n = (0.90)(0.85)(4)(0.85)(8.2)(30)$

$\phi P_n = 640^k$

$P_u = 112.7^k$ (due to wind)

Interaction:

$\frac{P_u}{\phi P_n} = \frac{112.7}{640} = 0.18 < 0.2$

$\rightarrow \frac{1}{2}\frac{P_u}{\phi P_n} + \frac{9}{8}\left(\frac{8}{9}\frac{M_u}{\phi M_n}\right) \leq 1.0$

$\frac{1}{2}\frac{112.7}{640} + \frac{9}{8}\left(\frac{8}{9}\frac{1077.7}{1130.9}\right) = 1.0 \leq 1.0$ ✓ok

→ Girder strength is adequate for interaction

Joist Interaction

A. Mincemoyer | Lateral | Final Report

Check Joist Strength Adequacy for Interaction:

- Joists along column line D
- Span 1
- midspan

from spBeam:

$M_u = 54.73'^k$
$\phi M_n = 104.52'^k$

$f'_c = 4$ ksi $\quad f_y = 60$ ksi
$\beta_1 = 0.85$ $\quad$ (1) #6 and (1) #7
$b = 6$

$$a = \frac{A_s f_y}{0.85 f'_c b} = \frac{(.44+.6)(60)}{.85(4)(6)} = 3.06"$$

$$c = a/\beta = 3.06/.85 = 3.6"$$

$$\varepsilon_t = \frac{\varepsilon_u}{c}(d_t - c) = \frac{.003}{3.6}\left[(24.5 - 1.5 - .75/2) - 3.6\right]$$

$\varepsilon_t = 0.016 \geq .005 \rightarrow \phi = 0.90$

$$\phi P_n = \phi\, 0.85 f'_c (bh - \Sigma A_{si}) + \Sigma A_{si} f_y$$

$$= (.90)(.85)(4)\left[(6)(24.5) - (.44+.6)\right] + (.44+.6)(60)$$

$\phi P_n = 509^k$ $\quad P_u = 46.0^k$ (due to wind)

Interaction:

$$\frac{P_u}{\phi P_n} = \frac{46.0}{509} = 0.09 < 0.2$$

$$\frac{1}{2}\frac{P_u}{\phi P_n} + \frac{9}{8}\left(\frac{8}{9}\frac{M_u}{\phi M_n}\right) \leq 1.0$$

$$\frac{1}{2}\frac{46.0}{509} + \frac{54.73}{104.52} = 0.57 \leq 1.0 \quad \checkmark ok$$

→ Joist strength is adequate for interaction

Appendix C.1: Gravity Loads on the Bridge

Dead and Live Loads

A. Mincemoyer	Bridge Loads	Final Report

Floor Dead Load:

Linear Metal Ceiling = 3 psf

3/4" Plywood Sheathing = 2.4 psf (ASCE 7-10)

Sprayed Plastic Foam Insulation = 1 psf

3 5/8" Metal Studs @ 16" o.c. = 3 psf

6" concrete slab on 3" composite deck = 57 psf

Carpet pad & adhesive = 1.5 psf

Carpet = 1 psf

Misc. & superimposed

mep = 5 psf
lighting = 5 psf
framing allowance = 10 psf

→ Total Floor Dead Load = 88.9 psf

Floor Live Load:

Uniform pedestrian loading = 90 psf
* per LRFD Guide Specifications for the Design of Pedestrian Bridges

Exterior Wall Load:

Aluminum Storefront = 12.0 psf
Composite Aluminum Panel = 13.0 psf
} use 15.0 psf conservatively

(calculated in Technical Report 2)

Roof Dead Load:

Roof Type RS-1 = 43.2 psf

(calculated in Technical Report 2)

Snow Loads

A. Mincemoyer | Bridge Loads | Final Report

Snow Drift onto Roof: Section 7.7.1

$h_c/h_b < 0.2 \Rightarrow$ not required

$\gamma = 0.13 p_g + 14 < 30$ pcf

$= 0.13(45) + 14 = 19.85$ pcf < 30 pcf ✓

$h_b = \frac{p_s}{\gamma} = \frac{35}{19.85} = 1.76'$

$h_c = 16.92 - 1.76 = 15.16'$

$h_c/h_b = 15.16/1.76 = 8.6 \rightarrow$ drift required

Leeward: (figure 7-9)

$l_u = 80.75'$

$h_d = 0.43 \sqrt[3]{l_u} \sqrt[4]{p_g + 10} - 1.5$

$= 0.43 \sqrt[3]{80.75'} \sqrt[4]{45+10} - 1.5$

$h_d = 3.56'$

Windward: (figure 7-9)

$l_u = 90'$

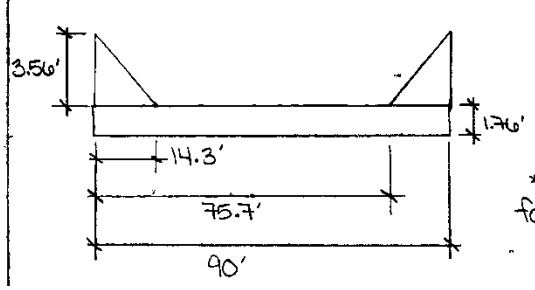
$h_d = [.43 \sqrt[3]{90'} \sqrt[4]{45+10} - 1.5](.75)$

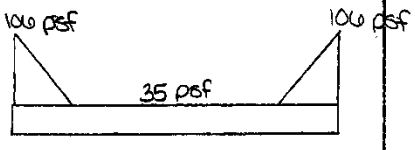
$h_d = 2.81'$

$\rightarrow h_d = 3.56$ ft should be used in design

$h_d < h_c \rightarrow w = 4h_d = 4(3.56) = 14.3$ ft

$h_d \gamma = 3.56(19.85) = 71$ psf





*Loads mirrored to account for drift due to Dillingham Center

Appendix C.2: Determination of Panel Point Loads

A. Mincemoyer | Bridge Loads | Final Report

Panel Point Loads:

Bridge Width = 9.5'
8 spans @ 11'-8" = 93'-4"
12' tall side trusses

Bottom Chord:

Tributary Area = 55.4 ft²

Dead Load:

(88.9 psf)(55.4 ft²) = 4.9 k

Live Load:

(90 psf)(55.4 ft²) = 5.0 k

Top Chord:

Tributary Area = 55.4 ft²

Dead Load:

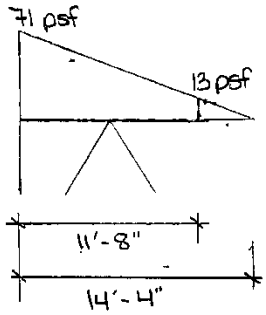
(43.2 psf)(55.4 ft²) = 2.4 k

Snow Load:

uniform load:

(35 psf)(55.4 ft²) = 1.9 k

load due to drift:



$\frac{71}{14.33} = \frac{x}{2.67}$ $x = 13$ psf

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load due to drift: (continued)

$(13\ psf)(9.5'/2)(11.67') = 0.7^k$

$(\frac{1}{2})(71-13)(9.5'/2)(11.67') = 1.6^k$

2.3^k on first panel point

$(\frac{1}{2})(13)(9.5'/2)(2.67') = 0.1^k$ on second panel point

Exterior Wall Load:

Tributary Area = $70\ ft^2$

$(15\ psf)(70\ ft^2) = 1.1^k$ on every panel point

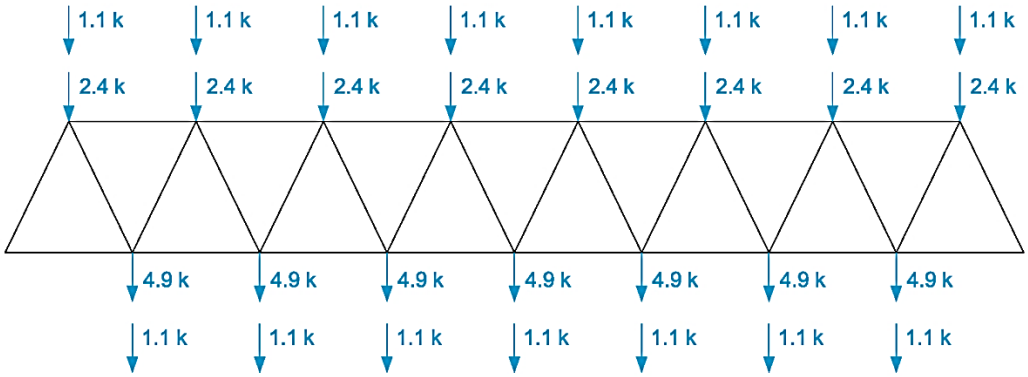
* See AutoCAD drawing for load summary *

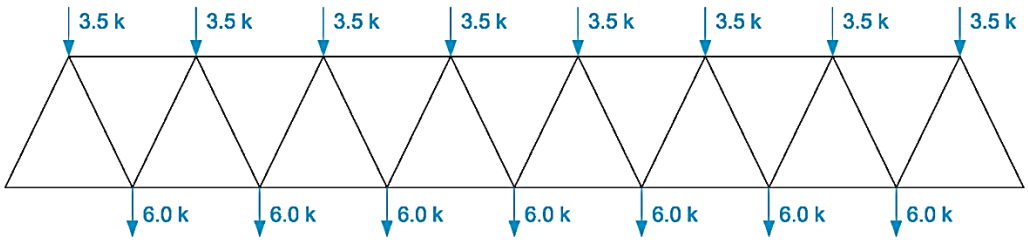
Appendix C.3: Panel Point Loads

Color Coding Key

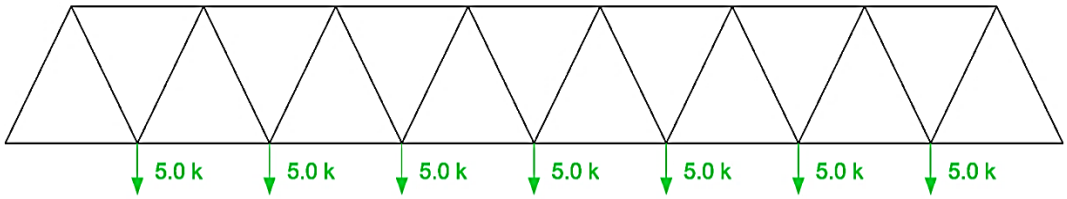
Dead Loads
Live Loads
Snow Loads
Load Combination Loads
Index
Member Force

Dead Loads

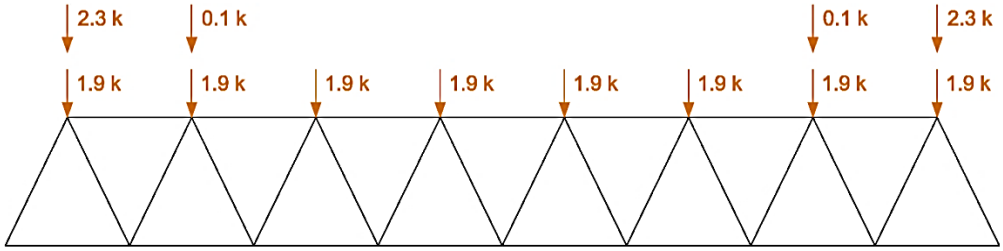


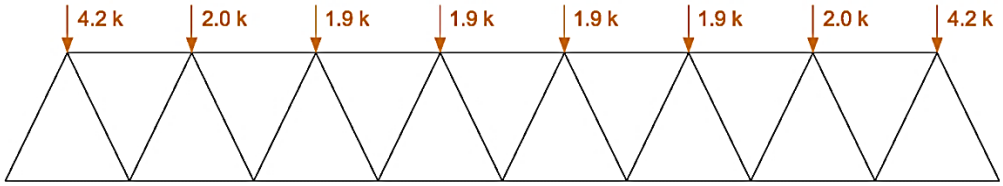


Live Loads



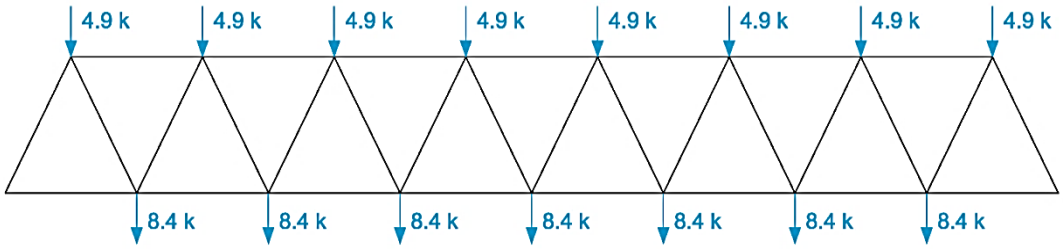
Snow Loads



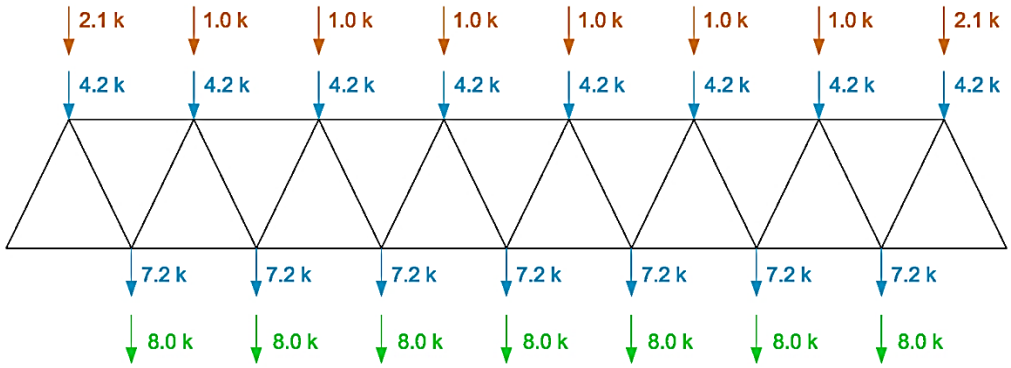


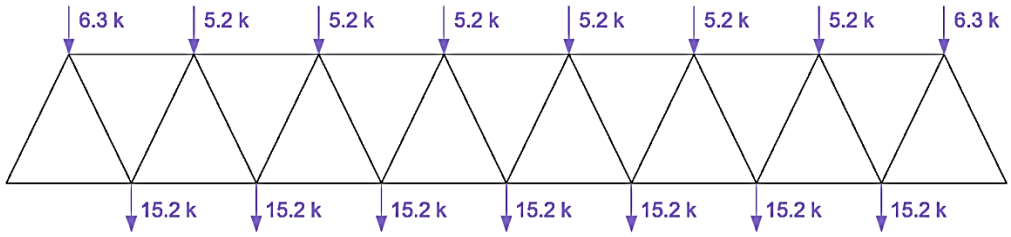
Appendix C.4: Panel Point Load Combinations

1.4 D

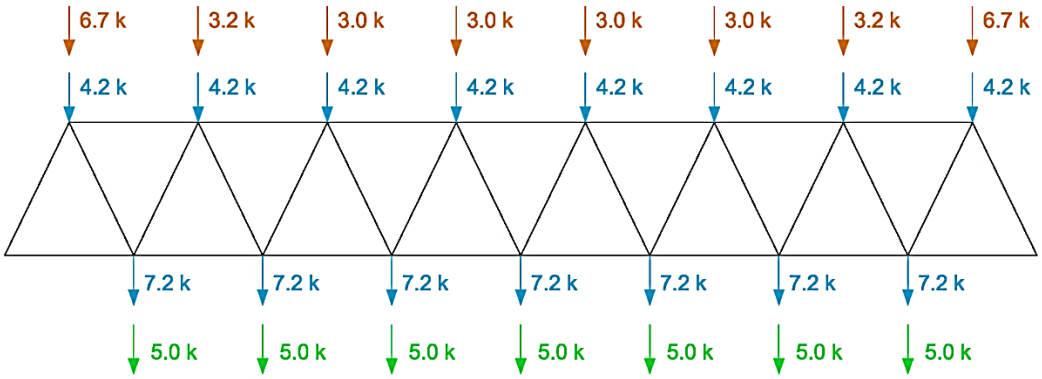


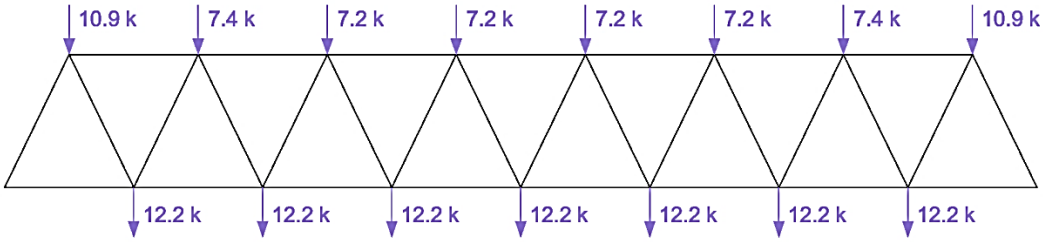
1.2 D + 1.6 L + 0.5 S





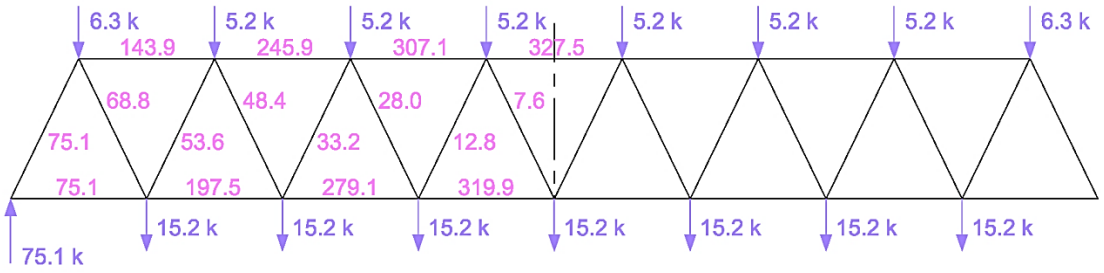
1.2 D + 1.6 S + L


6.7 k
3.2 k
3.0 k
3.0 k
3.0 k
3.0 k
3.2 k
6.7 k
4.2 k
4.2 k
4.2 k
4.2 k
4.2 k
4.2 k
4.2 k
4.2 k
7.2 k
7.2 k
7.2 k
7.2 k
7.2 k
7.2 k
7.2 k
5.0 k
5.0 k
5.0 k
5.0 k
5.0 k
5.0 k
5.0 k

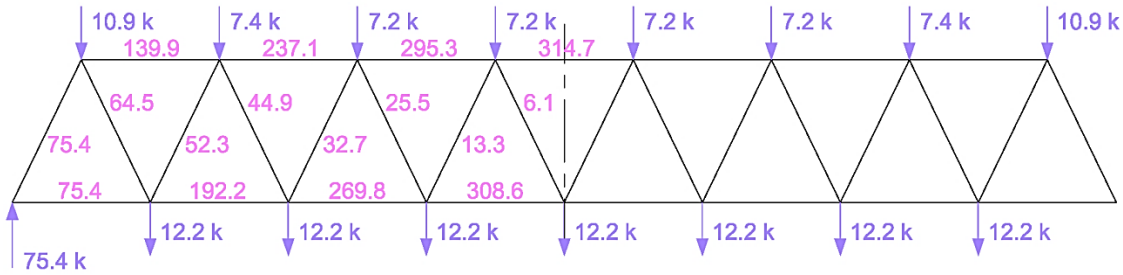

10.9 k
7.4 k
7.2 k
7.2 k
7.2 k
7.2 k
7.4 k
10.9 k
12.2 k
12.2 k
12.2 k
12.2 k
12.2 k
12.2 k
12.2 k

Appendix C.5: Member Indices

1.2 D + 1.6 L + 0.5 S



1.2 D + 1.6 S + L



Appendix C.6: Conversion of Indices to Member Forces

Converting Indexes to Forces

p =	5.8	ft		
h =	12.0	ft	p/h =	0.49
L =	13.3	ft	L/h =	1.11

	1.2 D + 1.6 L + 0.5 S			1.2 D + 1.6 S + L			Max Member Force
	Index	Ratio	Force (k)	Index	Ratio	Force (k)	(k)
Top Chord	143.9	0.49	70.0	139.9	0.49	68.1	70.0
	245.9	0.49	119.6	237.1	0.49	115.3	119.6
	307.1	0.49	149.3	295.3	0.49	143.6	149.3
	327.5	0.49	159.3	314.7	0.49	153.0	159.3
Diagonals	75.1	1.11	83.5	75.4	1.11	83.8	83.8
	68.8	1.11	76.5	64.5	1.11	71.7	76.5
	53.6	1.11	59.6	52.3	1.11	58.2	59.6
	48.4	1.11	53.8	44.9	1.11	49.9	53.8
	33.2	1.11	36.9	32.7	1.11	36.4	36.9
	28	1.11	31.2	25.5	1.11	28.4	31.2
	12.8	1.11	14.3	13.3	1.11	14.8	14.8
	7.6	1.11	8.5	6.1	1.11	6.8	8.5
Bottom Chord	75.1	0.49	36.6	75.4	0.49	36.7	36.7
	197.5	0.49	96.1	192.2	0.49	93.5	96.1
	279.1	0.49	135.7	269.8	0.49	131.2	135.7
	319.9	0.49	155.6	308.6	0.49	150.1	155.6

Appendix C.7: Method of Joints

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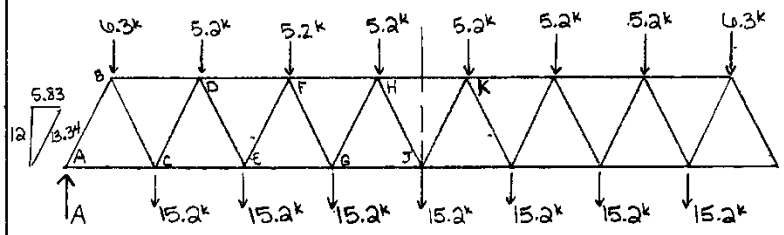
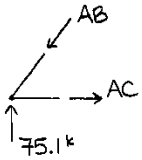
Verify Member Forces Using Method of Joints:

1.2D + 1.6E + 0.5S



$\Sigma F_y = 0 = -6.3 - 3(5.2) - 3.5(15.2) + A \rightarrow A = 75.1^k \uparrow$

Joint A:



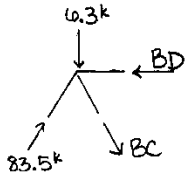
$\Sigma F_y = 0 = -(12/13.34)AB + 75.1$

$\rightarrow AB = 83.5^k \quad C$

$\Sigma F_x = 0 = -(5.83/13.34)\,83.5 + AC$

$\rightarrow AC = 36.5^k \quad T$

Joint B:



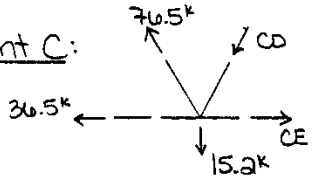
$\Sigma F_y = 0 = -6.3 + 83.5(12/13.34) - (12/13.34)BC$

$\rightarrow BC = 76.5^k \quad T$

$\Sigma F_x = 0 = 83.5(5.83/13.34) + (5.83/13.34)(76.5) - BD$

$\rightarrow BD = 69.9^k \quad C$

Joint C:



$\Sigma F_y = 0 = -15.2 + 76.5(12/13.34) - (12/13.34)CD$

$\rightarrow CD = 59.6^k \quad C$

$\Sigma F_x = 0 = -36.5 - 76.5(5.83/13.34) - 59.6(5.83/13.34) + CE$

$\rightarrow CE = 96.0^k \quad T$

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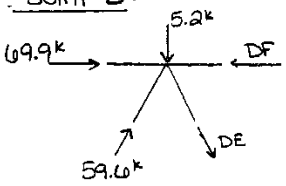
Joint D:



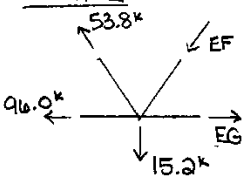
$\Sigma F_y = 0 = -5.2 + 59.6(12/13.34) - DE(12/13.34)$

$\rightarrow DE = 53.8^k$ T

$\Sigma F_x = 0 = 69.9 + 59.6(5.83/13.34) + 53.8(5.83/13.34) - DF$

$\rightarrow DF = 119.5^k$ C

Joint E:



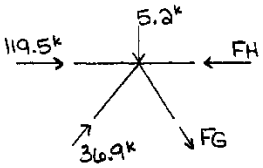
$\Sigma F_y = 0 = -15.2 + 53.8(12/13.34) - EF(12/13.34)$

$\rightarrow EF = 36.9^k$ C

$\Sigma F_x = 0 = -96 - 53.8(5.83/13.34) - 36.9(5.83/13.34) + EG$

$\rightarrow EG = 135.6^k$ T

Joint F:



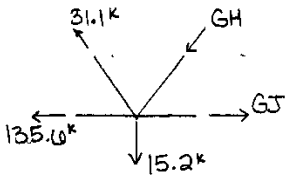
$\Sigma F_y = 0 = -5.2 + 36.9(12/13.34) - FG(12/13.34)$

$\rightarrow FG = 31.1^k$ T

$\Sigma F_x = 0 = 119.5 + 36.9(5.83/13.34) + 31.1(5.83/13.34) - FH$

$\rightarrow FH = 149.2^k$ C

Joint G:



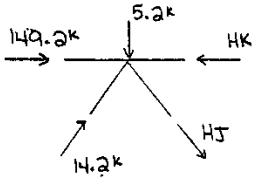
$\Sigma F_y = 0 = -15.2 + 31.1(12/13.34) - GH(12/13.34)$

$\rightarrow GH = 14.2^k$ C

$\Sigma F_x = -135.6 - 31.1(5.83/13.34) - 14.2(5.83/13.34) + GJ$

$\rightarrow GJ = 155.4^k$ T

Joint H:



$\Sigma F_y = 0 = -5.2 + 14.2(12/13.34) - HJ(12/13.34)$

$\rightarrow HJ = 8.4^k$ T

$\Sigma F_x = 0 = 149.2 + 14.2(5.83/13.34) + 8.4(5.83/13.34) - HK$

$\rightarrow HK = 159.1^k$ C

Appendix C.8: Member Design

A. Mincemoyer	Bridge Design	Final Report

Member Design:

Top Chord:

maximum member force = 159.3^k Compression

KL = 11.67 ft

using Table 4-4 of the steel Manual:

HSS7×7×¼ ϕP_c = 212^k > P_u = 159.3^k ✓ok

Bottom Chord:

maximum member force = 155.6^k Tension

KL = 11.67 ft

* for aesthetics, use HSS7×7

using Table 5-5 of the Steel Manual:

HSS7×7×¼ ϕP_n = 255^k > 155.6^k ✓ok

* HSS7×7×3/16 would work. But, HSS7×7×¼ was chosen for constructibility.

Diagonals:

maximum member force = 83.8^k Compression

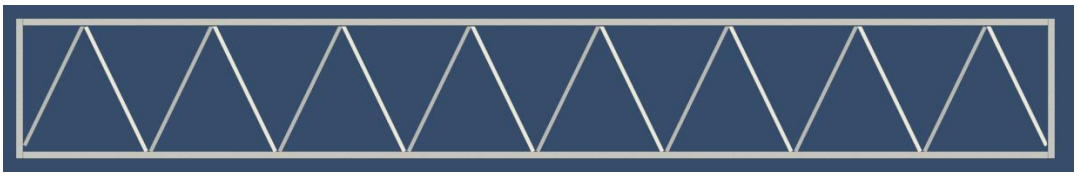
KL = 13.33 ft

using Table 4-4 of the Steel Manual:

HSS4×4×½ ϕP_o = 95.8^k > 83.8^k ✓ok

Appendix D.1: Bridge Trusses

Side Trusses



Top Truss

Bottom Truss

Appendix E.1: Luminaire Specification Sheet

Date: _____ Type: _____

Firm Name: _____

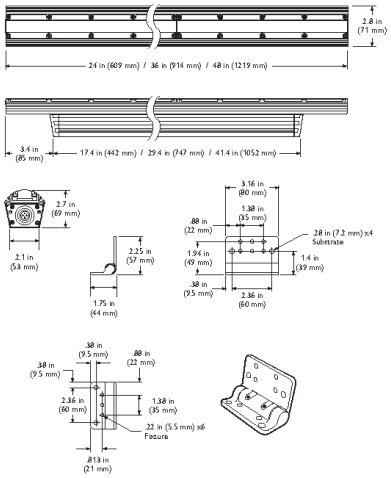
Project: _____

ColorGraze Powercore

30° x 60° beam angle

Linear exterior LED wall grazing fixture with intelligent color light

ColorGraze Powercore linear LED lighting fixtures are optimized for surface grazing, wall-wash lighting, and efficient signage illumination. Superior light quality offers uniform beam saturation as close as 6 in (152 mm). A compact, low-profile design combined with flexible mounting options allows for discreet placement within a wide range of architectural features. Intelligent, controllable fixtures are available in standard full-color configurations. Custom configurations with additional beam angles and custom LED channels are also available to support special applications.



- Tailor light output to specific applications — Available in three standard lengths, with standard 10° x 60° and 30° x 60° beam angles. Individually addressable 1 ft (305 mm) segments accommodate fine control of color-changing effects and pre-programmed light shows.
- High-performance illumination and beam quality — ColorGraze Powercore delivers up to 368 lumens of color-changing light per foot. Superior beam quality offers striation-free saturation as close as 6 in (152 mm) from fixture placement with no visible light scalloping between fixtures.
- Integrates Powercore technology — Powercore technology rapidly, efficiently, and accurately controls power output to fixtures directly from line voltage. The Philips Data Enabler Pro merges line voltage with control and delivers them to the fixture over a single standard cable, dramatically simplifying installation and lowering total system cost.
- Versatile installation options — Constant torque locking hinges offer simple and consistent position control from various angles. The low-profile aluminum housing accommodates placement within most architectural niches.
- Superior color consistency — Optibin, a proprietary binning optimization process developed by Philips Color Kinetics, guarantees consistency of hue across LEDs, fixtures, and manufacturing runs.
- Industry-leading controls — ColorGraze Powercore works seamlessly with the complete Philips Color Kinetics line of controllers, including Light System Manager, iPlayer 3, and ColorDial Pro, as well as third-party controllers.
- Support for installations requiring conduit to fixtures — ColorGraze Powercore Conduit fixtures have flying leads and threaded openings for 1/2 in NPT conduit to support installations in North America where conduit is required.
- Custom configurations for special applications —You can create custom configurations by exchanging the LED sources in any channel. Options include seven color temperatures ranging from 2700 K to 6500 K, Royal Blue, Blue, Green, Amber, and Red. Additional beam angles (including 9° x 9°, 10° x 30°, and 90° x 60°) are also available. Refer to the ColorGraze Powercore Ordering Information specification sheet for complete details.

For detailed product information, please refer to ColorGraze Powercore Product Guide at www.philipscolorkinetics.com/ls/rgb/colorgraze/

PHILIPS

Specifications

Due to continuous improvements and innovations, specifications may change without notice.

Item	Specification	2 ft (610 mm)	3 ft (914 mm)	4 ft (1219 mm)
	Lumens*	736	1104	1472
	LED Channels	Red / Green / Blue		
	Mixing Distance	6 in (152 mm) to uniform beam saturation		
	Lumen Maintenance†	100,000 hours L_{50} @ 25° C 90,000 hours L_{50} @ 50° C		
Electrical	Input Voltage	100 – 240 VAC, auto-switching, 50 / 60 Hz		
	Power Consumption *at full output, steady state*	35 W maximum	52.5 W maximum	70 W maximum
Control	Interface	Data Enabler Pro (DMX or Ethernet) Fixture firmware addressable 8- or 16-bit control		
	Control System	Philips full range of controllers, including Light System Manager, iPlayer 3, and ColorDial Pro, or third-party controllers		
Physical	Dimensions *(Height x Width x Depth)*	2.7 x 24 x 2.8 in (69 x 610 x 71 mm)	2.7 x 36 x 2.8 in (69 x 914 x 71 mm)	2.7 x 48 x 2.8 in (69 x 1219 x 71 mm)
	Weight	4.9 lb (2.2 kg)	8.1 lb (3.6 kg)	10.8 lb (4.9 kg)
	Housing	Extruded anodized aluminum		
	Lens	Clear polycarbonate		
	Fixture Connectors	Integral male / female waterproof connectors		
	Temperature	-40° – 122° F (-40° – 50° C) Operating -4° – 122° F (-20° – 50° C) Startup -40° – 176° F (-40° – 80° C) Storage		
	Humidity	0 – 95%, non-condensing		
	Fixture Run Lengths	To calculate fixture run lengths and total power consumption for your specific installation, download the Configuration Calculator from www.philipscolorkinetics.com/support/install_tool/		
Certification and Safety	Certification	UL / cUL, FCC Class A, CE, PSE, CCC		
	Environment	Dry / Damp / Wet Location, IP66		

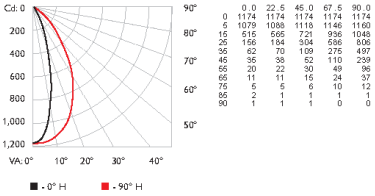
* Measurements comply with IES LM-79-08 testing procedures.

† L_{50} = 50% lumen maintenance (when light output drops below 50% of initial output). Ambient luminaire temperatures specified. Lumen maintenance calculations are based on lifetime prediction graphs supplied by LED source manufacturers. Calculations for white-light LED fixtures are based on measurements that comply with IES LM-80-08 testing procedures. Refer to www.philipscolorkinetics.com/support/appnotes/lm-80-08.pdf for more information.

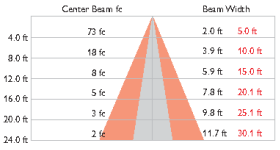
Photometrics

ColorGraze Powercore 2 ft, 30° x 60° beam angle

Polar Candela Distribution



Illuminance at Distance



34.3 ft (10.5 m)
1 fc maximum distance

Vert. Spread: 27.5°
Horiz. Spread: 64.2°

LED	Lumens	Efficacy
RGB	736	16.1

For lux multiply fc by 10.7

CHROMACORE® CKTECHNOLOGY | OPTIBIN® CKTECHNOLOGY | POWERCORE® CKTECHNOLOGY

Accessories

Item	Type	Size	Item Number	Philips 12NC
Leader Cable	UL / cUL	50 ft (15.2 m)	108-000042-00	910503700322
	CE / PSE	50 ft (15.2 m)	108-000042-01	910503700323
Jumper Cable	UL / cUL	End-to-End	108-000039-00	910503700314
		1 ft (305 mm)	108-000039-01	910503700315
		5 ft (1.5 m)	108-000039-02	910503700316
	CE / PSE	End-to-End	108-000040-00	910503700317
		1 ft (305 mm)	108-000040-01	910503700318
		5 ft (1.5 m)	108-000040-02	910503700319
Glare Shield		1 ft (305 mm)	120-000081-00	910503700745
		2 ft (610 mm)	120-000081-01	910503700746
		3 ft (914 mm)	120-000081-02	910503700747
		4 ft (1.2 m)	120-000081-03	910503700748
Additional Terminators		Quantity 10	120-000074-00	910503700580
Additional Hinge		Quantity 1	120-000098-00	910503700772

Use Item Number when ordering in North America.

Fixtures and Data Enabler Pro

Item	Type	Size	Item Number	Philips 12NC
ColorGraze Powercore	10° x 60°	2 ft (610 mm)	123-000030-00	910503700308
		3 ft (914 mm)	123-000030-01	910503700309
		4 ft (1219 mm)	123-000030-02	910503700310
	30° x 60°	2 ft (610 mm)	123-000030-03	910503700311
		3 ft (914 mm)	123-000030-04	910503700312
		4 ft (1219 mm)	123-000030-05	910503700313
ColorGraze Powercore Conduit (UL / cUL only)	10° x 60°	2 ft (610 mm)	123-000020-06	910503701833
		3 ft (914 mm)	123-000020-11	910503701838
		4 ft (1219 mm)	123-000020-16	910503701843
	30° x 60°	2 ft (610 mm)	123-000020-08	910503701835
		3 ft (914 mm)	123-000020-13	910503701840
		4 ft (1219 mm)	123-000020-18	910503701845
Data Enabler Pro	3/4 in / 1/2 in NPT (US trade size conduit)		106-000004-00	910503701210
	PG21 / PG13 (metric size conduit)		106-000004-01	910503701211

Use Item Number when ordering in North America.

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