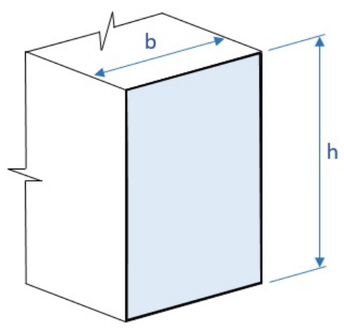
REFERENCES	CALCULATIONS	RESULTS
Code: ACI 318-14	**MEMBER #1 (SECTION POSITION 120.0 INCHES) COLUMN DESIGN REPORT** **Project details** **Project Name: Not Provided** **Project ID: Not Provided** Company: Not Provided Designer: Not Provided Client: Not Provided Project Notes: Not Provided Project Units: Imperial **General member design information** Dimentions:  Height $h = 16\ \text{in}$ Width $b = 16\ \text{in}$ Member length = $240\ \text{in}$ Material properties: Concrete strength $f_c = 5000\ \text{psi}$ Steel strength of longitudinal rebar $f_y = 60000\ \text{psi}$ Steel strength of shear rebar $f_{yt} = 50000\ \text{psi}$ Permissible crack width $c_w = 0.012\ \text{in}$ **Load Combinations (Ultimate Limit State)** For axial force in section: LC1: USER = $100\ \text{Kip}$ For bending moment in section (major axis): LC1: USER = $10\ \text{Kip-ft}$ For bending moment in section (minor axis): LC1: USER = $10\ \text{Kip-ft}$ **Load Combinations (Serviceability Limit State)** For axial force in section: LC1: USER = $0\ \text{Kip}$ For bending moment in section (major axis): LC1: USER = $0\ \text{Kip-ft}$ For bending moment in section (minor axis): LC1: USER = $0\ \text{Kip-ft}$	
	Detailing of Members DETAILING RULES FOR COLUMN (LONGITUDINAL REINFORCEMENT) Section input data: Section concrete area $A_g = 256.00\ \text{in}^2$ Longitudinal rebar area $A_{st} = 8.00\ \text{in}^2$ Check the steel ratio for the longitudinal steel: $$\rho = \frac{A_{st}}{A_g} = \frac{8.00}{256.00} = 0.03125$$ $$0.01 < 0.03125 < 0.08$$	**STATUS OK!**

Column check

MAXIMUM AXIAL COMPRESSION

Section input data:
Section concrete area $A_g = 256.00\ \text{in}^2$
Longitudinal rebar area $A_{st} = 8.00\ \text{in}^2$

Calculate the axial load capacity for concentric loading

$$P_u = \phi \cdot P_n = \phi \cdot K \cdot \left[0.85 \cdot \acute{f_c} \cdot (A_g - A_{st}) + f_y \cdot A_{st}\right] =$$

$$= 0.65 \cdot 0.8 \cdot \left[0.85 \cdot \acute{f_c} \cdot (A_g - A_{st}) + f_y \cdot A_{st}\right] =$$

$$= 0.65 \cdot 0.8 \cdot [0.85 \cdot 5000 \cdot (256.00 - 8.00) + 60000 \cdot 8.00] \cdot 0.001 = 797.68\ \text{Kip}$$

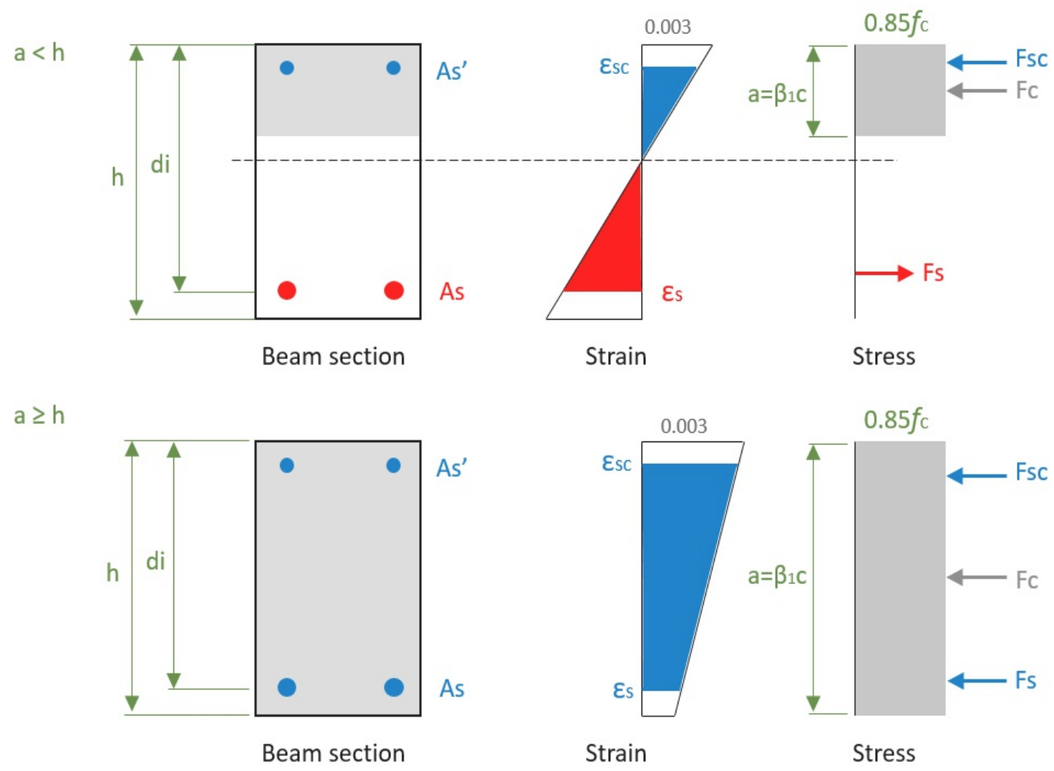
MAXIMUM AXIAL TENSION

Section input data:
Longitudinal rebar area $A_{st} = 8.00\ \text{in}^2$

Calculate the axial load capacity for concentric loading

$$T_n = -0.9 \cdot f_{yd} \cdot A_{st} = -0.9 \cdot 60000 \cdot 8.00 \cdot 0.001 = -432.00\ \text{Kip}$$

M-N INTERACTION



Calculation is based on iterative process:
- Calculate plastic centroid location $\overline{x_p}$
- Assume c in tension control zone and compression control zone
- Calculate strain e_s and e_{sc} when a < h:

$e_{sc} = e_c \cdot ((c - \acute{d})/c)$
$e_s = e_c \cdot ((d - c)/c)$
and a > h:
$e_{sc} = 0.002 \cdot (7 \cdot (c - \acute{d})/(7 \cdot c - 3 \cdot h))$
$e_s = 0.002 \cdot (7 \cdot (c - d)/(7 \cdot c - 3 \cdot h))$
- Calculate reinforcement stresses $f_s = \{e_s E_s\ (e_s \leq e_y),\ e_y\ (e_s > e_y)\}$
- Calculate equilibrium forces:

$N = F_{cc} + F_{sc} + F_s$
$a < h$: $N = \acute{f_c} \cdot b \cdot \beta_1 \cdot x + \sum f_{sci} \cdot \acute{A_{si}} + \sum f_{si} \cdot A_{si}$
$a \geq h$: $N = \acute{f_c} \cdot b \cdot h + \sum f_{sci} \cdot \acute{A_{si}} + \sum f_{si} \cdot A_{si}$
$a < h$: $M = F_{cc} \cdot (\overline{x_p} - \beta_1 x/2) + \sum f_{sci} \cdot (\overline{x_p} - \acute{d_i}) - \sum f_{si} \cdot (d_i - \overline{x_p})$
$a < h$: $M = F_{cc} \cdot (\overline{x_p} - h/2) + \sum f_{sci} \cdot (\overline{x_p} - \acute{d_i}) - \sum f_s \cdot (d_i - \overline{x_p})$

1. Axial + positive flexure about major axis

Section input data:
Section height h based on major axis: 16 in
Section width b based on major axis: 16 in

Rectangular compression block factors:

$$4000\ \text{psi} \leq f_c \leq 8000\ \text{psi} \rightarrow \beta_1 = 0.85 - (\frac{f_c - 4000}{1000}) \cdot 0.05 = 0.85 - (\frac{5000 - 4000}{1000}) \cdot 0.05 = 0.80$$

Section Rebar

Depth di (in)	bar diameter (in)	bar area Asi (in^2)
13.50	1.13	1.00
13.50	1.13	1.00
13.50	1.13	1.00
13.50	1.13	1.00
2.50	1.13	1.00
2.50	1.13	1.00
2.50	1.13	1.00
2.50	1.13	1.00

Calculation of plastic centroid location

$$\overline{x_p} = \frac{\acute{f_c} \cdot A_g \cdot (h - \text{neutral axis}) + \sum F_{sci} \cdot a_{sci} + \sum F_{si} \cdot a_{si}}{\acute{f_c} \cdot A_g + f_{sy} \cdot A_s + f_{sy} \cdot \acute{A_s}} =$$

$$= \frac{5000.00 \cdot 256.00 \cdot (16 - 8) + 3240000.00 + 600000.00}{5000.00 \cdot 256.00 + 60000.00 \cdot 4 + 60000.00 \cdot 4.00} = 8.00 \text{ in}$$

M-N interaction values

Iter.	c (in)	a (in)	φ	Pn (Kip)	Mn (Kip-ft)	φPn (Kip)	φMn (Kip-ft)	e (in)
Tension Control								
1	-	-	0.9	-480.0	0	-432.0	0	0
2	0.32	0.26	0.90	-462.6	11.4	-416.4	10.3	-0.3
3	0.64	0.51	0.90	-445.2	22.4	-400.7	20.2	-0.6
4	0.96	0.77	0.90	-427.8	33.1	-385.1	29.8	-0.9
5	1.28	1.02	0.90	-410.5	43.4	-369.4	39.1	-1.3
6	1.60	1.28	0.90	-349.5	73.3	-314.6	66.0	-2.5
7	1.92	1.53	0.90	-241.4	124.4	-217.3	112.0	-6.2
8	2.24	1.79	0.90	-159.2	163.3	-143.3	147.0	-12.3
9	2.56	2.05	0.90	-93.2	194.4	-83.9	175.0	-25.0
10	2.88	2.30	0.90	-38.0	220.2	-34.2	198.2	-69.5
11	3.20	2.56	0.90	9.6	242.1	8.7	217.9	301.5
12	3.52	2.81	0.90	51.8	261.2	46.6	235.0	60.5
13	3.84	3.07	0.90	89.8	277.9	80.8	250.1	37.2
14	4.15	3.32	0.90	124.6	292.9	112.2	263.6	28.2
15	4.47	3.58	0.90	157.0	306.3	141.3	275.7	23.4
16	4.79	3.84	0.90	187.3	318.5	168.6	286.7	20.4
17	5.11	4.09	0.89	216.0	329.6	193.0	294.4	18.3
18	5.43	4.35	0.85	243.4	339.6	207.8	289.9	16.7
19	5.75	4.60	0.82	269.7	348.8	220.7	285.4	15.5
20	6.07	4.86	0.79	295.1	357.2	232.1	280.9	14.5
21	6.39	5.11	0.76	319.6	364.8	242.3	276.6	13.7
22	6.71	5.37	0.73	343.5	371.8	251.5	272.3	13.0
23	7.03	5.62	0.71	366.8	378.1	260.0	268.1	12.4
24	7.35	5.88	0.69	389.5	383.9	267.8	263.9	11.8

25	7.67	6.14	0.67	411.8	389.0	275.1	259.9	11.3
26	7.99	6.39	0.65	433.8	393.6	281.9	255.8	10.9
Compression Control								
27	8.31	6.65	0.65	474.7	385.8	308.6	250.7	9.8
28	8.63	6.90	0.65	513.2	377.9	333.6	245.6	8.8
29	8.95	7.16	0.65	550.1	370.4	357.6	240.8	8.1
30	9.27	7.42	0.65	585.6	363.1	380.7	236.0	7.4
31	9.59	7.67	0.65	620.0	356.0	403.0	231.4	6.9
32	9.91	7.93	0.65	653.3	349.1	424.6	226.9	6.4
33	10.23	8.19	0.65	685.5	342.2	445.6	222.4	6.0
34	10.55	8.44	0.65	716.9	335.3	466.0	218.0	5.6
35	10.87	8.70	0.65	747.5	328.5	485.8	213.5	5.3
36	11.19	8.96	0.65	777.3	321.6	505.2	209.0	5.0
37	11.51	9.21	0.65	806.4	314.7	524.1	204.5	4.7
38	11.83	9.47	0.65	834.8	307.7	542.6	200.0	4.4
39	12.16	9.72	0.65	862.7	300.6	560.8	195.4	4.2
40	12.48	9.98	0.65	890.1	293.3	578.6	190.7	4.0
41	12.80	10.24	0.65	916.9	285.9	596.0	185.9	3.7
42	13.12	10.49	0.65	943.3	278.4	613.2	181.0	3.5
43	13.44	10.75	0.65	969.3	270.7	630.1	175.9	3.4
44	13.76	11.01	0.65	994.9	262.8	646.7	170.8	3.2
45	14.08	11.26	0.65	1020.1	254.6	663.1	165.5	3.0
46	14.40	11.52	0.65	1045.0	246.3	679.2	160.1	2.8
47	14.72	11.77	0.65	1069.5	237.8	695.2	154.5	2.7
48	15.04	12.03	0.65	1093.7	229.0	710.9	148.8	2.5
49	15.36	12.29	0.65	1117.7	219.9	726.5	143.0	2.4
50	15.68	12.54	0.65	1141.3	210.7	741.9	136.9	2.2
51	16.00	12.80	0.65	1164.8	201.1	757.1	130.7	2.1
52	-	-	0.65	1227.2	0	797.7	0	0

2. Axial + negative flexure about major axis

Section input data:
Section height h based on major axis: 16 in
Section width b based on major axis: 16 in

Rectangular compression block factors:

$$4000 \text{ psi} \leq f_c \leq 8000 \text{ psi} \rightarrow \beta_1 = 0.85 - (\frac{f_c - 4000}{1000}) \cdot 0.05 = 0.85 - (\frac{5000 - 4000}{1000}) \cdot 0.05 = 0.80$$

Section Rebar

Depth di (in)	bar diameter (in)	bar area Asi (in^2)
13.50	1.13	1.00
13.50	1.13	1.00
13.50	1.13	1.00
13.50	1.13	1.00
2.50	1.13	1.00
2.50	1.13	1.00
2.50	1.13	1.00
2.50	1.13	1.00

Calculation of plastic centroid location

$$\overline{x_p} = \frac{\acute{f_c} \cdot A_g \cdot (h - \text{neutral axis}) + \sum F_{sci} \cdot a_{sci} + \sum F_{si} \cdot a_{si}}{\acute{f_c} \cdot A_g + f_{sy} \cdot A_s + f_{sy} \cdot \acute{A_s}} =$$

$$= \frac{5000.00 \cdot 256.00 \cdot (16 - 8) + 3240000.00 + 600000.00}{5000.00 \cdot 256.00 + 60000.00 \cdot 4 + 60000.00 \cdot 4.00} = 8.00 \text{ in}$$

M-N interaction values

Iter.	c (in)	a (in)	φ	Pn (Kip)	Mn (Kip-ft)	φPn (Kip)	φMn (Kip-ft)	e (in)
Tension Control								
1	-	-	0.9	-480.0	0	-432.0	0	0
2	0.32	0.26	0.90	-462.6	11.4	-416.4	10.3	-0.3
3	0.64	0.51	0.90	-445.2	22.4	-400.7	20.2	-0.6
4	0.96	0.77	0.90	-427.8	33.1	-385.1	29.8	-0.9
5	1.28	1.02	0.90	-410.5	43.4	-369.4	39.1	-1.3
6	1.60	1.28	0.90	-349.5	73.3	-314.6	66.0	-2.5
7	1.92	1.53	0.90	-241.4	124.4	-217.3	112.0	-6.2
8	2.24	1.79	0.90	-159.2	163.3	-143.3	147.0	-12.3
9	2.56	2.05	0.90	-93.2	194.4	-83.9	175.0	-25.0
10	2.88	2.30	0.90	-38.0	220.2	-34.2	198.2	-69.5
11	3.20	2.56	0.90	9.6	242.1	8.7	217.9	301.5
12	3.52	2.81	0.90	51.8	261.2	46.6	235.0	60.5
13	3.84	3.07	0.90	89.8	277.9	80.8	250.1	37.2
14	4.15	3.32	0.90	124.6	292.9	112.2	263.6	28.2
15	4.47	3.58	0.90	157.0	306.3	141.3	275.7	23.4
16	4.79	3.84	0.90	187.3	318.5	168.6	286.7	20.4
17	5.11	4.09	0.89	216.0	329.6	193.0	294.4	18.3
18	5.43	4.35	0.85	243.4	339.6	207.8	289.9	16.7
19	5.75	4.60	0.82	269.7	348.8	220.7	285.4	15.5
20	6.07	4.86	0.79	295.1	357.2	232.1	280.9	14.5
21	6.39	5.11	0.76	319.6	364.8	242.3	276.6	13.7
22	6.71	5.37	0.73	343.5	371.8	251.5	272.3	13.0
23	7.03	5.62	0.71	366.8	378.1	260.0	268.1	12.4
24	7.35	5.88	0.69	389.5	383.9	267.8	263.9	11.8

25	7.67	6.14	0.67	411.8	389.0	275.1	259.9	11.3
26	7.99	6.39	0.65	433.8	393.6	281.9	255.8	10.9
Compression Control								
27	8.31	6.65	0.65	474.7	385.8	308.6	250.7	9.8
28	8.63	6.90	0.65	513.2	377.9	333.6	245.6	8.8
29	8.95	7.16	0.65	550.1	370.4	357.6	240.8	8.1
30	9.27	7.42	0.65	585.6	363.1	380.7	236.0	7.4
31	9.59	7.67	0.65	620.0	356.0	403.0	231.4	6.9
32	9.91	7.93	0.65	653.3	349.1	424.6	226.9	6.4
33	10.23	8.19	0.65	685.5	342.2	445.6	222.4	6.0
34	10.55	8.44	0.65	716.9	335.3	466.0	218.0	5.6
35	10.87	8.70	0.65	747.5	328.5	485.8	213.5	5.3
36	11.19	8.96	0.65	777.3	321.6	505.2	209.0	5.0
37	11.51	9.21	0.65	806.4	314.7	524.1	204.5	4.7
38	11.83	9.47	0.65	834.8	307.7	542.6	200.0	4.4
39	12.16	9.72	0.65	862.7	300.6	560.8	195.4	4.2
40	12.48	9.98	0.65	890.1	293.3	578.6	190.7	4.0
41	12.80	10.24	0.65	916.9	285.9	596.0	185.9	3.7
42	13.12	10.49	0.65	943.3	278.4	613.2	181.0	3.5
43	13.44	10.75	0.65	969.3	270.7	630.1	175.9	3.4
44	13.76	11.01	0.65	994.9	262.8	646.7	170.8	3.2
45	14.08	11.26	0.65	1020.1	254.6	663.1	165.5	3.0
46	14.40	11.52	0.65	1045.0	246.3	679.2	160.1	2.8
47	14.72	11.77	0.65	1069.5	237.8	695.2	154.5	2.7
48	15.04	12.03	0.65	1093.7	229.0	710.9	148.8	2.5
49	15.36	12.29	0.65	1117.7	219.9	726.5	143.0	2.4
50	15.68	12.54	0.65	1141.3	210.7	741.9	136.9	2.2
51	16.00	12.80	0.65	1164.8	201.1	757.1	130.7	2.1
52	-	-	0.65	1227.2	0	797.7	0	0

3. Axial + positive flexure about minor axis

Section input data:
Section height h based on minor axis: 16 in
Section width b based on minor axis: 16 in

Rectangular compression block factors:

$$4000 \text{ psi} \leq f_c \leq 8000 \text{ psi} \rightarrow \beta_1 = 0.85 - (\frac{f_c - 4000}{1000}) \cdot 0.05 = 0.85 - (\frac{5000 - 4000}{1000}) \cdot 0.05 = 0.80$$

Section Rebar

Depth di (in)	bar diameter (in)	bar area Asi (in^2)
13.50	1.13	1.00
13.50	1.13	1.00
9.83	1.13	1.00
9.83	1.13	1.00
6.17	1.13	1.00
6.17	1.13	1.00
2.50	1.13	1.00
2.50	1.13	1.00

Calculation of plastic centroid location

$$\overline{x_p} = \frac{\acute{f_c} \cdot A_g \cdot (h - \text{neutral axis}) + \sum F_{sci} \cdot a_{sci} + \sum F_{si} \cdot a_{si}}{\acute{f_c} \cdot A_g + f_{sy} \cdot A_s + f_{sy} \cdot \acute{A_s}} =$$

$$= \frac{5000.00 \cdot 256.00 \cdot (16 - 8) + 2800000.00 + 1040000.00}{5000.00 \cdot 256.00 + 60000.00 \cdot 4 + 60000.00 \cdot 4.00} = 8.00 \text{ in}$$

M-N interaction values

Iter.	c (in)	a (in)	φ	Pn (Kip)	Mn (Kip-ft)	φPn (Kip)	φMn (Kip-ft)	e (in)
Tension Control								
1	-	-	0.9	-480.0	0	-432.0	0	0
2	0.28	0.22	0.90	-465.0	9.9	-418.5	8.9	-0.3
3	0.55	0.44	0.90	-450.0	19.5	-405.0	17.5	-0.5
4	0.83	0.66	0.90	-434.9	28.8	-391.4	25.9	-0.8
5	1.10	0.88	0.90	-419.9	37.9	-377.9	34.1	-1.1
6	1.38	1.10	0.90	-404.9	46.6	-364.4	42.0	-1.4
7	1.66	1.33	0.90	-358.4	69.6	-322.5	62.6	-2.3
8	1.93	1.55	0.90	-305.8	95.0	-275.2	85.5	-3.7
9	2.21	1.77	0.90	-262.7	115.8	-236.4	104.2	-5.3
10	2.49	1.99	0.90	-225.8	133.5	-203.2	120.1	-7.1
11	2.76	2.21	0.90	-193.3	148.9	-173.9	134.0	-9.2
12	3.04	2.43	0.90	-163.9	162.6	-147.5	146.3	-11.9
13	3.31	2.65	0.90	-137.0	174.9	-123.3	157.4	-15.3
14	3.59	2.87	0.90	-111.8	186.1	-100.6	167.5	-20.0
15	3.87	3.09	0.90	-71.7	198.8	-64.5	178.9	-33.3
16	4.14	3.31	0.90	-30.6	211.1	-27.6	190.0	-82.7
17	4.42	3.54	0.90	7.1	222.3	6.4	200.1	373.3
18	4.70	3.76	0.90	42.2	232.6	38.0	209.3	66.1
19	4.97	3.98	0.90	75.1	242.1	67.6	217.9	38.7
20	5.25	4.20	0.88	106.1	250.8	92.9	219.7	28.4
21	5.52	4.42	0.84	135.5	258.9	114.2	218.3	22.9
22	5.80	4.64	0.81	163.5	266.4	133.0	216.6	19.5
23	6.08	4.86	0.79	202.8	271.4	159.4	213.4	16.1
24	6.35	5.08	0.76	240.8	275.9	183.4	210.1	13.7

25	6.63	5.30	0.74	277.0	280.1	204.6	206.9	12.1
26	6.90	5.52	0.72	311.4	284.0	223.6	203.9	10.9
Compression Control								
27	7.27	5.81	0.69	354.5	288.5	245.7	199.9	9.8
28	7.63	6.11	0.67	395.4	292.6	265.0	196.1	8.9
29	8.00	6.40	0.65	434.7	296.0	282.5	192.4	8.2
30	8.36	6.69	0.65	482.8	292.1	313.8	189.9	7.3
31	8.72	6.98	0.65	528.2	288.2	343.3	187.3	6.5
32	9.09	7.27	0.65	571.5	284.3	371.5	184.8	6.0
33	9.45	7.56	0.65	613.1	280.3	398.5	182.2	5.5
34	9.82	7.85	0.65	653.0	276.1	424.4	179.5	5.1
35	10.18	8.14	0.65	691.5	271.9	449.5	176.7	4.7
36	10.54	8.43	0.65	728.7	267.4	473.6	173.8	4.4
37	10.91	8.73	0.65	764.7	262.7	497.1	170.8	4.1
38	11.27	9.02	0.65	799.7	257.8	519.8	167.6	3.9
39	11.63	9.31	0.65	833.7	252.7	541.9	164.2	3.6
40	12.00	9.60	0.65	866.9	247.2	563.5	160.7	3.4
41	12.36	9.89	0.65	899.3	241.4	584.5	156.9	3.2
42	12.73	10.18	0.65	930.9	235.4	605.1	153.0	3.0
43	13.09	10.47	0.65	961.9	229.0	625.3	148.8	2.9
44	13.45	10.76	0.65	992.3	222.2	645.0	144.4	2.7
45	13.82	11.05	0.65	1022.2	215.1	664.4	139.8	2.5
46	14.18	11.34	0.65	1051.5	207.7	683.5	135.0	2.4
47	14.54	11.64	0.65	1080.3	199.9	702.2	129.9	2.2
48	14.91	11.93	0.65	1108.7	191.6	720.7	124.6	2.1
49	15.27	12.22	0.65	1136.7	183.1	738.9	119.0	1.9
50	15.64	12.51	0.65	1164.3	174.1	756.8	113.1	1.8
51	16.00	12.80	0.65	1191.6	164.7	774.5	107.0	1.7
52	-	-	0.65	1227.2	0	797.7	0	0

4. Axial + negative flexure about minor axis

Section input data:
Section height h based on minor axis: 16 in
Section width b based on minor axis: 16 in

Rectangular compression block factors:

$$4000 \text{ psi} \leq f_c \leq 8000 \text{ psi} \rightarrow \beta_1 = 0.85 - (\frac{f_c - 4000}{1000}) \cdot 0.05 = 0.85 - (\frac{5000 - 4000}{1000}) \cdot 0.05 = 0.80$$

Section Rebar

Depth di (in)	bar diameter (in)	bar area Asi (in^2)
13.50	1.13	1.00
13.50	1.13	1.00
9.83	1.13	1.00
9.83	1.13	1.00
6.17	1.13	1.00
6.17	1.13	1.00
2.50	1.13	1.00
2.50	1.13	1.00

Calculation of plastic centroid location

$$\overline{x_p} = \frac{\acute{f_c} \cdot A_g \cdot (h - \text{neutral axis}) + \sum F_{sci} \cdot a_{sci} + \sum F_{si} \cdot a_{si}}{\acute{f_c} \cdot A_g + f_{sy} \cdot A_s + f_{sy} \cdot \acute{A_s}} =$$

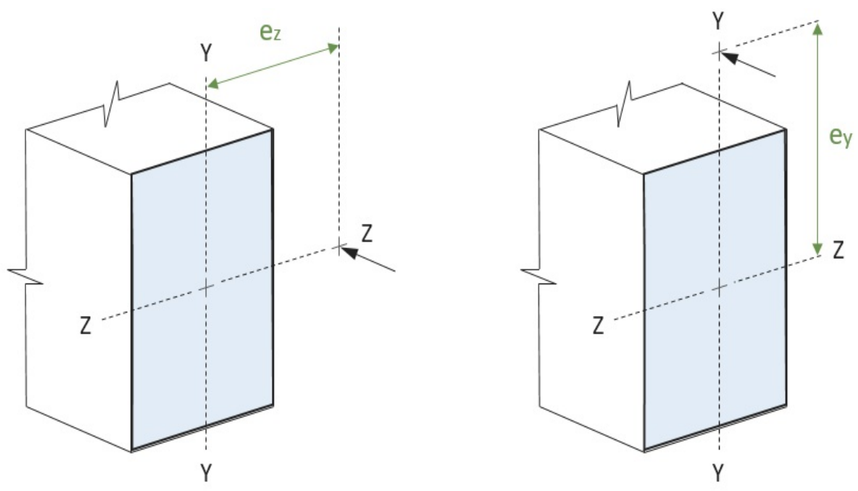
$$= \frac{5000.00 \cdot 256.00 \cdot (16 - 8) + 2800000.00 + 1040000.00}{5000.00 \cdot 256.00 + 60000.00 \cdot 4 + 60000.00 \cdot 4.00} = 8.00 \text{ in}$$

M-N interaction values

Iter.	c (in)	a (in)	φ	Pn (Kip)	Mn (Kip-ft)	φPn (Kip)	φMn (Kip-ft)	e (in)
Tension Control								
1	-	-	0.9	-480.0	0	-432.0	0	0
2	0.28	0.22	0.90	-465.0	9.9	-418.5	8.9	-0.3
3	0.55	0.44	0.90	-450.0	19.5	-405.0	17.5	-0.5
4	0.83	0.66	0.90	-434.9	28.8	-391.4	25.9	-0.8
5	1.10	0.88	0.90	-419.9	37.9	-377.9	34.1	-1.1
6	1.38	1.10	0.90	-404.9	46.6	-364.4	42.0	-1.4
7	1.66	1.33	0.90	-358.4	69.6	-322.5	62.6	-2.3
8	1.93	1.55	0.90	-305.8	95.0	-275.2	85.5	-3.7
9	2.21	1.77	0.90	-262.7	115.8	-236.4	104.2	-5.3
10	2.49	1.99	0.90	-225.8	133.5	-203.2	120.1	-7.1
11	2.76	2.21	0.90	-193.3	148.9	-173.9	134.0	-9.2
12	3.04	2.43	0.90	-163.9	162.6	-147.5	146.3	-11.9
13	3.31	2.65	0.90	-137.0	174.9	-123.3	157.4	-15.3
14	3.59	2.87	0.90	-111.8	186.1	-100.6	167.5	-20.0
15	3.87	3.09	0.90	-71.7	198.8	-64.5	178.9	-33.3
16	4.14	3.31	0.90	-30.6	211.1	-27.6	190.0	-82.7
17	4.42	3.54	0.90	7.1	222.3	6.4	200.1	373.3
18	4.70	3.76	0.90	42.2	232.6	38.0	209.3	66.1
19	4.97	3.98	0.90	75.1	242.1	67.6	217.9	38.7
20	5.25	4.20	0.88	106.1	250.8	92.9	219.7	28.4
21	5.52	4.42	0.84	135.5	258.9	114.2	218.3	22.9
22	5.80	4.64	0.81	163.5	266.4	133.0	216.6	19.5
23	6.08	4.86	0.79	202.8	271.4	159.4	213.4	16.1
24	6.35	5.08	0.76	240.8	275.9	183.4	210.1	13.7

25	6.63	5.30	0.74	277.0	280.1	204.6	206.9	12.1
26	6.90	5.52	0.72	311.4	284.0	223.6	203.9	10.9
Compression Control								
27	7.27	5.81	0.69	354.5	288.5	245.7	199.9	9.8
28	7.63	6.11	0.67	395.4	292.6	265.0	196.1	8.9
29	8.00	6.40	0.65	434.7	296.0	282.5	192.4	8.2
30	8.36	6.69	0.65	482.8	292.1	313.8	189.9	7.3
31	8.72	6.98	0.65	528.2	288.2	343.3	187.3	6.5
32	9.09	7.27	0.65	571.5	284.3	371.5	184.8	6.0
33	9.45	7.56	0.65	613.1	280.3	398.5	182.2	5.5
34	9.82	7.85	0.65	653.0	276.1	424.4	179.5	5.1
35	10.18	8.14	0.65	691.5	271.9	449.5	176.7	4.7
36	10.54	8.43	0.65	728.7	267.4	473.6	173.8	4.4
37	10.91	8.73	0.65	764.7	262.7	497.1	170.8	4.1
38	11.27	9.02	0.65	799.7	257.8	519.8	167.6	3.9
39	11.63	9.31	0.65	833.7	252.7	541.9	164.2	3.6
40	12.00	9.60	0.65	866.9	247.2	563.5	160.7	3.4
41	12.36	9.89	0.65	899.3	241.4	584.5	156.9	3.2
42	12.73	10.18	0.65	930.9	235.4	605.1	153.0	3.0
43	13.09	10.47	0.65	961.9	229.0	625.3	148.8	2.9
44	13.45	10.76	0.65	992.3	222.2	645.0	144.4	2.7
45	13.82	11.05	0.65	1022.2	215.1	664.4	139.8	2.5
46	14.18	11.34	0.65	1051.5	207.7	683.5	135.0	2.4
47	14.54	11.64	0.65	1080.3	199.9	702.2	129.9	2.2
48	14.91	11.93	0.65	1108.7	191.6	720.7	124.6	2.1
49	15.27	12.22	0.65	1136.7	183.1	738.9	119.0	1.9
50	15.64	12.51	0.65	1164.3	174.1	756.8	113.1	1.8
51	16.00	12.80	0.65	1191.6	164.7	774.5	107.0	1.7
52	-	-	0.65	1227.2	0	797.7	0	0

5. Strength check



Section input data:

Actual axial force $P = 100.00$ Kip

Actual bending moment about major axis $M_{uz} = 10.00$ Kip-ft

Actual bending moment about minor axis $M_{uy} = 10.00$ Kip-ft

Eccentricity of actual forces along major axis $e_y = 1.2000$ in

Eccentricity of actual forces along minor axis $e_z = 1.2000$ in

Limited axial force (Mx-N axis plane) $\phi \cdot P_{nz} = 774.18$ Kip

Limited axial force (My-N axis plane) $\phi \cdot P_{ny} = 780.93$ Kip

Limited bending moment about major axis $\phi \cdot M_{nz} = 75.71$ Kip-ft

Limited bending moment about minor axis $\phi \cdot M_{ny} = 77.45$ Kip-ft

$$\text{Axial + biaxial bending check case for rectangular section}$$

$$\alpha_n = 0.7 + \frac{1.7 \cdot P_u}{0.6 \cdot P_{no}} = 0.7 + \frac{1.7 \cdot 100}{0.6 \cdot 797.68} = 1.06$$

$$1.0 \geq \alpha_n \leq 2.0$$

$$\left[\frac{M_z}{\phi \cdot M_{ux}}\right]^{\alpha_n} + \left[\frac{M_y}{\phi \cdot M_{uy}}\right]^{\alpha_n} = \left[\frac{10.00}{75.71}\right]^{1.06} + \left[\frac{10.00}{77.45}\right]^{1.06} = 0.23 \leq 1.0$$

STATUS OK!

Axial compression check case

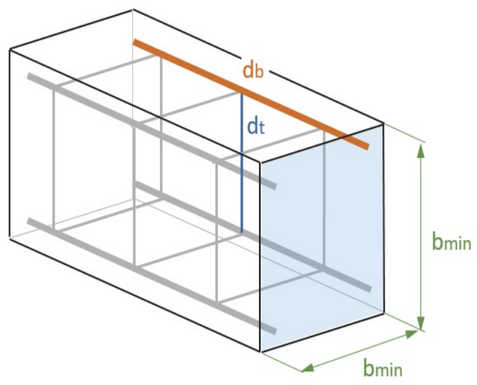
$$P_n = 100.00 \text{ Kip} \leq \phi \cdot P_{no} = 797.68 \text{ Kip}$$

STATUS OK!

CHAPTER 9 (Section 9.7)

Lateral support check for compression steel

BUCKLING OF SLENDER REINFORCING BARS



Section input data:
Spacing of the stirrups s = 10 in
Diameter of the main bars $16 \cdot d_b = 16 \cdot 1.128 = 18.048 \text{ in}$
Diameter of the transverse reinforcement (stirrups) $48 \cdot d_t = 48 \cdot 0.5 = 24 \text{ in}$
Smaller dimension of the beam section $b_{min} = 16 \text{ in}$

Calculate maximum spacing of the stirrups for purpose of buckling bar stability

$$s_{max} = min[16 \cdot d_b, 48 \cdot d_t, b_{min}] = 16 \text{ in}$$

$$s = 10 \text{ in} \leq s_{max} = 16 \text{ in}$$

STATUS OK!