CAP DESIGN

CAP DESIGN

Code: AASHTO STANDARD (17th Edition 2002) - Ultimate Strength Design

Units: US

Pier View: Upstation.

DESIGN PARAMETERS

f'c = 3500.0 psi	
Fy flex = 60000.0 psi	Fy shear = 60000.0 psi
phi flex = 0.90	phi shear = 0.85
Ec = 3586.6 ksi	Es = 29000.0 ksi
crack control factor z = 170.00 kips / in	
Concrete Type : Normal Weight.	
Design of cap at face of column.	

CAP GEOMETRY

Straight Cap : Length(X) = 63.00 ft Depth(Z) = 72.00 in

Cap Section Properties

Sec.	Area ft ^2	Ixx in ^4	Izz in ^4
1	54.00	7558272.00	3359232.00

MAIN REINFORCEMENT

	Bar size	Quantity	Bar dist. in	As total in^2	From ft	To ft	Hook
TOP							
	# 11	8	3.45	12.480	0.00	63.00	Both
BOTTOM							
	# 11	17	3.45	26.520	0.00	63.00	Both
	# 11	17	6.98	26.520	0.00	63.00	None
	# 11	6	10.50	9.360	0.00	63.00	None

STIRRUPS

From ft	To ft	Stirrup Size	n legs	Spacing in	Aprv/s in^2 / ft
0.00	3.00	# 6	4	24.00	10.56
3.00	6.00	# 6	4	12.00	21.12
6.00	9.00	# 6	4	3.00	84.48
9.00	17.00	# 6	4	12.00	21.12

From ft	To ft	Stirrup Size	n legs	Spacing in	Aprv/s in^2 / ft
17.00	41.00	# 6	4	24.00	10.56
41.00	57.00	# 6	4	18.00	14.08
57.00	63.00	# 6	4	24.00	10.56

Clear Cover on Sides = 2.00 in

FLEXURE DESIGN

Span 1: From 0.00 ft To 3.00 ft

Loc ft	AbsLoc ft	H in	Mmax Mmin kips-ft	pMn kips-ft	Comb	Asb-req in^2	Asb-prv in^2	Asb-eff in^2	Ast-req in^2	Ast-prv in^2	Ast-eff in^2

Span 2: From 3.00 ft To 60.00 ft

Loc ft	AbsLoc ft	H in	Mmax Mmin kips-ft	pMn kips-ft	Comb	Asb-req in^2	Asb-prv in^2	Asb-eff in^2	Ast-req in^2	Ast-prv in^2	Ast-eff in^2
3.0	6.0	108	0.0	26844.6	0	0.00	62.40	62.40	0.00	12.48	12.48
			-2607.8	-5815.4	1750	0.00	62.40	62.40	7.45	12.48	12.48
6.0	9.0	108	4089.0	26844.6	1768	12.05	62.40	62.40	0.00	12.48	12.48
			0.0	-5815.4	0	0.00	62.40	62.40	0.00	12.48	12.48
14.0	17.0	108	15446.5	26844.6	1753	35.37	62.40	62.40	0.00	12.48	12.48
			0.0	-5815.4	0	0.00	62.40	62.40	0.00	12.48	12.48
22.0	25.0	108	22961.8	26844.6	1753	54.04	62.40	62.40	0.00	12.48	12.48
			0.0	-5815.4	0	0.00	62.40	62.40	0.00	12.48	12.48
30.0	33.0	108	24407.7	26844.6	1753	57.76	62.40	62.40	0.00	12.48	12.48
			0.0	-5815.4	0	0.00	62.40	62.40	0.00	12.48	12.48
38.0	41.0	108	22545.6	26844.6	1750	52.98	62.40	62.40	0.00	12.48	12.48
			0.0	-5815.4	0	0.00	62.40	62.40	0.00	12.48	12.48
54.0	57.0	108	0.0	26844.6	0	0.00	62.40	62.40	0.00	12.48	12.48
			-3471.9	-5815.4	1753	0.00	62.40	62.40	9.95	12.48	12.48

Span 3: From 60.00 ft To 63.00 ft

Loc ft	AbsLoc ft	H in	Mmax Mmin kips-ft	pMn kips-ft	Comb	Asb-req in^2	Asb-prv in^2	Asb-eff in^2	Ast-req in^2	Ast-prv in^2	Ast-eff in^2

SHEAR AND TORSION DESIGN

Span 1: From 0.00 ft To 3.00 ft

Loc ft	AbsLoc ft	Pos	Vu kips	Comb	Tu kips-ft	Comb	phi*Vc kips	T-lim kips-ft	Avs/s in^2/ft	2Ats/s in^2/ft	Av/s in^2/ft	Aprv/s in^2/ft	Alt in^2

Span 2: From 3.00 ft To 60.00 ft

Loc ft	AbsLoc ft	Pos	Vu kips	Comb	Tu kips-ft	Comb	phi*Vc kips	T-lim kips-ft	Avs/s in^2/ft	2Ats/s in^2/ft	Av/s in^2/ft	Aprv/s in^2/ft	Alt in^2
3.00	6.00	R	1965.4	1753	240.6	3322	757.0	703.9	2.72	0.00	2.72	84.48	0.00
6.00	9.00	L	1933.8	1753	240.6	3322	738.5	703.9	2.76	0.00	2.76	84.48	0.00
		R	1547.8	1753	185.0	3187	738.5	703.9	1.87	0.00	1.87	21.12	0.00
14.00	17.00	L	1463.6	1753	185.0	3187	738.5	703.9	1.67	0.00	1.67	21.12	0.00
		R	988.7	1763	248.3	3186	738.5	703.9	0.72	0.00	0.72	10.56	0.00
22.00	25.00	L	904.5	1763	248.3	3186	738.5	703.9	0.72	0.00	0.72	10.56	0.00
		R	346.8	1760	294.7	2791	738.5	703.9	0.00	0.00	0.00	10.56	0.00
30.00	33.00	L	262.6	1760	368.7	3331	738.5	703.9	0.00	0.00	0.00	10.56	0.00
		R	659.3	1755	479.1	3320	738.5	703.9	0.72	0.00	0.72	10.56	0.00
38.00	41.00	L	743.5	1755	479.1	3320	738.5	703.9	0.72	0.00	0.72	10.56	0.00
		R	1524.0	1750	595.2	3319	738.5	703.9	1.81	0.00	1.81	14.08	0.00
54.00	57.00	L	1692.5	1750	595.2	3319	757.0	703.9	2.11	0.00	2.11	14.08	0.00

Span 3: From 60.00 ft To 63.00 ft

Loc ft	AbsLoc ft	Pos	Vu kips	Comb	Tu kips-ft	Comb	phi*Vc kips	T-lim kips-ft	Avs/s in^2/ft	2Ats/s in^2/ft	Av/s in^2/ft	Aprv/s in^2/ft	Alt in^2

Shear and Torsion Design : Notes

- Pos is the design position. L suggests the calculation is done at immediate left of "Loc" and R suggests at immediate right of it.
- T-lim is the limiting value of torsion for the concrete section. If actual torsion is higher than this value, torsional steel has to be provided.
- Avs/s is the required area of steel per unit length for shear force.
- 2Ats/s is the required area of steel per unit length for two legs of torsional reinforcement.
- Av/s is the total required area of steel per unit length due to shear plus torsion.
- Aprvs/s is the total provided area of steel per unit length due to shear (stirrups).
- Alt is the total longitudinal steel required due to torsion in addition to the REQUIRED flexural steel.

CRACKING/FATIGUE CHECK

Span 1: From 0.00 ft To 3.00 ft

Loc ft	AbsLoc ft	H in	Cracking fs-t fs-b ksi	Cracking ratio fs-t ratio fs-b	Cracking Comb	Fatigue fs-t fs-b ksi	Fatigue ratio fs-t ratio fs-b

Span 2: From 3.00 ft To 60.00 ft

Loc ft	AbsLoc ft	H in	Cracking fs-t fs-b ksi	Cracking ratio fs-t ratio fs-b	Cracking Comb	Fatigue fs-t fs-b ksi	Fatigue ratio fs-t ratio fs-b
3.00	6.0	108.0	18.4	0.55	16	4.8	0.23
			0.0	0.00	0	0.0	0.00
6.00	9.0	108.0	0.0	0.00	0	1.9	0.08
			6.5	0.18	34	0.5	0.02
14.00	17.0	108.0	0.0	0.00	0	0.0	0.00
			24.0	0.67	19	2.9	0.16
22.00	25.0	108.0	0.0	0.00	0	0.0	0.00
			35.5	0.99	19	5.3	0.33
30.00	33.0	108.0	0.0	0.00	0	0.0	0.00
			37.6	1.05 *	19	6.0	0.39
38.00	41.0	108.0	0.0	0.00	0	0.0	0.00
			34.4	0.96	16	7.2	0.41
54.00	57.0	108.0	25.8	0.77	34	3.5	0.20
			0.0	0.00	0	0.4	0.02

Span 3: From 60.00 ft To 63.00 ft

Loc ft	AbsLoc ft	H in	Cracking fs-t fs-b ksi	Cracking ratio fs-t ratio fs-b	Cracking Comb	Fatigue fs-t fs-b ksi	Fatigue ratio fs-t ratio fs-b

Cracking and fatigue Check : Notes

* Cracking / fatigue checking failed.

Column Design

COLUMN DESIGN - Column: 1

Code: AASHTO STANDARD (17th Edition 2002) - Factored Load Design
Units: US
Pier View: Upstation.
Design/Analysis Method: Moment Magnification - Unbraced Column.

Column Type: Rectangular 72.00 x 72.00 in

Column Section Properties

Sec.	Area ft^2	Ixx in^4	Izz in^4
1	36.00	2239488.00	2239488.00

DESIGN PARAMETERS

f'c = 3500.0 psi	fy = 60000.0 psi
phi flex = 0.90	phi axial = 0.70
Ec = 3586.6 ksi	Es = 29000 ksi
Concrete Type : Normal Weight.	

Reinforcement

Rebar Pattern: Rectangular
Rebar Orientation: Face Parallel

Reinforcement Schedule

Layer	Dir	Size	No. bars	Bar Dist. in
1	X	11	10	3.20
1	Z	11	9	3.20

Reinforcement summary

Main bars summary:

	34 # 11 bars
Total number of bars in the column: 34	
Ties size: # 3	

Moment Magnification calculation - Mx (global)

Loc ft	Comb	K	Cm	Beta	Delta B	Delta S	pPc kips
45.00	57C	3.4219	1.0000	0.8074	----	3.7841	2856.01
95.50	57C	3.4219	1.0000	0.7761	----	2.5642	2906.30
45.00	1289C	3.4219	1.0000	0.0988	----	1.5011	4697.75
95.50	1289C	3.4219	1.0000	0.9837	----	1.7588	2602.26

Moment Magnification calculation - Mz (global)

Loc ft	Comb	K	Cm	Beta	Delta B	Delta S	pPc kips
45.00	57C	1.5703	1.0000	0.6584	----	1.1736	14780.56
95.50	57C	1.5703	1.0000	0.6769	----	1.1440	14617.02
45.00	1289C	1.5703	1.0000	0.7909	----	1.1383	13686.51
95.50	1289C	1.5703	1.0000	0.9074	----	1.1122	12850.86

Design values used after Moment Magnification (e-min effect included).

Loc ft	Comb	Fx kips	Fy kips	Fz kips	Mx kips-ft	My kips-ft	Mz kips-ft
45.00	57C	246.2	2311.3	0.1	2011.6	-2.1	-4838.3
95.50	57C	-246.2	1988.4	-0.1	-1172.7	-2.1	-9509.9
45.00	1289C	185.9	1819.1	85.6	6268.7	-81.5	-3756.2
95.50	1289C	-179.6	1508.6	-74.6	-610.3	-81.5	-6631.5

COLUMN DESIGN

Bot/Top Elev. ft	Comb	Pu kips	Mux kips-ft	Muz kips-ft	pMn kips-ft	Incl deg	pPn/Pu	pMn/Mu
45.00	1289C	1819.1	6268.7	3756.2	9214.9	30.93	1.00	1.26094
95.50	57C	1988.4	1172.7	9509.9	9632.9	82.97	1.00	1.00532

COLUMN DESIGN

Bot/Top Elev. ft	Comb	As_min in^2	As_max in^2	As_req in^2
45.00	1289C	51.84	414.72	53.04
95.50	57C	51.84	414.72	53.04

K values for all columns used in unbraced moment magnification

Column	Kx	Kz

Column	Kx	Kz
1	3.42	1.57
2	3.42	1.57

Column Design : Notes
Min reinforcement = 1.0000 % of Ag = 51.84 in^2.
For layer 1, direction X: Minimum bar distance is: 1.41 in. Effective bar distance is: 5.88 in.
For layer 1, direction Z: Minimum bar distance is: 1.41 in. Effective bar distance is: 6.79 in.
---- Values do not exist at that location as computation is done at the top and bottom of clear length of column.

Column Design

COLUMN DESIGN - Column: 2

Code: AASHTO STANDARD (17th Edition 2002) - Factored Load Design

Units: US

Pier View: Upstation.

Design/Analysis Method: Moment Magnification - Unbraced Column.

Column Type: Rectangular 72.00 x 72.00 in

Column Section Properties

Sec.	Area ft^2	Ixx in^4	Izz in^4
1	36.00	2239488.00	2239488.00

DESIGN PARAMETERS

f'c = 3500.0 psi	fy = 60000.0 psi
phi flex = 0.90	phi axial = 0.70
Ec = 3586.6 ksi	Es = 29000 ksi

Concrete Type : Normal Weight.

Reinforcement

Rebar Pattern: Rectangular

Rebar Orientation: Face Parallel

Reinforcement Schedule

Layer	Dir	Size	No. bars	Bar Dist. in
1	X	11	12	3.20
1	Z	11	12	3.20

Reinforcement summary

Main bars summary:

44 # 11 bars

Total number of bars in the column: 44

Ties size: # 3

Moment Magnification calculation - Mx (global)

Loc ft	Comb	K	Cm	Beta	Delta B	Delta S	pPc kips
45.00	37C	3.4219	1.0000	0.7105	----	3.7896	3017.90
95.50	37C	3.4219	1.0000	0.6543	----	2.5669	3120.30
45.00	1273C	3.4219	1.0000	0.0873	----	1.5011	4747.67
95.50	1273C	3.4219	1.0000	0.5804	----	1.7637	3266.24

Moment Magnification calculation - Mz (global)

Loc ft	Comb	K	Cm	Beta	Delta B	Delta S	pPc kips
45.00	37C	1.5703	1.0000	0.6788	----	1.1735	14600.61
95.50	37C	1.5703	1.0000	0.6655	----	1.1440	14717.77
45.00	1273C	1.5703	1.0000	0.7951	----	1.1385	13654.70
95.50	1273C	1.5703	1.0000	0.9018	----	1.1120	12888.61

Design values used after Moment Magnification (e-min effect included).

Loc ft	Comb	Fx kips	Fy kips	Fz kips	Mx kips-ft	My kips-ft	Mz kips-ft
45.00	37C	-246.6	1988.6	-0.0	1733.3	-1.1	4895.4
95.50	37C	246.6	1665.7	0.0	-983.4	-1.1	9471.2
45.00	1273C	-186.7	1383.1	67.0	5374.1	254.7	3899.0
95.50	1273C	180.3	1072.6	-56.0	-732.4	254.7	6532.1

COLUMN DESIGN

Bot/Top Elev. ft	Comb	Pu kips	Mux kips-ft	Muz kips-ft	pMn kips-ft	Incl deg	pPn/Pu	pMn/Mu
45.00	1273C	1383.1	5374.1	3899.0	10046.8	35.96	1.00	1.51319
95.50	37C	1665.7	983.4	9471.2	10647.6	84.07	1.00	1.11820

COLUMN DESIGN

Bot/Top Elev. ft	Comb	As_min in^2	As_max in^2	As_req in^2
45.00	1273C	51.84	414.72	68.64
95.50	37C	51.84	414.72	68.64

K values for all columns used in unbraced moment magnification

Column	Kx	Kz

Column	Kx	Kz
1	3.42	1.57
2	3.42	1.57

Column Design : Notes
Min reinforcement = 1.0000 % of Ag = 51.84 in^2.
For layer 1, direction X: Minimum bar distance is: 1.41 in. Effective bar distance is: 4.55 in.
For layer 1, direction Z: Minimum bar distance is: 1.41 in. Effective bar distance is: 4.55 in.
---- Values do not exist at that location as computation is done at the top and bottom of clear length of column.

ISOLATED FOOTING DESIGN

ISOLATED FOOTING DESIGN

Code: AASHTO STANDARD (17th Edition 2002) - Ultimate Strength Design
Units: US
Pier View: Upstation.

GEOMETRY

Name : FTG01
Shape : Rectangular, Type : Pile/Shaft Cap
Bf(X) = 14.00 ft, Hf(Z) = 14.00 ft, Thickness(Y) = 60.00 in
Ag = 196.00 ft^2, Ix = 268.89 ft^2, Iz = 268.89 ft^2
Footing eccentric: Start at X = -7.00 ft from centerline of column.
Footing eccentric: Start at Z = -7.00 ft from centerline of column.
Columns located on the footing:
Column No. 1 at x = 0.00 ft, Rectangular 72.00 in x 72.00 in
Surcharge = 0.30 ksf
Piles: Chamfer Size: W = 13.83 in, D = 14.69 in, T1 = 0.62 in, T2 = 0.00 in
Service Capacity: 234.00 kips Factored Capacity: 328.00 kips
Piles Section Properties: Area = 0.18 ft^2 Ix = 904.00 in^4 Iz = 326.00 in^4

DESIGN PARAMETERS

f'c = 3500.00 psi	fy = 60000.00 psi
phi flex = 0.90	phi shear = 0.85
Ec = 3586.6 ksi	Es = 29000.0 ksi
Crack control factor z = 130.00 kips/in	
Concrete Type : Normal Weight.	

Pile Reactions, Service (Without the reduction of overstress allowance)

Pile	Loc(X) ft	Loc(Z) ft	X in	Z in	comb	Ovs	P kips	Mxx kft	Mzz kft	Pile Reac. kips
1	-5.50	-1.50	18.00	-66.0	1573	1.400	-1595.26	-2892.63	2891.78	230.88
					635	1.400	-1401.27	3034.78	1170.25	62.30
2	-1.83	-1.50	62.00	-66.0	1588	1.400	-1587.65	-3009.88	2724.38	192.23
					636	1.400	-1415.81	3340.90	1536.04	43.49
3	1.83	-1.50	106.00	-66.0	637	1.400	-1415.81	-3340.98	1536.04	159.22
					628	1.400	-1455.24	3340.90	2639.77	17.48
4	5.50	-1.50	150.00	-66.0	620	1.400	-1401.27	-3034.86	1170.25	138.58
					647	1.400	-1469.78	3034.78	3005.56	-18.83
5	-5.50	-5.17	18.00	-22.0	1528	1.400	-1627.55	-2394.81	3030.99	192.91
					632	1.400	-1305.15	1827.16	910.43	100.60

Bentley	Tampa	Sheet #	DS-2
		Job #	100010194
Program: LEAP® RC-PIER® V8i (SELECTseries1)		By	DRB
Version: Version: 09.00.01	Copyright © Bentley Systems, Inc. 1984 - 2009.	Date	Nov/5/2009
	www.bentley.com Phone: 1-800-778-4277	Checked	
File Name: **I-75 PPI**		Date	

Pile	Loc(X) ft	Loc(Z) ft	X in	Z in	comb	Ovs	P kips	Mxx kft	Mzz kft	Pile Reac. kips
6	-1.83	-5.17	62.00	-22.0	1573	1.400	-1595.26	-2892.63	2891.78	152.01
					635	1.400	-1401.27	3034.78	1170.25	87.73
7	1.83	-5.17	106.00	-22.0	1213	1.400	-1561.30	-2892.63	2103.34	115.83
					628	1.400	-1455.24	3340.90	2639.77	63.04
8	5.50	-5.17	150.00	-22.0	621	1.400	-1394.78	-2649.33	1010.30	97.43
					648	1.400	-1476.27	2649.25	3165.52	22.32
9	-5.50	-8.83	18.00	22.0	1124	1.400	-1627.55	2394.71	3030.99	192.91
					623	1.400	-1305.15	-1827.24	910.43	100.60
10	-1.83	-8.83	62.00	22.0	1079	1.400	-1595.26	2892.53	2891.78	152.00
					620	1.400	-1401.27	-3034.86	1170.25	87.73
11	1.83	-8.83	106.00	22.0	914	1.400	-1568.91	3009.78	2270.73	115.96
					645	1.400	-1455.24	-3340.98	2639.77	63.04
12	5.50	-8.83	150.00	22.0	634	1.400	-1394.78	2649.25	1010.30	97.43
					643	1.400	-1476.27	-2649.33	3165.52	22.32
13	-5.50	-12.50	18.00	66.0	1079	1.400	-1595.26	2892.53	2891.78	230.88
					620	1.400	-1401.27	-3034.86	1170.25	62.30
14	-1.83	-12.50	62.00	66.0	1079	1.400	-1595.26	2892.53	2891.78	191.45
					637	1.400	-1415.81	-3340.98	1536.04	43.49
15	1.83	-12.50	106.00	66.0	636	1.400	-1415.81	3340.90	1536.04	159.21
					645	1.400	-1455.24	-3340.98	2639.77	17.48
16	5.50	-12.50	150.00	66.0	635	1.400	-1401.27	3034.78	1170.25	138.58
					644	1.400	-1469.78	-3034.86	3005.56	-18.83

Pile Reactions, Factored

Pile	Loc(X) ft	Loc(Z) ft	X in	Z in	comb	Ovs	P kips	Mxx kft	Mzz kft	Pile Reac. kips
1	-5.50	-1.50	18.0	-66.0	3307	---	-1994.07	-3615.78	3614.72	288.60
					2369	---	-1751.59	3793.47	1462.82	77.88
2	-1.83	-1.50	62.0	-66.0	3322	---	-1984.56	-3762.35	3405.47	240.29
					2370	---	-1769.76	4176.13	1920.06	54.36
3	1.83	-1.50	106.0	-66.0	2371	---	-1769.76	-4176.23	1920.06	199.02
					2362	---	-1819.05	4176.13	3299.72	21.85
4	5.50	-1.50	150.0	-66.0	2354	---	-1751.59	-3793.57	1462.82	173.23
					2381	---	-1837.23	3793.47	3756.96	-23.54
5	-5.50	-5.17	18.0	-22.0	3262	---	-2034.43	-2993.51	3788.73	241.14
					2366	---	-1631.43	2283.96	1138.03	125.75
6	-1.83	-5.17	62.0	-22.0	3307	---	-1994.07	-3615.78	3614.72	190.01
					2369	---	-1751.59	3793.47	1462.82	109.66
7	1.83	-5.17	106.0	-22.0	2947	---	-1951.63	-3615.78	2629.17	144.78
					2362	---	-1819.05	4176.13	3299.72	78.80
8	5.50	-5.17	150.0	-22.0	2355	---	-1743.48	-3311.67	1262.88	121.79
					2382	---	-1845.34	3311.57	3956.89	27.90
9	-5.50	-8.83	18.0	22.0	2858	---	-2034.43	2993.39	3788.73	241.14
					2357	---	-1631.43	-2284.05	1138.03	125.75
10	-1.83	-8.83	62.0	22.0	2813	---	-1994.07	3615.67	3614.72	190.01
					2354	---	-1751.59	-3793.57	1462.82	109.66
11	1.83	-8.83	106.0	22.0	2648	---	-1961.14	3762.23	2838.42	144.95
					2379	---	-1819.05	-4176.23	3299.72	78.80
12	5.50	-8.83	150.0	22.0	2368	---	-1743.48	3311.57	1262.88	121.79
					2377	---	-1845.34	-3311.67	3956.89	27.90
13	-5.50	-12.50	18.0	66.0	2813	---	-1994.07	3615.67	3614.72	288.60
					2354	---	-1751.59	-3793.57	1462.82	77.88
14	-1.83	-12.50	62.0	66.0	2813	---	-1994.07	3615.67	3614.72	239.31

Pile	Loc(X) ft	Loc(Z) ft	X in	Z in	comb	Ovs	P kips	Mxx kft	Mzz kft	Pile Reac. kips
					2371	---	-1769.76	-4176.23	1920.06	54.36
15	1.83	-12.50	106.0	66.0	2370	---	-1769.76	4176.13	1920.06	199.02
					2379	---	-1819.05	-4176.23	3299.72	21.85
16	5.50	-12.50	150.0	66.0	2369	---	-1751.59	3793.47	1462.82	173.22
					2378	---	-1837.23	-3793.57	3756.96	-23.54

Pile Reactions, Service (After the reduction of overstress allowance)

Pile	Loc(X) ft	Loc(Z) ft	X in	Z in	comb	Ovs	P kips	Mxx kft	Mzz kft	Pile Reac. kips
1	-5.50	-1.50	18.00	-66.0	1573	1.400	-1595.26	-2892.63	2891.78	164.92
					635	1.400	-1401.27	3034.78	1170.25	44.50
2	-1.83	-1.50	62.00	-66.0	1588	1.400	-1587.65	-3009.88	2724.38	137.31
					636	1.400	-1415.81	3340.90	1536.04	31.06
3	1.83	-1.50	106.00	-66.0	637	1.400	-1415.81	-3340.98	1536.04	113.73
					628	1.400	-1455.24	3340.90	2639.77	12.49
4	5.50	-1.50	150.00	-66.0	620	1.400	-1401.27	-3034.86	1170.25	98.99
					647	1.400	-1469.78	3034.78	3005.56	-13.45
5	-5.50	-5.17	18.00	-22.0	4	1.000	-1578.28	-34.86	2497.56	162.83
					632	1.400	-1305.15	1827.16	910.43	71.86
6	-1.83	-5.17	62.00	-22.0	4	1.000	-1578.28	-34.86	2497.56	128.77
					635	1.400	-1401.27	3034.78	1170.25	62.66
7	1.83	-5.17	106.00	-22.0	4	1.000	-1578.28	-34.86	2497.56	94.71
					628	1.400	-1455.24	3340.90	2639.77	45.03
8	5.50	-5.17	150.00	-22.0	621	1.400	-1394.78	-2649.33	1010.30	69.60
					648	1.400	-1476.27	2649.25	3165.52	15.94
9	-5.50	-8.83	18.00	22.0	5	1.000	-1578.28	34.76	2497.56	162.83
					623	1.400	-1305.15	-1827.24	910.43	71.86
10	-1.83	-8.83	62.00	22.0	5	1.000	-1578.28	34.76	2497.56	128.77
					620	1.400	-1401.27	-3034.86	1170.25	62.66
11	1.83	-8.83	106.00	22.0	5	1.000	-1578.28	34.76	2497.56	94.71
					645	1.400	-1455.24	-3340.98	2639.77	45.03
12	5.50	-8.83	150.00	22.0	634	1.400	-1394.78	2649.25	1010.30	69.60
					643	1.400	-1476.27	-2649.33	3165.52	15.94
13	-5.50	-12.50	18.00	66.0	1079	1.400	-1595.26	2892.53	2891.78	164.92
					620	1.400	-1401.27	-3034.86	1170.25	44.50
14	-1.83	-12.50	62.00	66.0	1079	1.400	-1595.26	2892.53	2891.78	136.75
					637	1.400	-1415.81	-3340.98	1536.04	31.06
15	1.83	-12.50	106.00	66.0	636	1.400	-1415.81	3340.90	1536.04	113.72
					645	1.400	-1455.24	-3340.98	2639.77	12.48
16	5.50	-12.50	150.00	66.0	635	1.400	-1401.27	3034.78	1170.25	98.99
					644	1.400	-1469.78	-3034.86	3005.56	-13.45

Footing Design : Notes

Only max. force in piles is considered for design.

Pile coordinates X and Z are from the most left edge of the footing.

Plong= Lateral load in longitudinal direction at the top of pile, Kips.

Php= Available resisting horizontal component due to batter= batter * Vertical pile reaction, Kips.

Plong-Php= Remaining lateral force required to resist by pile.

Max. Pile Reaction Used in Design: (without selfweight and surcharge)

Factored pile reaction	272.53 kips
Service pile reaction	218.02 kips
Fatigue pile reaction	18.01 kips

Reinforcement Schedule

Dir	Quantity	Size	Bar dist. in	As total in^2	Spacing in	Hook
X	28	# 10	15.50	35.56	5.95	None
Z	28	# 10	17.50	35.56	5.95	None

Flexure

Dir	Loc ft	d in	Mmax kft	Comb	Asb_req in^2	Asb_prv in^2	Asb_eff in^2	Ast_req in^2	Ast_prv in^2	Ast_eff in^2
X	-3.00	44.50	2725.3	3307	18.57	35.56	33.13	0.00	0.00	0.00
X	3.00	44.50	2725.3	3307	18.57	35.56	33.13	0.00	0.00	0.00
Z	-3.00	42.50	2725.3	3307	19.49	35.56	33.13	0.00	0.00	0.00
Z	3.00	42.50	2725.3	3307	19.49	35.56	33.13	0.00	0.00	0.00

One Way Shear

Col	Dir	Dist ft	Comb	d in	Vu kips	phi*Vc kips
1	X	-6.71	3307	44.50	0.0	751.9
	X	6.71	3307	44.50	0.0	751.9
	Z	-6.54	3307	42.50	0.0	718.1
	Z	6.54	3307	42.50	0.0	718.1

Two Way Shear

#	Bo ft	Ao ft^2	Comb	Avg. d in	Vu kips	phi*Vc kips
Columns						
1	38.50	92.64	3307	43.50	3270.3	4042.4
Piles - max						
6	19.11	22.82	3307	43.50	272.5	2006.5

#	Bo ft	Ao ft^2	Comb	Avg. d in	Vu kips	phi*Vc kips
Piles - min						
1	7.78	15.12	3307	43.50	272.5	816.6

Two Way Shear Note

TWO WAY SHEAR IN FOOTING IS NOT DESIGNED AND STIRRUPS ARE NOT CONSIDERED.

ISOLATED FOOTING DESIGN

ISOLATED FOOTING DESIGN

Code: AASHTO STANDARD (17th Edition 2002) - Ultimate Strength Design
Units: US
Pier View: Upstation.

GEOMETRY

Name : FTG02
Shape : Rectangular, Type : Pile/Shaft Cap
Bf(X) = 14.00 ft, Hf(Z) = 14.00 ft, Thickness(Y) = 60.00 in
Ag = 196.00 ft^2, Ix = 268.89 ft^2, Iz = 268.89 ft^2
Footing eccentric: Start at X = -7.00 ft from centerline of column.
Footing eccentric: Start at Z = -7.00 ft from centerline of column.
Columns located on the footing:
Column No. 2 at x = 0.00 ft, Rectangular 72.00 in x 72.00 in
Surcharge = 0.30 ksf
Piles: Chamfer Size: W = 13.83 in, D = 14.69 in, T1 = 0.62 in, T2 = 0.00 in
Service Capacity: 234.00 kips Factored Capacity: 328.00 kips
Piles Section Properties: Area = 0.18 ft^2 Ix = 904.00 in^4 Iz = 326.00 in^4

DESIGN PARAMETERS

f'c = 3500.00 psi	fy = 60000.00 psi
phi flex = 0.90	phi shear = 0.85
Ec = 3586.6 ksi	Es = 29000.0 ksi
Crack control factor z = 130.00 kips/in	
Concrete Type : Normal Weight.	

Pile Reactions, Service (Without the reduction of overstress allowance)

Pile	Loc(X) ft	Loc(Z) ft	X in	Z in	comb	Ovs	P kips	Mxx kft	Mzz kft	Pile Reac. kips
1	-5.50	-1.50	18.00	-66.0	644	1.400	-1052.52	-2580.80	-1242.34	106.02
					635	1.400	-1121.03	2580.73	-3114.36	-33.56
2	-1.83	-1.50	62.00	-66.0	1585	1.400	-1273.26	-2525.86	-2315.96	128.32
					636	1.400	-1106.50	2864.08	-2739.67	4.76
3	1.83	-1.50	106.00	-66.0	1210	1.400	-1299.61	-2420.07	-2956.03	163.74
					628	1.400	-1067.06	2864.08	-1617.03	32.00
4	5.50	-1.50	150.00	-66.0	1210	1.400	-1299.61	-2420.07	-2956.03	204.05
					647	1.400	-1052.52	2580.73	-1242.34	51.27
5	-5.50	-5.17	18.00	-22.0	643	1.400	-1046.04	-2225.64	-1077.94	71.37
					634	1.400	-1127.52	2225.56	-3278.76	1.09

Pile	Loc(X) ft	Loc(Z) ft	X in	Z in	comb	Ovs	P kips	Mxx kft	Mzz kft	Pile Reac. kips
6	-1.83	-5.17	62.00	-22.0	1585	1.400	-1273.26	-2525.86	-2315.96	93.87
					636	1.400	-1106.50	2864.08	-2739.67	43.81
7	1.83	-5.17	106.00	-22.0	1210	1.400	-1299.61	-2420.07	-2956.03	130.74
					647	1.400	-1052.52	2580.73	-1242.34	69.52
8	5.50	-5.17	150.00	-22.0	1225	1.400	-1303.18	-2285.80	-3035.89	171.99
					648	1.400	-1046.04	2225.56	-1077.94	85.11
9	-5.50	-8.83	18.00	22.0	648	1.400	-1046.04	2225.56	-1077.94	71.37
					621	1.400	-1127.52	-2225.64	-3278.76	1.09
10	-1.83	-8.83	62.00	22.0	1076	1.400	-1265.65	2419.98	-2142.48	93.86
					637	1.400	-1106.50	-2864.16	-2739.67	43.81
11	1.83	-8.83	106.00	22.0	896	1.400	-1299.61	2419.98	-2956.03	130.74
					644	1.400	-1052.52	-2580.80	-1242.34	69.52
12	5.50	-8.83	150.00	22.0	881	1.400	-1303.18	2285.71	-3035.89	171.99
					643	1.400	-1046.04	-2225.64	-1077.94	85.11
13	-5.50	-12.50	18.00	66.0	647	1.400	-1052.52	2580.73	-1242.34	106.02
					620	1.400	-1121.03	-2580.80	-3114.36	-33.56
14	-1.83	-12.50	62.00	66.0	628	1.400	-1067.06	2864.08	-1617.03	127.11
					637	1.400	-1106.50	-2864.16	-2739.67	4.75
15	1.83	-12.50	106.00	66.0	911	1.400	-1292.00	2525.77	-2782.55	164.25
					645	1.400	-1067.06	-2864.16	-1617.03	31.99
16	5.50	-12.50	150.00	66.0	896	1.400	-1299.61	2419.98	-2956.03	204.05
					644	1.400	-1052.52	-2580.80	-1242.34	51.27

Pile Reactions, Factored

Pile	Loc(X) ft	Loc(Z) ft	X in	Z in	comb	Ovs	P kips	Mxx kft	Mzz kft	Pile Reac. kips
1	-5.50	-1.50	18.0	-66.0	2378	---	-1315.66	-3226.00	-1552.93	132.53
					2369	---	-1401.29	3225.91	-3892.94	-41.95
2	-1.83	-1.50	62.0	-66.0	3319	---	-1591.58	-3157.33	-2894.95	160.40
					2370	---	-1383.12	3580.10	-3424.58	5.94
3	1.83	-1.50	106.0	-66.0	2944	---	-1624.51	-3025.09	-3695.04	204.68
					2362	---	-1333.83	3580.10	-2021.29	39.99
4	5.50	-1.50	150.0	-66.0	2944	---	-1624.51	-3025.09	-3695.04	255.07
					2381	---	-1315.66	3225.91	-1552.93	64.09
5	-5.50	-5.17	18.0	-22.0	2377	---	-1307.54	-2782.05	-1347.43	89.21
					2368	---	-1409.40	2781.95	-4098.45	1.37
6	-1.83	-5.17	62.0	-22.0	3319	---	-1591.58	-3157.33	-2894.95	117.34
					2370	---	-1383.12	3580.10	-3424.58	54.76
7	1.83	-5.17	106.0	-22.0	1750	---	-1972.94	-102.95	-3892.65	167.27
					2381	---	-1315.66	3225.91	-1552.93	86.90
8	5.50	-5.17	150.0	-22.0	1750	---	-1972.94	-102.95	-3892.65	220.35
					2382	---	-1307.54	2781.95	-1347.43	106.39
9	-5.50	-8.83	18.0	22.0	2382	---	-1307.54	2781.95	-1347.43	89.21
					2355	---	-1409.40	-2782.05	-4098.45	1.37
10	-1.83	-8.83	62.0	22.0	2810	---	-1582.06	3024.97	-2678.10	117.32
					2371	---	-1383.12	-3580.20	-3424.58	54.76
11	1.83	-8.83	106.0	22.0	1751	---	-1972.94	102.81	-3892.65	167.27
					2378	---	-1315.66	-3226.00	-1552.93	86.90
12	5.50	-8.83	150.0	22.0	1751	---	-1972.94	102.81	-3892.65	220.35
					2377	---	-1307.54	-2782.05	-1347.43	106.39
13	-5.50	-12.50	18.0	66.0	2381	---	-1315.66	3225.91	-1552.93	132.53
					2354	---	-1401.29	-3226.00	-3892.94	-41.96
14	-1.83	-12.50	62.0	66.0	2362	---	-1333.83	3580.10	-2021.29	158.89

Pile	Loc(X) ft	Loc(Z) ft	X in	Z in	comb	Ovs	P kips	Mxx kft	Mzz kft	Pile Reac. kips
					2371	---	-1383.12	-3580.20	-3424.58	5.94
15	1.83	-12.50	106.0	66.0	2645	---	-1615.00	3157.21	-3478.19	205.31
					2379	---	-1333.83	-3580.20	-2021.29	39.99
16	5.50	-12.50	150.0	66.0	2630	---	-1624.51	3024.97	-3695.04	255.06
					2378	---	-1315.66	-3226.00	-1552.93	64.08

Pile Reactions, Service (After the reduction of overstress allowance)

Pile	Loc(X) ft	Loc(Z) ft	X in	Z in	comb	Ovs	P kips	Mxx kft	Mzz kft	Pile Reac. kips
1	-5.50	-1.50	18.00	-66.0	644	1.400	-1052.52	-2580.80	-1242.34	75.73
					635	1.400	-1121.03	2580.73	-3114.36	-23.97
2	-1.83	-1.50	62.00	-66.0	1585	1.400	-1273.26	-2525.86	-2315.96	91.65
					636	1.400	-1106.50	2864.08	-2739.67	3.40
3	1.83	-1.50	106.00	-66.0	1210	1.400	-1299.61	-2420.07	-2956.03	116.96
					628	1.400	-1067.06	2864.08	-1617.03	22.85
4	5.50	-1.50	150.00	-66.0	1	1.000	-1282.63	-36.02	-2549.26	145.91
					647	1.400	-1052.52	2580.73	-1242.34	36.62
5	-5.50	-5.17	18.00	-22.0	643	1.400	-1046.04	-2225.64	-1077.94	50.98
					634	1.400	-1127.52	2225.56	-3278.76	0.78
6	-1.83	-5.17	62.00	-22.0	1	1.000	-1282.63	-36.02	-2549.26	75.89
					636	1.400	-1106.50	2864.08	-2739.67	31.29
7	1.83	-5.17	106.00	-22.0	1	1.000	-1282.63	-36.02	-2549.26	110.65
					647	1.400	-1052.52	2580.73	-1242.34	49.66
8	5.50	-5.17	150.00	-22.0	1	1.000	-1282.63	-36.02	-2549.26	145.42
					648	1.400	-1046.04	2225.56	-1077.94	60.80
9	-5.50	-8.83	18.00	22.0	648	1.400	-1046.04	2225.56	-1077.94	50.98
					621	1.400	-1127.52	-2225.64	-3278.76	0.78
10	-1.83	-8.83	62.00	22.0	2	1.000	-1282.63	35.93	-2549.26	75.89
					637	1.400	-1106.50	-2864.16	-2739.67	31.29
11	1.83	-8.83	106.00	22.0	2	1.000	-1282.63	35.93	-2549.26	110.65
					644	1.400	-1052.52	-2580.80	-1242.34	49.66
12	5.50	-8.83	150.00	22.0	2	1.000	-1282.63	35.93	-2549.26	145.42
					643	1.400	-1046.04	-2225.64	-1077.94	60.80
13	-5.50	-12.50	18.00	66.0	647	1.400	-1052.52	2580.73	-1242.34	75.73
					620	1.400	-1121.03	-2580.80	-3114.36	-23.97
14	-1.83	-12.50	62.00	66.0	628	1.400	-1067.06	2864.08	-1617.03	90.79
					637	1.400	-1106.50	-2864.16	-2739.67	3.40
15	1.83	-12.50	106.00	66.0	911	1.400	-1292.00	2525.77	-2782.55	117.32
					645	1.400	-1067.06	-2864.16	-1617.03	22.85
16	5.50	-12.50	150.00	66.0	2	1.000	-1282.63	35.93	-2549.26	145.91
					644	1.400	-1052.52	-2580.80	-1242.34	36.62

Footing Design : Notes

Only max. force in piles is considered for design.

Pile coordinates X and Z are from the most left edge of the footing.

Plong= Lateral load in longitudinal direction at the top of pile, Kips.

Php= Available resisting horizontal component due to batter= batter * Vertical pile reaction, Kips.

Plong-Php= Remaining lateral force required to resist by pile.

Max. Pile Reaction Used in Design: (without selfweight and surcharge)

Factored pile reaction	238.99 kips
Service pile reaction	191.19 kips
Fatigue pile reaction	20.56 kips

Reinforcement Schedule

Dir	Quantity	Size	Bar dist. in	As total in^2	Spacing in	Hook
X	28	# 10	15.50	35.56	5.95	None
Z	28	# 10	17.50	35.56	5.95	None

Flexure

Dir	Loc ft	d in	Mmax kft	Comb	Asb_req in^2	Asb_prv in^2	Asb_eff in^2	Ast_req in^2	Ast_prv in^2	Ast_eff in^2
X	-3.00	44.50	2389.9	2944	16.23	35.56	33.13	0.00	0.00	0.00
X	3.00	44.50	2389.9	2944	16.23	35.56	33.13	0.00	0.00	0.00
Z	-3.00	42.50	2389.9	2944	17.03	35.56	33.13	0.00	0.00	0.00
Z	3.00	42.50	2389.9	2944	17.03	35.56	33.13	0.00	0.00	0.00

One Way Shear

Col	Dir	Dist ft	Comb	d in	Vu kips	phi*Vc kips
1	X	-6.71	2944	44.50	0.0	751.9
	X	6.71	2944	44.50	0.0	751.9
	Z	-6.54	2944	42.50	0.0	718.1
	Z	6.54	2944	42.50	0.0	718.1

Two Way Shear

#	Bo ft	Ao ft^2	Comb	Avg. d in	Vu kips	phi*Vc kips
Columns						
1	38.50	92.64	2944	43.50	2867.9	4042.4
Piles - max						
6	19.11	22.82	2944	43.50	239.0	2006.5

#	Bo ft	Ao ft^2	Comb	Avg. d in	Vu kips	phi*Vc kips
Piles - min						
1	7.78	15.12	2944	43.50	239.0	816.6

Two Way Shear Note

TWO WAY SHEAR IN FOOTING IS NOT DESIGNED AND STIRRUPS ARE NOT CONSIDERED.