

SST TOWER PIER/MAT FOUNDATION DESIGN WORK SHEET:

Sales Order #: 21570
Site Name: Parkland Sanitary Force Main
Project #: 100° SST PIERMAT FOUNDATION
DRW. #: GM-06520
Site #: N/A
Site Location:
Client:
Revision: 0
Geotech Report #: 08G0417
Report By: EPC Engineering & Testing
Of: Duluth, MN
Report Date: 12/3/2008
Allowable bearing pressure: 1500 psi
Concrete Compressive Strength: 4000 psi

Ultimate Bearing Pressure: 3000 psf
Vertical Down: 99.15 kips
MAX Uplift: 95 kips
MAX Shear/Leg: 6.85 kips
Axial Load: 16.25 kips
OTM: 672.8 ft kips
Total Shear @ Base: 6.8 kips

Tower weight: 3900 lbs
Fy of Re-bars (ksi): 60 ksi

Tower Spread (Input): 8
Tower Spread (Dimension sign): 8'-0" ft 8 ft
1/3 Distance: 2'-3 11/16" 2'-4"/12 ft
2/3 Distance: 4'-7 7/16" 4'-7"/12 ft
1/2 Face Distance: 4'-0" ft 4 ft

Pier Diameter (Pad Width): 3'-0" ft 3 ft
1/2 Pier Diameter (1/2 Pad width): 1'-6" 1'-6"/12 ft
Total PIER HEIGHT: 5'-3" ft 5 ft
Finished Height Above Grade: 1 ft 1 ft
Total Mat Width: 24'-0" ft 18 ft
1/2 Total Mat Width: 12'-0" 9 ft
Mat Thickness: 1'-9" ft 1'-6"/12 ft
Tower height: 180 ft
Total height: 7'-0" 6'-6"/12 ft

Volume of Concrete Pier:
Total Volume of Concrete:
Pier height below grade: 4'-3" 4 ft
PIER BAR SIZE: 9 # Rebar
PIER BAR NUMBER: 13
Size of Horizontal Ties: 4 12" Spacing
MAT BAR SIZE: 9 # Rebar
MAT BAR NUMBER: 14
TOTAL MAT BAR NUMBER: 56
Anchor Bolt Diameter: 1.5 in 1'-6"/12 inch
Quantity of Anchor Bolts: 4
Bolt Circle Diameter: 9.5 in 9'-6"/12 inch
Anchor Bolt Projection: 9 in 9 inch
Anchor bolt length: 48 in 48 inch
Distance Base Plate & Pad: in
Thickness Base Plate: in

DRAWN: KMM
DATE: 10/12/2010
CHECKED: C.JM
DATE: 10/12/2010

SQUARE BAR SIZE: 9
SQUARE BAR NUMBER: 16
PIERS MOVE UP DIMENSION: 0.00 ft

INPUT DATA AND DESIGN PARAMETERS

MAT WIDTH	18	ft	CONCRETE DENSITY	150	pcf		
MAT THICKNESS	1.5	ft	BACKFILL DENSITY	110	pcf		
PIER DIAMETER	3	ft	MINSOIL DENSITY	110	pcf	SMALLER AXIAL LOAD	
PIER TOTAL HEIGHT	5	ft	AXIAL LOAD	16250	lb	24947	lb
PIER HEIGHT AGL	1	ft	UPLIFT LOAD	95000	lb		
INPUT WATER TABLE	5	ft	BASE SHEAR FORCE	6800	lb	BASE SHEAR	
WATER TABLE FOR CALCS	5	ft	OTM	672800	ft-lb		
MAT LENGTH	18	ft	CONCRETE STRENGTH	4000	psi		
r (PIER)	0.012		ALLOWABLE BEAR PRESSURE	1500			
r (MAT)	0.007		ULTIMATE BEAR PRESSURE	3000	psf	SOIL PROPERTIES	
COHESION	500	psf	TOWER SPREAD	8			
COFRICTION	0.45	base footing	LOCAL OTM	9111	ft-lb		
			LOAD FACTOR	1.30			

BAR SIZING MODULE

PIER AREA	1017.88	in^2	dp	25.5	in		
PIER BAR AREA	12.21	in^2	MAX PIER BAR SHEAR	193531.3928	lb		
SQUARE AREA	1296.00	in^2	PIER BAR SHEAR	10466.94091	lb		
SUQARE BAR AREA	15.55	in^2	AREA BARSHEAR	0.174449015	in^2	ACI 11-13	
MAT AREA	3888.00	in^2	DESIGN SPACING	6.978	in		
MAT BAR AREA	27.22	in^2	PIER BAR ACI LIMITS	15	in	ACI 11.5.4.2	
			dm	12	in		
MAX SQAURE SHEAR	193531.393	lb	MAX MAT BAR SHEAR	36429.43865	lb		
SQAURE BAR SHEAR	10828.125	lb	MAT BAR SHEAR	8951.785714	lb		
AREA BARSHEAR	0.18046875	in^2	AREA BARSHEAR	0.149196429	in^2		
DESIGN SPACING	7.21875	in	DESIGN SPACING	14.92	in		
SQU. BAR ACI LIMITS	15	in	MAT BAR ACI LIMITS	24	in		

PIER BAR SIZE	9	#	SPACING OK FOR PIER BAR SIZING	REBAR UP. CAP.	494688	lb
PIER BAR NUMBER	13		SPACING OK FOR SQUARE BAR SIZING	REBAR UP. CHECK	PIER REBAR OK FOR UPLIFT	
SQUARE BAR SIZE	9	#	SPACING OK FOR MAT BAR SIZING			
SQUARE BAR NUMBER	16					
MAT BAR SIZE	9	#	PIER HEIGHT DESIGN OK			
MAT BAR NUMBER	28					

ECENTRICITY CALCULATION

SOIL HEIGHT	4	ft	MAT WEIGHT	72900	lb		
PIER VOLUME	84.823	ft^3	PIER WEIGHT	15904	lb		
TOTAL VOLUME	1296	ft^3	SOIL WEIGHT	133229	lb		
ECENTRICITY, e	2.3412		Qo	235575	lb		
ECENTRICITY, B/6	3.0000		PIER TO CENTER	4.62	ft		
SIDE EDGE CHECK	SIDE EDGE OK		N/A	ft			
BOTTOM EDGE CHECK	BOTTOM EDGE OK		N/A	ft			

FOUNDATION OTM CALCULATION

MOMENT FROM MAT	656100	lb-ft		
MOMENT FROM PIER	143139	lb-ft		
MOMENT FROM SOIL	1199065	lb-ft		
MOMENT FROM AXIAL	187103	lb-ft		
DESIGNED UNFACTORED MOMENT	2185407	lb-ft		
REQUIRED UNFACTORED MOMENT	551538	lb-ft		
OVERTURNING SAFETY FACTOR	3.962			

DOWN, UPLIFT, AND OVERTURNING MOMENT CHECKING

ACTUAL AREA WIDTH	13.3175	ft	WEIGHT OF SOIL	133229	lb		
ACTUAL AREA LENGTH	13.3175	ft	WEIGHT OF CONCRETE	88804	lb		

ALLOWABLE SOIL BEARING CALCULATION

WHEN e<=B/6	1295	psf		
WHEN e>B/6	1310	psf		

INVERSE SOIL HEIGHT	0	ft	DESIGN UPLIFT	156417	lb
FOOTING PERIMETER	72	ft	REQUIRED UPLIFT	95000	lb
INVERSE SOIL VOLUME	0	ft^3	DESIGN DOWN	539360	lb
INVERSE SOIL WEIGHT	0	lb	REQUIRED DOWN	570060	lb

RESULT FOUNDATION OTM OK
FOOTING BEARING OK

SLIDING FRICTION

FRICTION CAPACITY	106008.952	lb
RESULT	ANALYSIS OK IN HORIZONTAL MOVEMENT	

PUNCHING SHEAR IN FOOTING

PU1	361440.539	lb			
d	15	in	f	0.75	
e1	27	in	vc	126.4911064	psi
vu1	13.9444652	psi	SH1	94.86832981	psi
PU2	95000	lb	JF	1355197.5	
MU2	131191.2	lb-in	R2	5296.103395	
b2	51	in	v2	0.4	
AREAP	3060	in^2	AREAF	46656	in^2
vu2	30.3024197	psi	SH2	189.7366596	psi

RESULT FOUNDATION DESIGN, ONEWAY SHEAR PUNCHING OK
FOUNDATION DESIGN, TWO-WAY SHEAR PUNCHING OK

ANCHOR BOLT DESIGN

LEG TYPE & SIZE	P3.5	(FROM TOWER DESIGN)	SET INDEX	8	
LEG TYPE & SIZE	P3.5	(FROM SET INDEX)	FLANGE THICK	1.5	in
BOLT DIAMETER	1.5	in	OTM	9111	ft-lb
BOLT QUANTITY	4		AXIALWEIGHT	99150	lb
BOLT LENGTH	48	in	SHEARFORCE	6850	lb
BOLT CIRCLE DIA	9.5	in	Fc	4000	psi
BASE PLATE DIA	15	in	Fy	60000	psi
BOLT PROJECTION	9	in	BASE PLATE STR	561	psi

RESULT OK IN LEG TYPE AND SIZE MATCH
ANALYSIS OK FOR ANCHOR BOLT RATIO
ANALYSIS OK FOR PUNCHING
ANALYSIS OK FOR BASE PLATE STRENGTH

MINTENSTRBLTU	55000	psi	DIA NUTPUNCHING	2.38	in
ALLTENSTRBLT	36300	psi	THREADS PER LENG	6	in
YIELDSTRFLANGE	50000	psi	OUTSIDE DIA	15.5	in
DATA2	4.8	in			

DIASTREBOLT	1.33761667	in	AREASTREBOLT	1.40525209	in^2
AXIALBOLT	24787.5	lb	AREANOMBOLT	1.76715	in^2
			STRESSBOLT	17639.18387	psi

BOLTDEGREE	90	degree			
Yt	67.6875	in^2	BOLTRADIUS	1.570795	rad

CALCULATED BEARING	1295	psf
ALLOWABLE BEARING	1500	psf

MAT CONCRETE ONE WAY SHEAR (WIDE BEAM)

FACTORED SOIL BEARING	1683	psf
LENGTH, C1	3.500	ft
LENGTH, C2	2.883	ft
LENGTH, C3	5.191	ft
REQUIRED SHEAR ON WIDE BEAM	157253	lb
DESIGNED SHEAR ON WIDE BEAM	307373	lb

MAT CONCRETE TWO WAY PUNCHING

FACTORED SOIL BEARING	1683	psf
TOTAL AREA, A0	324	ft^2
SIDE LENGTH 1, b1	11.000	ft
SIDE LENGTH 2, b2	9.926	ft
AREA 1, A1	109.187	ft^2
AREA 2, A2	214.813	ft^2
REQUIRED PUNCHING FORCE	361501	lb
DESIGNED PUNCHING CAPACITY	1429361	lb

MAT CONCRETE TWO WAY PUNCHING (AROUND PIER)

REQUIRED PUNCHING FORCE	99150	lb
DESIGNED PUNCHING CAPACITY	321881	lb