ENGINEERED SOLUTIONS of Georgia
Foundation Repair & Waterproofing

A Lifetime of Support

2260 Northwest Parkway Suite E Marietta, GA 30067

HELICAL PILE FOUNDATION SUBMITTAL FOR:

Meyers Solids Handling Improvements
Mobile Area Water & Sewer System
Mobile AL

June 6, 2022

PREPARED UNDER THE DIRECT CONTROL AND SUPERVISION OF:

THIS SEAL PERTAINS ONLY TO THE PIERS INSTALLED BY ENGINEERED SOLUTIONS OF GEORGIA. THIS SEAL DOES NOT SERVE AS OR REPRESENT THE PROJECT ENGIENER OF RECORD AND SHALL NOT BE CONSTRUED AS SUCH.

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Design Summary For Piers 1-14

PIER DESIGN

Piles: Min,2 7/8" O.D. X 0.276" W.T. with a triple 8",10",12" Helix
(Or approved equal)
Pile Finish: Hot Dip Galvanized
Max Pier spacing is 7' OC

Allowable geotechnical loads (FS=2)

- Axial Compression: 25K
- Axial Tension: 10K
- Lateral: 2K

INSTALLATION NOTES

- Required minimum installation torque: 5555 ft-lbs.
- Torque not to exceed: 7,500 ft-lbs.
- Minimum helical plate depth below ground surface is 10 feet.
- Piles may need to be installed beyond the specified depth to achieve required torque.
- After pier is installed to required depth install supplemental 6" OD x 0.375" wall steel pipe 10' deep. Tremie grout inside of casing to provide bonding to helical pier shaft
- Install & lock off pier bracket to pier shaft per note 5 on cut sheet
- Attach bracket to footing using (2)
- Geotechnical information has been provided for the project by Thompson Engineering (Project # 21-1101-0057) If installed pier length in fluid soil exceeds 5ft contact ESOG engineering department.

Engineering For Piers 1-14

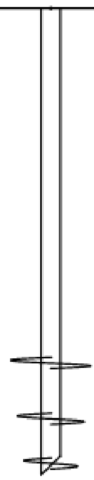
Helical Piles 1-14 Axial Capacity Calculations

Project Name: Solids Building Meyers Plant
Project Number: 22040
Project Type: New Foundation
Project Address: Semmes, AL,
Company Name: Engineered Solutions of Georgia
Prepared By: Raja El-Awar Reviewed By: Mark E. Tominey
Date: Wednesday, February 23, 2022

MacLean™ CIVIL PRODUCTS

SOIL BORING DATA

Boring ID: B-2 Depth to Groundwater 31 (ft)

Depth (ft)	Soil Type	Helical Pile Diagram	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
8	Sand		115	0	27
9	Sand		115	0	29
10	Sand		115	0	29
11	Sand		115	0	29
12	Sand		115	0	29
13	Sand		115	0	29
14	Sand		115	0	29
15	Sand		115	0	29
16	Sand		115	0	29
17	Sand		115	0	29
18	Sand		115	0	29
19	Sand		120	0	31
20	Sand		120	0	31
21	Sand		120	0	31
22	Sand		120	0	31
23	Sand		120	0	31
24	Sand		120	0	31
25	Sand		120	0	31
26	Sand		125	0	37
27	Sand		125	0	37
28	Sand		125	0	37
29	Sand		125	0	37
30	Sand		125	0	37
31	Sand		125	0	37
32	Sand		125	0	37
33	Sand		125	0	37
34	Sand		125	0	37
35	Sand		125	0	37
36	Sand		125	0	37
37	Sand		125	0	37
38	Sand		125	0	37
39	Sand		125	0	37
40	Sand		125	0	37
41	Sand		125	0	37
42	Sand		125	0	37
43	Sand		125	0	37
44	Sand		125	0	37

REQUIRED LOADS (Allowable)

Required Compression Load:	25	kips
Required Tension Load:	10	kips

HELICAL PILE CONFIGURATION

2.875" O.D. Pipe (0.203" Wall Thickness) installed with a batter angle of 0 degrees to a depth of 28 feet followed by 2.875" O.D. Pipe (0.203" Wall Thickness) beginning at a depth of 21 feet. The pile is affixed to the structure using a NCB060604CP1B bracket.

Helix 6:	None		
Helix 5:	None		
Helix 4:	None		
Helix 3:	12 in	located at	23.5 ft
Helix 2:	10 in	located at	26 ft
Helix 1:	8 in	located at	28 ft

SAFETY FACTORS APPLIED

Compression:	2	Tension:	3
		Buckling:	2

CALCULATION RESULTS

Ultimate Geotechnical Bearing Capacity:			
105.02 kips	>	50 kips	PASS
Ultimate Geotechnical Tension Capactiy:			
98.93 kips	>	30 kips	PASS
Mechanical Compression Capacity of Shaft:			
70 kips	>	50 kips	PASS
Mechanical Tension Capacity of Shaft:			
70 kips	>	30 kips	PASS
Buckling Strength:			
70 kips	>	50 kips	PASS
Torque Capacity:			
7500 ft-lbs	>	5556 ft-lbs	PASS

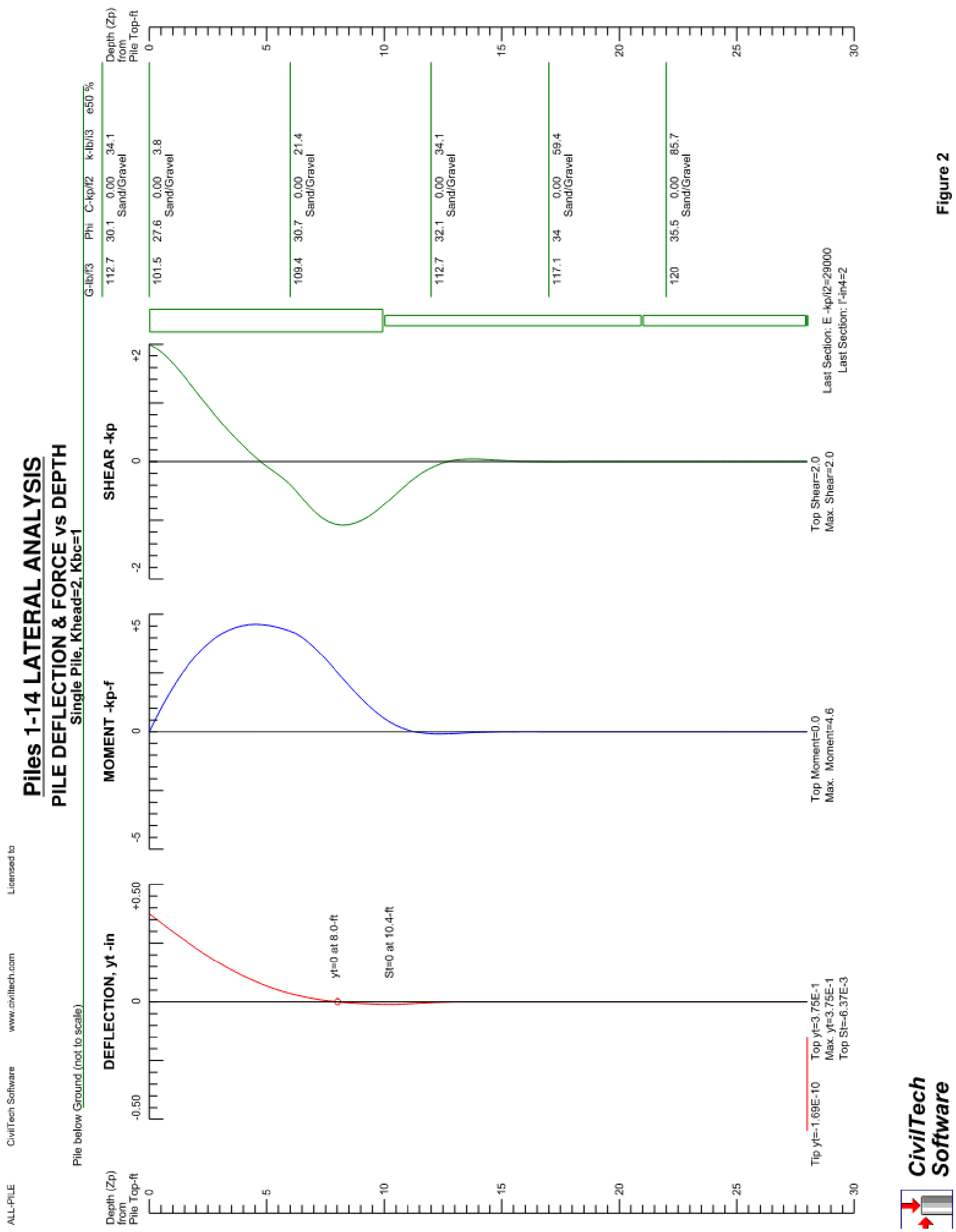
Torque Capacity Based on Kt Factor = 9

NOTES

This helical pile configuration is based on industry standard design methodologies. If your project requires an ICC-ES AC 358 evaluated product, please contact MacLean Civil Products at civil-csr@macleanpower.com. Prior to final pile design, preliminary tests, conducted with the proposed pile configuration are recommended.

CATALOG NUMBERS

Item Description	ID #	Qty
Bracket	NCB060604CP1B	1
Extension Shaft	P28E84	3
Extension Shaft w/ Helix 1	N/A	0
Extension Shaft w/ Helix 2	N/A	0
Combo First Extension	N/A	0
Lead Shaft	P2884S81012	1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Piles 1-14 LATERAL ANALYSIS
PILE DEFLECTION & FORCE vs DEPTH
Single Pile, Khead=2, Kbc=1
Pile below Ground (not to scale)
Depth (Zp) from Pile Top-ft
G-lb/f3 Phi C-kp/f2 k-lb/i3 e50 %
112.7 30.1 0.00 34.1 Sand/Gravel
101.5 27.6 0.00 3.8 Sand/Gravel
109.4 30.7 0.00 21.4 Sand/Gravel
112.7 32.1 0.00 34.1 Sand/Gravel
117.1 34 0.00 59.4 Sand/Gravel
120 35.5 0.00 85.7 Sand/Gravel
DEFLECTION, yt -in
MOMENT -kp-f
SHEAR -kp
yt=0 at 8.0-ft
St=0 at 10.4-ft
Tip yt=-1.69E-10
Top yt=3.75E-1
Max. yt=3.75E-1
Top St=-6.37E-3
Top Moment=0.0
Max. Moment=4.6
Top Shear=2.0
Max. Shear=2.0
Last Section: E -kp/i2=29000
Last Section: I"-in4=2
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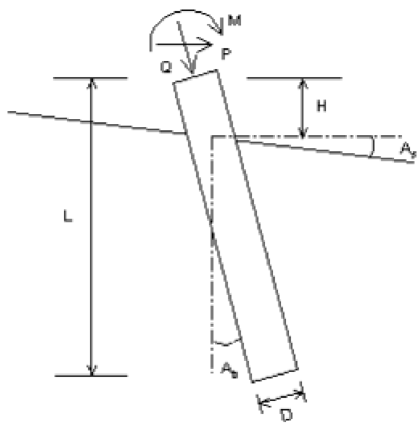
Figure 2

LATERAL ANALYSIS

Figure 2



Drilled Pile (dia <=24 in. or 61 cm)

Loads:
Load Factor for Vertical Loads= 1.0
Load Factor for Lateral Loads= 1.0
Loads Supported by Pile Cap= 0 %
Shear Condition: Static

(with Load Factor)
Vertical Load, Q= 25.0 -kp
Shear Load, P= 2.0 -kp
Moment, M= 0.0 -kp-f

Profile:
Pile Length, L= 28.0 -ft
Top Height, H= -2 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0
Free Head Condition

Soil Data:

Depth -ft	Gamma -lb/f3	Phi	C -kp/f2	K -lb/i3	e50 or Dr %	Nspt
0	112.7	30.1	0.00	34.1	30.24	8
2	101.5	27.6	0.00	3.8	10.31	2
8	109.4	30.7	0.00	21.4	23.94	6
14	112.7	32.1	0.00	34.1	30.24	8
19	117.1	34	0.00	59.4	40.01	12
24	120	35.5	0.00	85.7	48.08	16

Pile Data:

Depth -ft	Width -in	Area -in2	Per. -in	I -in4	E -kp/i2	Weight -kp/f
0.0	6	7.4	18.8	24.8	29000	0.041
10.0	2.875	2.7	9.0	2.1	29000	0.008
21.0	2.875	2.7	9	2.1	29000	.008
28.0	2.875	6.5	9	2.1	29000	.008

Single Pile Lateral Analysis:
Top Deflection, yt= 0.37500-in
Max. Moment, M= 4.57-kp-f
Top Deflection Slope, St= -0.00637
OK! Top Deflection, 0.3750-in is less than the Allowable Deflection= 1.00-in

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.
The Max. Moment calculated by program is an internal force from the applied load conditions. Structural engineer has to check whether the pile has enough capacity to resist the moment with adequate factor of safety. If not, the pile may fail under the load conditions.

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Combined Axial & Bending Capacity For Pipe Piles

Casing	Helical Piers 1-14	
Casing O.D=	6.000	in
Casing w.t=	0.375	in
Corrosion Allowance=	0.000	in
Casing I.D=	5.250	in
Area =	6.627	in^2
Z=	11.883	in^3
F_y=	50.0	ksi

Required Axial Strength (P)=	25.0	kips
Required Flexural Strength (M)=	4.6	k-ft

Axial

Nominal Axial Strength

$P_n=F_y*A$	331.3	Kips

Allowable Axial Strength

Ω_{axial}	1.67	
$P_{a\ (axial)}=P_n/\Omega_{axial}$	198.4	Kips

Test Axial Strength

Ω_{Test}	1.3	
$P_{a\ (test)}=P_n/\Omega_{test}$	265.1	Kips

Bending

Nominal Flexural Strength

$M_n=F_y*Z$	594.1	k-in
	49.5	k-ft

Allowable Flexural Strength

$\Omega_{bending}$	1.67	
$Ma_{(bending)}=Mn/\Omega_{bending}$	29.6	k-ft

Test Flexural Strength

Ω_{Test}	1.3	
$Ma_{(test)}=Mn/\Omega_{test}$	39.6	k-ft

Combined Strength

$P/Pa_{(bending)} + M/Ma_{(bending)}$	0.28	Pile Ok

AISC Steel Manual (13th Edition) SectionH1-1

Design Summary For Piers 15-39

PIER DESIGN

Piles: Min, 2 7/8” O.D. X 0.276” W.T. with a triple helix 8”,10”,12”
(Or approved equal)
Pile Finish: Hot Dip Galvanized
Max Pier spacing: See attached drawing for locations

Allowable geotechnical loads (FS=2)

- Axial Compression: 15K
- Axial Tension: 5K
- Lateral: 1K

INSTALLATION NOTES

- Required minimum installation torque: 3333 ft-lbs.
- Torque not to exceed: 7,500 ft-lbs.
- Minimum helical plate depth below ground surface is 10 feet.
- Piles may need to be installed beyond the specified depth to achieve required torque.
- Lock off pier bracket to pier shaft per note 5 on cut sheet
- Geotechnical information has been provided for the project by Thompson Engineering (Project # 21-1101-0057) If installed pier length in fluid soil exceeds 5ft contact ESOG engineering department.

Engineering For Piers 15-39

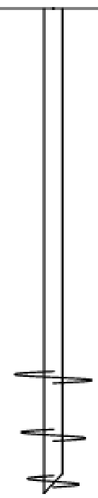
Helical Piles 15-39 Axial Capacity Calculations

MacLean CIVIL PRODUCTS™

Project Name:	Solids Building Meyers Plant
Project Number:	22040
Project Type:	
Project Address:	Semmes, AL,
Company Name	Engineered Solutions of Georgia
Prepared By:	Raja El-Awar Reviewed By: Mark E. Tominey
Date	Wednesday, February 23, 2022

SOIL BORING DATA

Boring ID: B-2 — Depth to Groundwater 31 (ft)



Depth (ft)	Soil Type	Helical Pile Diagram	Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)
1	Sand		115	0	30
2	Sand		115	0	30
3	Sand		115	0	30
4	Sand		115	0	27
5	Sand		115	0	27
6	Sand		115	0	27
7	Sand		115	0	27
8	Sand		115	0	27
9	Sand		115	0	29
10	Sand		115	0	29
11	Sand		115	0	29
12	Sand		115	0	29
13	Sand		115	0	29
14	Sand		115	0	29
15	Sand		115	0	29
16	Sand		115	0	29
17	Sand		115	0	29
18	Sand		115	0	29
19	Sand		120	0	31
20	Sand		120	0	31
21	Sand		120	0	31
22	Sand		120	0	31
23	Sand		120	0	31
24	Sand		120	0	31
25	Sand		120	0	31
26	Sand		125	0	37
27	Sand		125	0	37
28	Sand		125	0	37
29	Sand		125	0	37
30	Sand		125	0	37
31	Sand		125	0	37
32	Sand		125	0	37
33	Sand		125	0	37
34	Sand		125	0	37
35	Sand		125	0	37
36	Sand		125	0	37
37	Sand		125	0	37

REQUIRED LOADS (Allowable)

Required Compression Load:	15	kips
Required Tension Load:	10	kips

HELICAL PILE CONFIGURATION

2.875" O.D. Pipe (0.203" Wall Thickness) installed with a batter angle of 0 degrees to a depth of 21 feet followed by 2.875" O.D. Pipe (0.203" Wall Thickness) beginning at a depth of 14 feet. The pile is affixed to the structure using a NCB060604CP1B bracket.

Helix 6:	None		
Helix 5:	None		
Helix 4:	None		
Helix 3:	12 in	located at	16.5 ft
Helix 2:	10 in	located at	19 ft
Helix 1:	8 in	located at	21 ft

SAFETY FACTORS APPLIED

Compression:	2	Tension:	3
		Buckling:	2

CALCULATION RESULTS

Ultimate Geotechnical Bearing Capacity:			
46.83 kips	>	30 kips	PASS
Ultimate Geotechnical Tension Capactiy:			
40.95 kips	>	30 kips	PASS
Mechanical Compression Capacity of Shaft:			
70 kips	>	30 kips	PASS
Mechanical Tension Capacity of Shaft:			
70 kips	>	30 kips	PASS
Buckling Strength:			
70 kips	>	30 kips	PASS
Torque Capacity:			
7500 ft-lbs	>	3333 ft-lbs	PASS

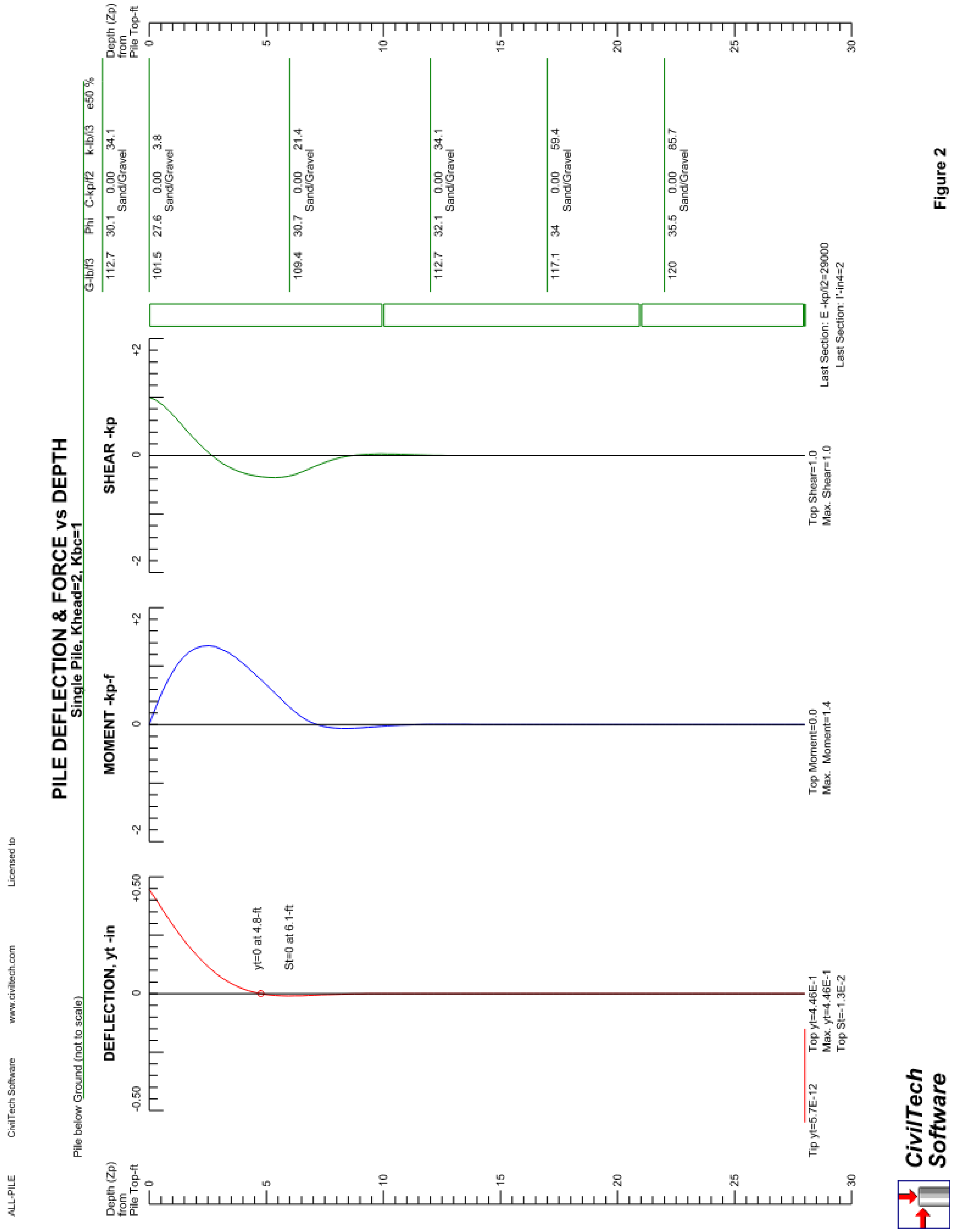
Torque Capacity Based on Kt Factor = 9

NOTES

This helical pile configuration is based on industry standard design methodologies. If your project requires an ICC-ES AC 358 evaluated product, please contact MacLean Civil Products at civil-csr@macleanpower.com. Prior to final pile design, preliminary tests, conducted with the proposed pile configuration are recommended.

CATALOG NUMBERS

Item Description	ID #	Qty
Bracket	NCB060604CP1B	1
Extension Shaft	P28E84	2
Extension Shaft w/ Helix 1	N/A	0
Extension Shaft w/ Helix 2	N/A	0
Combo First Extension	N/A	0
Lead Shaft	P2884S81012	1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PILE DEFLECTION & FORCE vs DEPTH
Single Pile, Khead=2, Kbc=1
Pile below Ground (not to scale)
DEFLECTION, yt -in
MOMENT -kp-f
SHEAR -kp
Depth (Zp) from Pile Top-ft
yt=0 at 4.8-ft
St=0 at 6.1-ft
Tip yt=5.7E-12
Top yt=4.46E-1
Max. yt=4.46E-1
Top St=-1.3E-2
Top Moment=0.0
Max. Moment=1.4
Top Shear=1.0
Max. Shear=1.0
Last Section: E -kp/ft2=29000
Last Section: I'-in4=2
G-lb/f3 Phi C-kp/f2 k-lb/i3 e50 %
112.7 30.1 0.00 34.1 Sand/Gravel
101.5 27.6 0.00 3.8 Sand/Gravel
109.4 30.7 0.00 21.4 Sand/Gravel
112.7 32.1 0.00 34.1 Sand/Gravel
117.1 34 0.00 59.4 Sand/Gravel
120 35.5 0.00 85.7 Sand/Gravel
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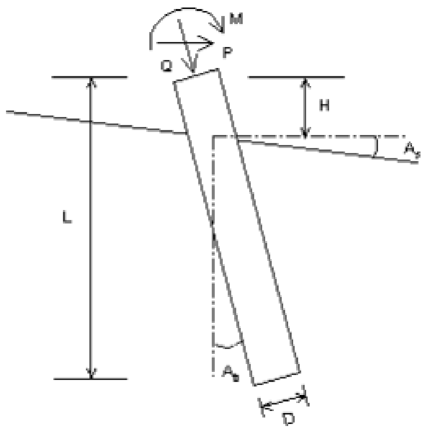
Figure 2

LATERAL ANALYSIS

Figure 2



Drilled Pile (dia <=24 in. or 61 cm)

Loads:
Load Factor for Vertical Loads= 1.0
Load Factor for Lateral Loads= 1.0
Loads Supported by Pile Cap= 0 %
Shear Condition: Static

(with Load Factor)
Vertical Load, Q= 15.0 -kp
Shear Load, P= 1.0 -kp
Moment, M= 0.0 -kp-f

Profile:
Pile Length, L= 28.0 -ft
Top Height, H= -2 -ft
Slope Angle, As= 0
Batter Angle, Ab= 0
Free Head Condition

Soil Data:

Depth -ft	Gamma -lb/f3	Phi	C -kp/f2	K -lb/i3	e50 or Dr %	Nspt
0	112.7	30.1	0.00	34.1	30.24	8
2	101.5	27.6	0.00	3.8	10.31	2
8	109.4	30.7	0.00	21.4	23.94	6
14	112.7	32.1	0.00	34.1	30.24	8
19	117.1	34	0.00	59.4	40.01	12
24	120	35.5	0.00	85.7	48.08	16

Pile Data:

Depth -ft	Width -in	Area -in2	Per. -in	I -in4	E -kp/i2	Weight -kp/f
0.0	2.875	2.7	9.0	2.1	29000	0.012
10.0	2.875	2.7	9.0	2.1	29000	0.008
21.0	2.875	2.7	9	2.1	29000	.008
28.0	2.875	6.5	9	2.1	29000	.008

Single Pile Lateral Analysis:
Top Deflection, yt= 0.44600-in
Max. Moment, M= 1.35-kp-f
Top Deflection Slope, St= -0.01300
OK! Top Deflection, 0.4460-in is less than the Allowable Deflection= 1.00-in

Note: If the program cannot find a result or the result exceeds the upper limit. The result will be displayed as 99999.
The Max. Moment calculated by program is an internal force from the applied load conditions. Structural engineer has to check whether the pile has enough capacity to resist the moment with adequate factor of safety. If not, the pile may fail under the load conditions.

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Combined Axial & Bending Capacity For Pipe Piles

Casing	Helical Piers 15-39
Casing O.D=	2.875 in
Casing w.t=	0.276 in
Corrosion Allowance=	0.000 in
Casing I.D=	2.323 in
Area =	2.254 in^2
Z=	1.871 in^3
F_y=	50.0 ksi

Required Axial Strength (P)=	15.0 kips
Required Flexural Strength (M)=	1.4 k-ft

Axial

Nominal Axial Strength

$P_n=F_y*A$	112.7 Kips

Allowable Axial Strength

Ω_{axial}	1.67
$P_{a\ (axial)}=P_n/\Omega_{axial}$	67.5 Kips

Test Axial Strength

Ω_{Test}	1.3
$P_{a\ (test)}=P_n/\Omega_{test}$	90.1 Kips

Bending

Nominal Flexural Strength

$M_n=F_y*Z$	93.6 k-in
	7.8 k-ft

Allowable Flexural Strength

$\Omega_{bending}$	1.67
$Ma_{(bending)}=Mn/\Omega_{bending}$	4.7 k-ft

Test Flexural Strength

Ω_{Test}	1.3
$Ma_{(test)}=Mn/\Omega_{test}$	6.2 k-ft

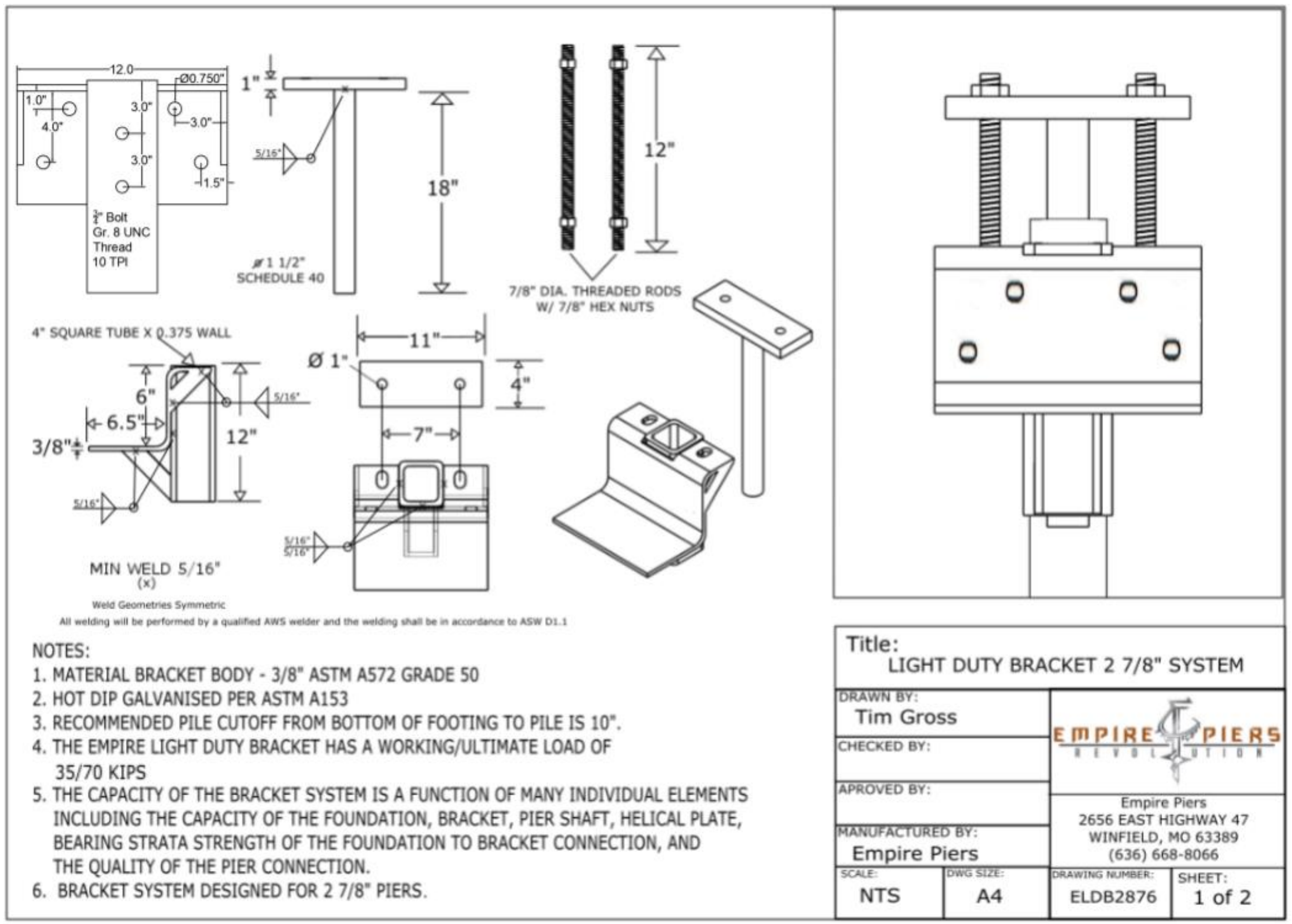
Combined Strength

$P/Pa_{(bending)} + M/Ma_{(bending)}$	0.52	Pile Ok

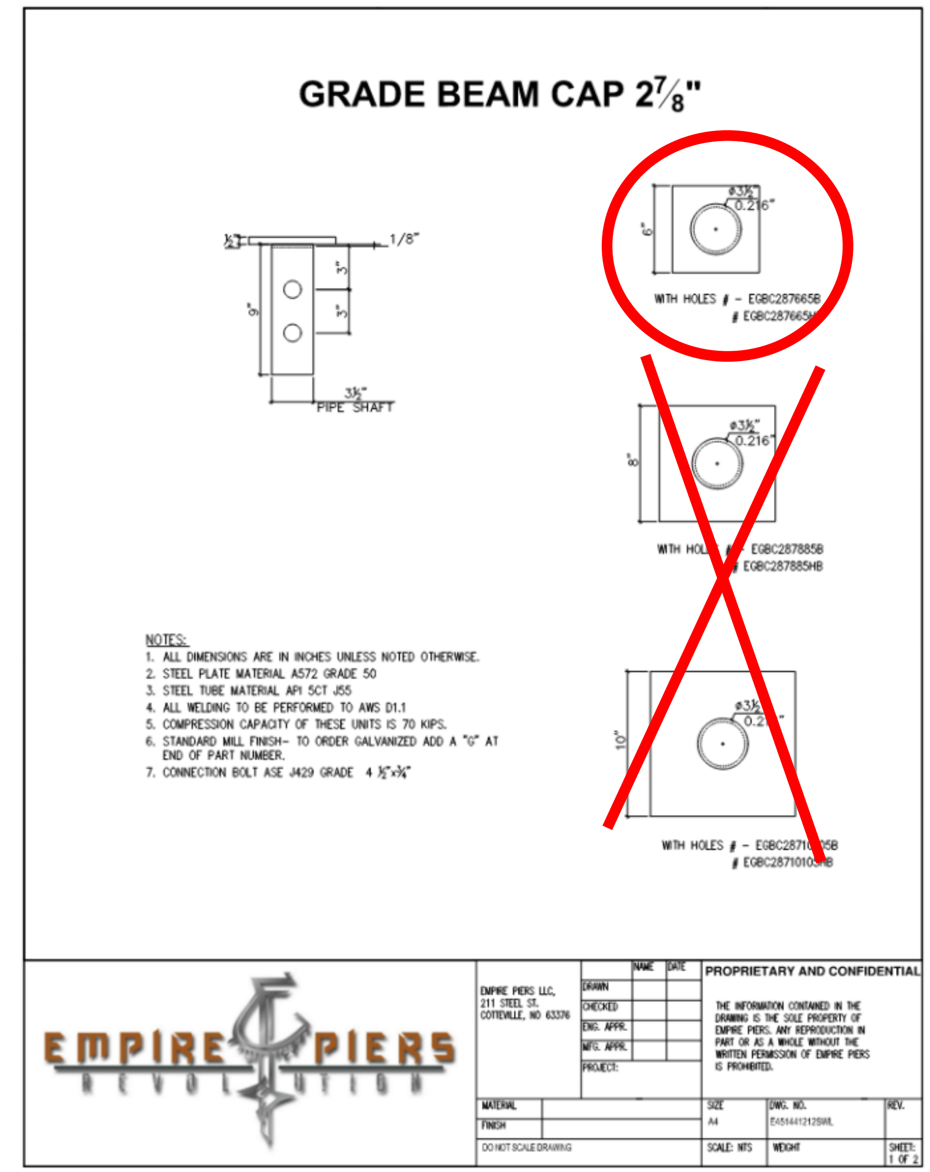
AISC Steel Manual (13th Edition) SectionH1-1

Cut Sheets For Piers

BRACKET DETAILS



Pier Bracket for Pier @ Existing Footings
(See below for bolt pattern design)



Top Connection for Pier

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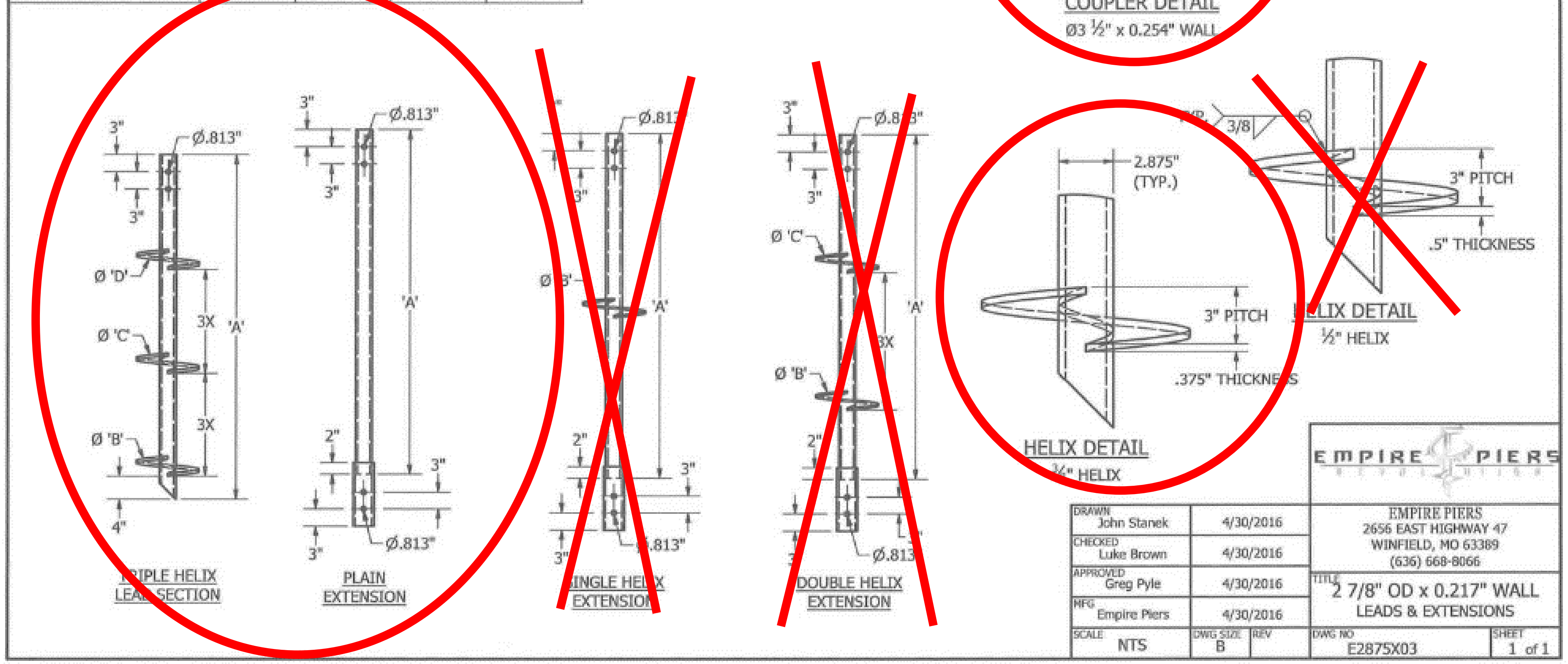
LEAD, EXTENSION & COUPLER DETAILS

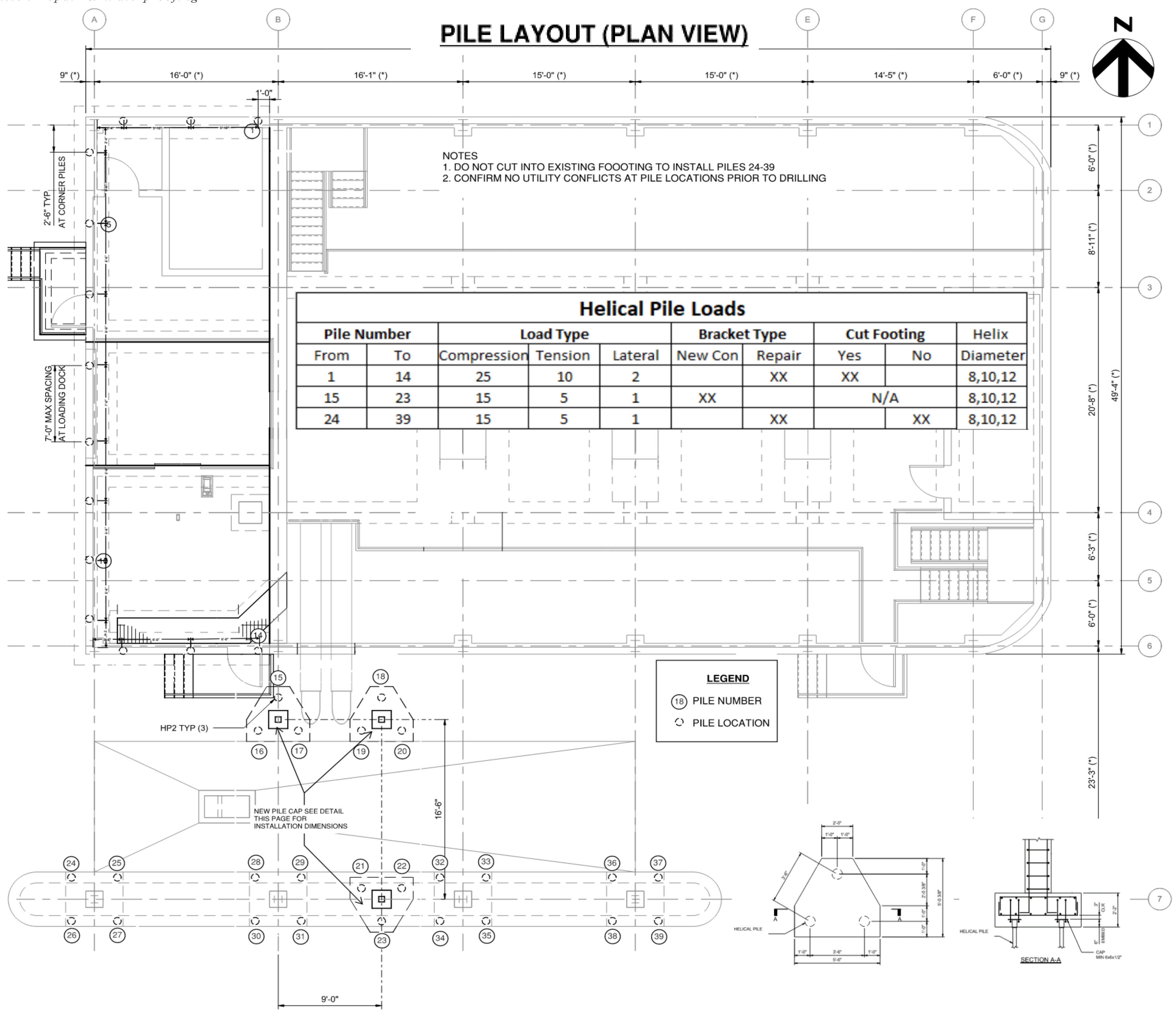


LEAD SECTIONS - PARTS LIST				
PART NUMBER	DIM 'A'	DIM 'B'	DIM 'C'	DIM 'D'
E2878481012L	84"	8"	10"	12"
E28784101214L	84"	10"	12"	14"
E28712081012L	120"	8"	10"	12"
E287120101214L	120"	10"	12"	14"
E28736E	36"			
E28760E	60"			
E28784E	84"			
E287120E	120"			
E2876012E	60"	12"		
E2876014E	60"	14"		
E2878414E	84"	14"		
E287841414E	84"	14"	14"	
E28712014E	120"	14"		
E2871201414	120"	14"	14"	

GENERAL NOTES

1. SHAFT MATERIAL - Ø2 7/8" OD J-55 API 5CT CERTIFIED PIPE.
Fy = 55 KSI, Ft = 75 KSI.
2. FINISH HOT DIPPED GALV. PER ASTM A 123/153.
3. ALL WELDING TO BE PERFORM BY QUALIFIED WELDER TO AWS D1.1
4. TORQUE STRENGTH RATING OF 9,500 FT-LBS
5. ULTIMATE CAPACITY OF UNIT IS 85.5 KIPS
6. HELIX SPACING SHALL BE 3 X THE DIAMINTER FROM THE LOWEST HELIX IN ACCORDANCE WITH ICC-ES AC358.
7. STEEL HELIX MATERIAL TO CONFORM TO ASTM A572, 50 KSI. HELIX GEOMETRY IN ACCORDANCE WITH ICC-ES AC358.
8. COUPLING BOLTS: 4 1/2" x 3/4" ASE J429 GRADE 5 BOLT SHEAR = 85 KSI, YEILD STRENGTH = 92 KSI, TENSILE STRENGTH = 120 KSI
9. ALL MATERIAL IS MANUFACTURED IN U.S.

DRAWN John Stanek	4/30/2016	EMPIRE PIERS 2656 EAST HIGHWAY 47 WINFIELD, MO 63389 (636) 668-8066	
CHECKED Luke Brown	4/30/2016		
APPROVED Greg Pyle	4/30/2016	TITLE 2 7/8" OD x 0.217" WALL LEADS & EXTENSIONS	
MFG Empire Piers	4/30/2016		
SCALE NTS	DWG SIZE B / REV	DWG NO E2875X03	SHEET 1 of 1



Helical Pile Loads

Pile Number		Load Type			Bracket Type		Cut Footing		Helix
From	To	Compression	Tension	Lateral	New Con	Repair	Yes	No	Diameter
1	14	25	10	2		XX	XX		8,10,12
15	23	15	5	1	XX		N/A		8,10,12
24	39	15	5	1		XX		XX	8,10,12

ANCHOR BOLT PATTERN DESIGN FOR UNDERPINNING BRACKET TO FOOTING

Company:		Date:	5/12/2022
Engineer:		Page:	1/6
Project:			
Address:			
Phone:			
E-mail:			

1.Project information

Customer company:
Customer contact name:
Customer e-mail:
Comment:

Project description:
Location:
Fastening description:

2. Input Data & Anchor Parameters

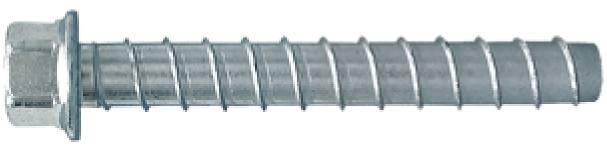
General
Design method:ACI 318-14
Units: Imperial units

Anchor Information:
Anchor type: Concrete screw
Material: Carbon Steel (Galvanized)
Diameter (inch): 0.625
Nominal Embedment depth (inch): 5.500
Effective Embedment depth, h_{ef} (inch): 4.240
Code report: ICC-ES ESR-2713
Anchor category: 1
Anchor ductility: No
h_{min} (inch): 8.50
c_{ac} (inch): 6.38
C_{min} (inch): 1.75
S_{min} (inch): 3.00

Base Material
Concrete: Normal-weight
Concrete thickness, h (inch): 12.00
State: Uncracked
Compressive strength, f'_c (psi): 3500
$\Psi_{c,V}$: 1.4
Reinforcement condition: B tension, B shear
Supplemental reinforcement: No
Reinforcement provided at corners: No
Ignore concrete breakout in tension: No
Ignore concrete breakout in shear: No
Ignore 6do requirement: Not applicable
Build-up grout pad: No

Base Plate
Length x Width x Thickness (inch): 6.00 x 11.00 x 0.38

Recommended Anchor
Anchor Name: Titen HD® - 5/8"Ø Titen HD, hnom:5.5" (140mm)
Code Report: ICC-ES ESR-2713

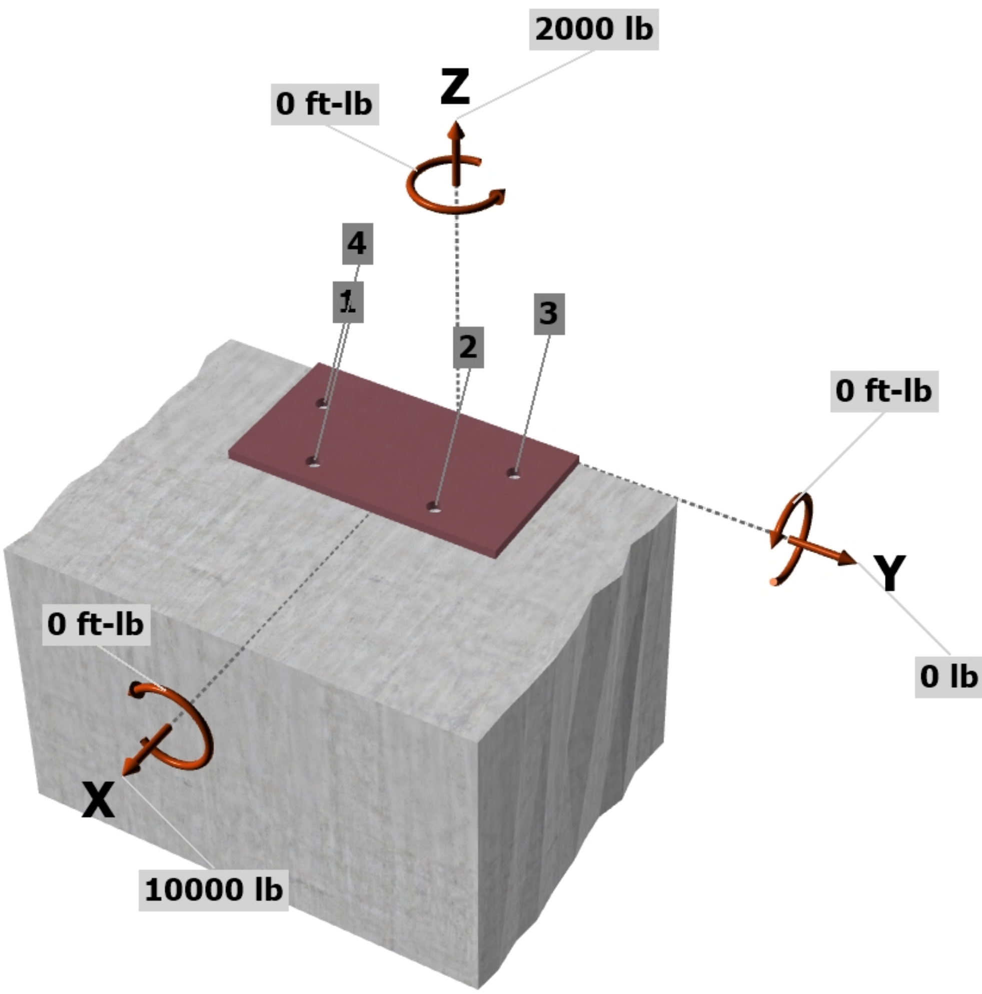


Load and Geometry
Load factor source: ACI 318 Section 5.3
Load combination: not set
Seismic design: No
Anchors subjected to sustained tension: Not applicable
Apply entire shear load at front row: No
Anchors only resisting wind and/or seismic loads: Yes

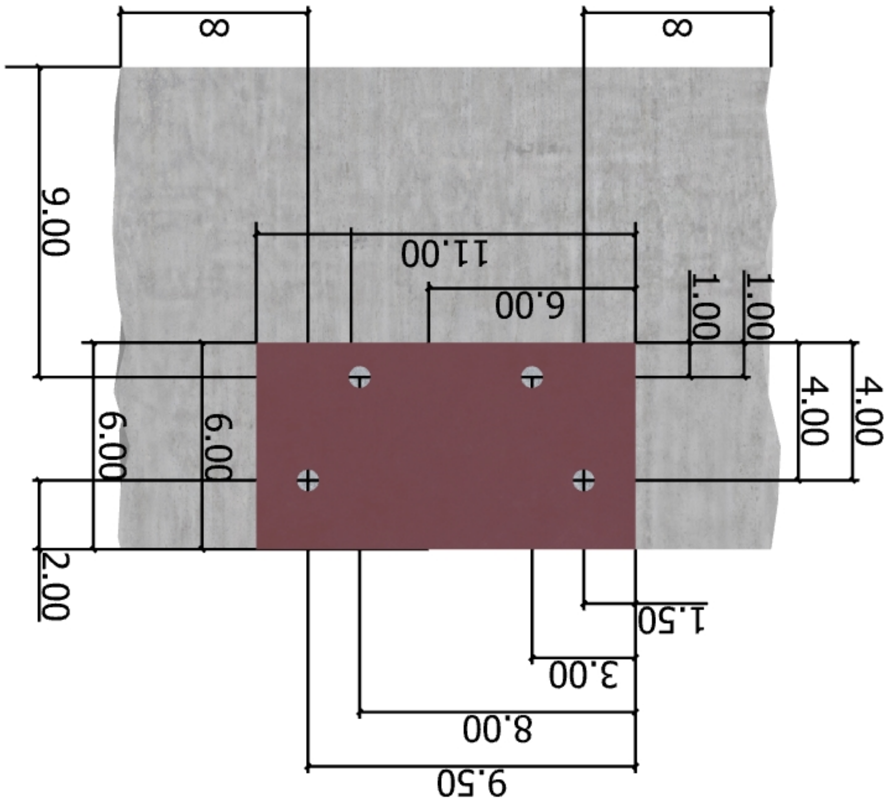
Strength level loads:

N_{ua} [lb]: 2000
V_{uax} [lb]: 10000
V_{uay} [lb]: 0
M_{ux} [ft-lb]: 0
M_{uy} [ft-lb]: 0
M_{uz} [ft-lb]: 0

<Figure 1>



<Figure 2>



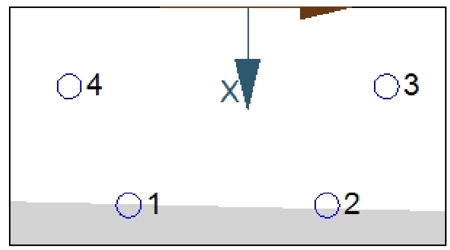
Company:		Date:	5/12/2022
Engineer:		Page:	4/6
Project:			
Address:			
Phone:			
E-mail:			

3. Resulting Anchor Forces

Anchor	Tension load, N_{ua} (lb)	Shear load x, V_{uax} (lb)	Shear load y, V_{uay} (lb)	Shear load combined, $\sqrt{(V_{uax})^2+(V_{uay})^2}$ (lb)
1	0.0	2266.4	-140.2	2270.7
2	42.6	2733.6	-140.2	2737.2
3	1586.1	2873.8	140.2	2877.2
4	1493.7	2126.2	140.2	2130.8
Sum	3122.3	10000.0	0.0	10016.0

Maximum concrete compression strain (‰): 0.05
Maximum concrete compression stress (psi): 235
Resultant tension force (lb): 3122
Resultant compression force (lb): 1122
Eccentricity of resultant tension forces in x-axis, e'_{Nx} (inch): 0.68
Eccentricity of resultant tension forces in y-axis, e'_{Ny} (inch): 0.96
Eccentricity of resultant shear forces in x-axis, e'_{Vx} (inch): 0.00
Eccentricity of resultant shear forces in y-axis, e'_{Vy} (inch): 0.00

<Figure 3>



4. Steel Strength of Anchor in Tension (Sec. 17.4.1)

N_{sa} (lb)	ϕ	ϕN_{sa} (lb)
30360	0.65	19734

5. Concrete Breakout Strength of Anchor in Tension (Sec. 17.4.2)

$N_b = k_c \lambda_a \sqrt{f'_c} h_{ef}^{1.5}$ (Eq. 17.4.2.2a)

k_c	λ_a	f'_c (psi)	h_{ef} (in)	N_b (lb)
24.0	1.00	3500	4.240	12396

$\phi N_{cbg} = \phi\,(A_{Nc} / A_{Nco})\,\Psi_{ec,N}\,\Psi_{ed,N}\,\Psi_{c,N}\,\Psi_{cp,N} N_b$ (Sec. 17.3.1 & Eq. 17.4.2.1b)

A_{Nc} (in^2)	A_{Nco} (in^2)	$c_{a,min}$ (in)	$\Psi_{ec,N}$	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕN_{cbg} (lb)
211.38	161.80	2.00	0.785	0.794	1.00	0.998	12396	0.65	6548

6. Pullout Strength of Anchor in Tension (Sec. 17.4.3)

$\phi N_{pn} = \phi \Psi_{c,P} \lambda_a N_p (f'_c / 2{,}500)^n$ (Sec. 17.3.1, Eq. 17.4.3.1 & Code Report)

$\Psi_{c,P}$	λ_a	N_p (lb)	f'_c (psi)	n	ϕ	ϕN_{pn} (lb)
1.0	1.00	9810	3500	0.50	0.65	7545

8. Steel Strength of Anchor in Shear (Sec. 17.5.1)

V_{sa} (lb)	ϕ_{grout}	ϕ	$\phi_{grout}\phi V_{sa}$ (lb)
10000	1.0	0.60	6000

9. Concrete Breakout Strength of Anchor in Shear (Sec. 17.5.2)

Shear perpendicular to edge in x-direction:

$V_{bx} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{bx} (lb)
4.24	0.625	1.00	3500	9.00	12964

$\phi V_{cbgx} = \phi\,(A_{Vc} / A_{Vco})\,\Psi_{ec,V}\,\Psi_{ed,V}\,\Psi_{c,V}\,\Psi_{h,V}V_{bx}$ (Sec. 17.3.1 & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{bx} (lb)	ϕ	ϕV_{cbgx} (lb)
384.00	364.50	0.978	1.000	1.400	1.061	12964	0.70	13884

Shear parallel to edge in x-direction:

$V_{by} = \min|7(l_e / d_a)^{0.2}\sqrt{d_a}\lambda_a\sqrt{f'_c}c_{a1}^{1.5}; 9\lambda_a\sqrt{f'_c}c_{a1}^{1.5}|$ (Eq. 17.5.2.2a & Eq. 17.5.2.2b)

l_e (in)	d_a (in)	λ_a	f'_c (psi)	c_{a1} (in)	V_{by} (lb)
4.24	0.625	1.00	3500	2.00	1358

$\phi V_{cbgx} = \phi\,(2)(A_{Vc} / A_{Vco})\,\Psi_{ec,V}\,\Psi_{ed,V}\,\Psi_{c,V}\,\Psi_{h,V}V_{by}$ (Sec. 17.3.1, 17.5.2.1(c) & Eq. 17.5.2.1b)

A_{Vc} (in^2)	A_{Vco} (in^2)	$\Psi_{ec,V}$	$\Psi_{ed,V}$	$\Psi_{c,V}$	$\Psi_{h,V}$	V_{by} (lb)	ϕ	ϕV_{cbgx} (lb)
36.00	18.00	1.000	1.000	1.400	1.000	1358	0.70	5324

10. Concrete Pryout Strength of Anchor in Shear (Sec. 17.5.3)

$\phi V_{cp} = \phi k_{cp}N_{cb} = \phi k_{cp}(A_{Nc} / A_{Nco})\,\Psi_{ed,N}\,\Psi_{c,N}\,\Psi_{cp,N}N_b$ (Sec. 17.3.1 & Eq. 17.5.3.1a)

k_{cp}	A_{Nc} (in^2)	A_{Nco} (in^2)	$\Psi_{ed,N}$	$\Psi_{c,N}$	$\Psi_{cp,N}$	N_b (lb)	ϕ	ϕV_{cp} (lb)
2.0	47.48	161.80	0.794	1.000	0.998	12396	0.70	4036

11. Results

Interaction of Tensile and Shear Forces (Sec. R17.6)

Tension	Factored Load, N_{ua} (lb)	Design Strength, $øN_n$ (lb)	Ratio	Status
Steel	1586	19734	0.08	Pass
Concrete breakout	**3122**	**6548**	**0.48**	**Pass (Governs)**
Pullout	1586	7545	0.21	Pass

Shear	Factored Load, V_{ua} (lb)	Design Strength, $øV_n$ (lb)	Ratio	Status
Steel	2877	6000	0.48	Pass
T Concrete breakout x+	**10000**	**13884**	**0.72**	**Pass (Governs)**
|| Concrete breakout x-	**280**	**5324**	**0.05**	**Pass (Governs)**
Pryout	2877	4036	0.71	Pass

Interaction check	$(N_{ua}/\phi N_{ua})^{5/3}$	$(V_{ua}/\phi V_{ua})^{5/3}$	Combined Ratio	Permissible	Status
Sec. R17.6	0.29	0.58	87.0%	1.0	Pass

5/8"Ø Titen HD, hnom:5.5" (140mm) meets the selected design criteria.

12. Warnings

- For irregular anchor patterns, the designer must consider sizing of base plate holes to ensure shear loads are distributed to anchors as designed.

- Designer must exercise own judgement to determine if this design is suitable.

- Refer to manufacturer’s product literature for hole cleaning and installation instructions.