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Foundation Repair & Waterproofing

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HELICAL PILE FOUNDATION SUBMITTAL FOR:

Big Creek Greenway Extension
City of Alpharetta
Department of Public Works
1790 Hembree Road
Alpharetta, Ga. 30009

February 27, 2020

PREPARED UNDER THE DIRECT CONTROL AND SUPERVISION OF:

Digitally signed by Nick Crispell
Date: 2020.02.27 10:20:09-05'00'

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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Building Materials

Abutments (Bridge and Boardwalk)

Bracket

Bracket Manufacturer: IDEAL
Bracket Type: New Construction Bracket
Bracket Model: IDL-NCB-8x8.75
Modified with 3/4”x8” H.S.

Piers

Pier Manufacturer: IDEAL
Pier:
2 7/8”x0.203” for 12 K Piers
2 7/8”x0.203” for 35 K Piers
2 7/8”x0.276” for 38 K Piers

Bents

Vertical Bracket

Bracket Manufacturer: IDEAL
Bracket Type: Boardwalk Saddle Bracket
Bracket Model: 350BWB8.75x8x38BG

Vertical Piers

Pier Manufacturer: IDEAL
Top 10’ or more of pier to be 3.5”x0.216”
Rest of pier to be 2 7/8” OD x 0.203”
Use 12 x 1/2” Helix Configuration

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Cross Brace Bracket

Bracket Manufacturer: IDEAL
Bracket Type: Tie Back Adapter
Bracket Model: IDL-TBA-CPLG

Cross Brace Piers

Pier Manufacturer: IDEAL
Top 10’ or more of pier to be 2 7/8”x0.203”
Rest of pier to be 2 3/8” OD x 0.154”
Use 10-12 x 3/8” Helix Configuration

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Required Allowable Load Capacity

Excerpt from construction plans titled "Big Creek Greenway Extension" by Pond Project No. 1180336

Sheet No. S301, Rev. 2 dated 7/18/2019
Sheet No. S501, Rev. 2 dated 7/18/2019

Abutments of Board Walk

35 K Compression Piers for details 1/S501, 4/S501, 5/S501

Abutments of Bridge

12 K Compression Piers for details 11/S301
38 K Compression Piers for details 2/S301

Bents

35 K Compression Piers for details 1/S501

Cross Brace Piers

±10 K Alternate Direction Piers for details 2/S501

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Engineering Abutments (Bridge and Boardwalk)

Abutment Pier Brackets

IDL-NCB-8x8.75 Brackets Allowable capacity exceeds smaller 278NC80G bracket = 58.1 kips per ESR-3750 table 1A

58.1 kips > 38 kips Required OK

From ESR-3750

TABLE 1A—BRACKET CAPACITY (P1) FOR SIDE LOAD AND DIRECT LOAD BRACKETS USED WITH $2^{7}/_{8}$-INCH SHAFTS[5,7]

PRODUCT NUMBER	DESCRIPTION	SHAFT DIAMETER (inches)	ALLOWABLE CAPACITY (kips)		
			Compression	Tension	Lateral
278CF	Repair Bracket	$2^{7}/_{8}$	29.4[1]	N/A	N/A
278NC80G	New Construction Bracket	$2^{7}/_{8}$	58.1[2]	40.8[3,6]	1.0[4]

For **SI:** 1 inch = 25.4 mm, 1 kip (1000 lbf) = 4.48 kN.

[1]Load capacity is based on full scale load tests per AC358 with an installed 5'-0" unbraced pile length having a maximum of one coupling per 2015, 2012 and 2009 IBC Section 1810.2.1 and 2006 IBC 1808.2.9.2. Repair brackets must be concentrically loaded and the bracket plate must be fully engaged with bottom of concrete foundation. Only localized limit states such as mechanical strength of steel components and concrete bearing have been evaluated. Minimum specified compressive strength of concrete is 3,000 psi (20.68 MPa).

[2]The allowable compressive load capacity is based on the mechanical strength of the steel bracket, concrete punching shear capacity, and concrete bearing strength. The allowable load capacities have been determined assuming that minimum reinforcement has been provided as specified by ACI 318-14 Section 9.6.1.2 and ACI 318-11 Section 10.5.1. The minimum embedment of the bracket is 12.6 inches. The embedment depth is the distance between the top of the bracket plate to the top of the concrete footing. End of helical pile shaft must be fully bearing on bracket plate. The concrete footing must have a minimum width of 33.2 inches, and must be normal-weight concrete having a minimum compressive strength of 2,500 psi.

[3]The allowable tensile load capacity is based on the mechanical strength of the steel bracket, punching shear capacity and bearing to concrete footing. The allowable load capacities have been determined assuming that minimum reinforcement has been provided as specified by ACI 318-14 Section 9.6.1.2 and ACI 318-11 Section 10.5.1. The minimum embedment of the bracket is 12.11 inches. The embedment depth is the distance between the bottom of the bracket plate to the bottom of the concrete footing. The capacity is based using two ¾-inch through bolts as described in Section 3.2.4.2 of this report. The concrete footing must have a minimum width of 28.2 inches, and must be normal-weight concrete having a minimum compressive strength of 2,500 psi.

[4]The allowable lateral capacity is based on limit states associated with mechanical steel strength, concrete breakout in accordance with ACI 318, and bracket bearing on unreinforced concrete in accordance with ACI 318. The bracket must be installed with a minimum embedment depth of 4 inches measured from the bottom of the bracket plate to the bottom of the concrete footing, and a minimum edge distance of 6.5 inches measured from the bracket plate edge to the concrete footing edge. The concrete footing must have a minimum width of 21 inches, and must be normal-weight concrete having a minimum compressive strength of 2,500 psi.

[5]The capacities listed in Table 1A assume the pile foundation system is sidesway braced per 2015, 2012 and 2009 IBC Section 1810.2.2 and 2006 IBC Section 1808.2.5.

[6] The bolt threads are excluded from the connection shear plane.

[7] Allowable capacities are based on bare steel losing 0.036-inch (318 µm) steel thickness as indicated in Section 3.9 of AC358 for a 50-year service life.

N/A = not applicable.

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Abutment Piers

Using pier 2 7/8" OD x 0.203" and 0.276" wall

Geo-Hydro Project report Number 181281.20 dated May 10th, 2019 has SPT minimum blow counts of 3.

Therefore, ground is classified as soft per section 3.11.2.1 of AC358 with effective date of July 1st, 2007.

Abutments pier tops are in the ground therefore unbraced shaft length, Lu is 0 ft per Section 1810.2.1 of the 2012 IBC

Pier Shaft allowable capacity = 60 kips per ESR-3750 table 3A

60 kips > 38 kips Required OK

From ESR-3750

TABLE 3A—SHAFT ALLOWABLE CAPACITY (P2) FOR $2^{7}/_{8}$–INCH-DIAMETER PILE WITH COUPLER ECCENTRICITY[3,4,5] (kips)

SHAFT TYPE	UNBRACED SHAFT LENGTH, L_u (FT) [1]	(P2) ALLOWABLE CAPACITY (KIPS) FOR $2^{7}/_{8}$-INCH DIAMETER SHAFTS					
		COMPRESSION (KIPS)			TENSION (KIPS)	LATERAL SHEAR (KIPS)	BENDING MOMENT (KIPS-FT)
		0 Coupler	1 Coupler[2]	2 Couplers[2]			
$2^{7}/_{8}$-inch OD (0.203-inch wall thickness)	0	60.0	40.4	19.7	23.6	13.3	4.41
	5	25.4	20.8	13.5			
	10	11.4	10.4	8.2			
$2^{7}/_{8}$-inch OD (0.276-inch wall thickness)	0	60.0	60.0	30.3	34.1	18.6	6.05
	5	35.1	29.6	20.0			
	10	15.4	14.3	11.6			

For **SI:** 1 inch = 25.4 mm; 1 ft = 0.305 m; 1 kip (1000 lbf) = 4.48 kN.

[1] L_u=Total unbraced pile length per 2015, 2012 and 2009 IBC Section 1810.2.1 and 2006 IBC Section 1808.2.9.2, including the length in air, water or in fluid soils, and the embedment length into firm or soft soil (non-fluid soil). k = Effective length factor. kLu = total effective unbraced length of the pile, where kLu = 0 represent a fully braced condition in that the total pile length is fully embedded in firm or soft soil and the supported structure is braced in accordance 2015, 2012 and 2009 IBC Section 1810.2.2 (Section 1808.2.5 of the 2006 IBC).
[2] Number of couplings within L_u
[3] The capacities shown in Table 3A are for $2^{7}/_{8}$-inch-diameter pilings installed with a maximum 1 degree of inclination and the assumption that the pile shaft is concentrically loaded.
[4] Capacities based on two ¾-inch bolts with matching nuts installed complying with Section 3.3.6. The bolt threads are excluded from the connection shear plane.
[5] Allowable capacities are based on bare steel losing 0.036-inch (318 µm) steel thickness as indicated in Section 3.9 of AC358 for a 50-year service life.

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Abutment Helical Pier Bearing Plates

12" Helix plate = 39.7 kips > 38 kips Required OK

From ESR-3750

TABLE 4A—HELICAL BEARING PLATE CAPACITY (P3) FOR $2^{7}/_{8}$-INCH HELICAL PILES[1,2,3]

HELIX DIAM. (IN)	SHAFT TYPE	HELIX THICKNESS (IN)	HELIX PITCH (IN)	ALLOWABLE CAPACITY[3] (P3) (KIPS)
8	2.875-inch (0.203-inch wall and 0.276-inch wall)	0.5	3.0	59.7
10	2.875-inch (0.203-inch wall and 0.276-inch wall)	0.5	3.0	49.3
12	2.875-inch (0.203-inch wall and 0.276-inch wall)	0.5	3.0	39.7
14	2.875-inch (0.203-inch wall and 0.276-inch wall)	0.5	3.0	48.0

For **SI:** 1 inch = 25.4 mm, 1 kip = 4.448 kN.

[1]For helical piles with more than one helix, the allowable helix capacity, P3, for the helical foundation systems, may be taken as the sum of the least allowable capacity of each individual helix.

[2]As described in Section 3.2.2 of this report, all helical bearing plates are made from same material, and have the same edge geometry, thickness and pitch.

[3]Allowable capacities are based on bare steel losing 0.036-inch (318 µm) steel thickness as indicated in Section 3.9 of AC358 for a 50-year service life.

Abutment Pier Torques

Torque Correlation = 9 per ESR-3750 table 5A
Factor of safety 2 per Section 1810.3.3.1.7 of 2012 IBC

38 kip piers

Minimum Installed Torque = 38 kips x 2 / 9 = 8,445 ft-lbs
Maximum Torque Rating 9,900 ft-lbs > 8,445 ft-lbs OK

35 kip piers

Minimum Installed Torque = 35 kips x 2 / 9 = 7,778 ft-lbs
Maximum Torque Rating 8,300 ft-lbs > 7,778 ft-lbs OK

12 kip piers

Minimum Installed Torque = 12 kips x 2 / 9 = 2,667 ft-lbs
Maximum Torque Rating 8,300 ft-lbs > 2,667 ft-lbs OK

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From ESR-3750

TABLE 5A—SOIL CAPACITY (P4) – AXIAL TENSION AND COMPRESSION FOR $2^{7}/_{8}$-INCH HELICAL PILES[1]

GEOTECHNICAL RELATED PROPERTIES	$2^{7}/_{8}$-INCH HELICAL PILE (0.203-INCH WALL THICKNESS)		$2^{7}/_{8}$-INCH HELICAL PILE (0.276-INCH WALL THICKNESS)	
	Compression	Tension	Compression	Tension
Mechanical Torsion Rating (ft-lbs)[3]	8,300	8,300	9,900	9,900
Maximum Torque Per Soil Tests (ft-lbs)[4]	8,300	8,300	9,900	9,900
Maximum Installation Torque Rating (ft-lbs)[5]	8,300	8,300	9,900	9,900
Torque Correlation Factor, K_t (ft^{-1})	9.0	7.0	9.0	7.0
Maximum Ultimate Soil Capacity / Maximum Allowable Soil Capacity (P4) from Torque Correlations (kips)[2]	74.7/37.4	58.1/29.1	89.0/44.5	69.3/34.6

For **SI:** 1 foot = 0.305 m, 1 lbf = 4.448 N, 1 lbf-ft = 1.356 N-m.

[1]Soil capacity (P4) must be determined per Section 4.1.5 of this report.
[2]Maximum ultimate soil capacity is determined from $P_{ult} = K_t \times T$ based on the corresponding maximum installation torque rating for the specific pile model. Allowable soil capacity is determined from $Pa = P_{ult}/2.0$ based on the corresponding maximum installation torque rating for the specific pile model. See Section 4.1.5 for additional information.
[3]Mechanical torsion rating is the maximum torsional resistance of the steel shaft.
[4]Maximum Torque Per Soil Tests is the maximum torque achieved during field axial verification testing that was conducted to verify the pile axial capacity related to pile-soil interaction.
[5]Maximum Installation Torque rating is the lower of the "mechanical torsion rating" and the "maximum torque per soil tests".

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Engineering Bents

Bents Vertical Pier Brackets

278BWB8.75x8x38BG Brackets Allowable capacity = 35 kips per attached manufacturer cut sheet

35 kips = 35 kips Required OK

Bents Vertical Piers

Using pier 2 7/8" OD x 0.203" with a single 12" Helix

Top 10-ft of pier to have 3.5"x0.216" wall increased section to resist buckling through the unsupported length.

Geo-Hydro Project report Number 181281.20 dated May 10th, 2019 has SPT minimum blow counts of 3. However, with the exception of boring B-16 all the borings with SPT values less than 5 are all located at the windward parkway road crossing. The windward road crossing section is not a helical piered section. Boring B-16 is located near the boardwalk abutments and not the boardwalk bents. The minimum 1,500 fps seismic wave velocity corresponds to SPT values greater than 5 using "Guidelines for Estimation of Shear Wave Velocity Profiles" dated December 2012 and issued by the Pacific Earthquake Engineering Research center.

With SPT values of 5 or greater the ground is classified as firm for pier shaft bracing per section 3.11.2.1 of AC358 with effective date of July 1st, 2007.

Pier shafts are in air for 8" to 3' max. per detail 1/S501. Increasing to 4' max in air with concrete bent cap changing to steel bent cap.

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Pier shafts become braced 5 feet into firm soils per Section 1810.2.1 of the 2012 IBC.

Therefore, unbraced shaft length, Lu is 9' = 5' Firm soil + 4' in Air.

See Attachment A for 2 7/8" OD x 0.203" pier check.
Minimum torque to be 7,800 ft-lbs per Attachment A.

See Attachment B for buckling check of the unsupported pier length.

<u>Bents Vertical Pier Bearing Plates</u>
12" Helix plate = 39.7 kips > 35 kips Required OK

From ESR-3750

TABLE 4A—HELICAL BEARING PLATE CAPACITY (P3) FOR $2^{7}/_{8}$-INCH HELICAL PILES[1,2,3]

HELIX DIAM. (IN)	SHAFT TYPE	HELIX THICKNESS (IN)	HELIX PITCH (IN)	ALLOWABLE CAPACITY[3] (P3) (KIPS)
8	2.875-inch (0.203-inch wall and 0.276-inch wall)	0.5	3.0	59.7
10	2.875-inch (0.203-inch wall and 0.276-inch wall)	0.5	3.0	49.3
12	2.875-inch (0.203-inch wall and 0.276-inch wall)	0.5	3.0	39.7
14	2.875-inch (0.203-inch wall and 0.276-inch wall)	0.5	3.0	48.0

For **SI:** 1 inch = 25.4 mm, 1 kip = 4.448 kN.
[1]For helical piles with more than one helix, the allowable helix capacity, P3, for the helical foundation systems, may be taken as the sum of the least allowable capacity of each individual helix.
[2]As described in Section 3.2.2 of this report, all helical bearing plates are made from same material, and have the same edge geometry, thickness and pitch.
[3]Allowable capacities are based on bare steel losing 0.036-inch (318 µm) steel thickness as indicated in Section 3.9 of AC358 for a 50-year service life.

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Engineering Cross Brace Bracket

Cross Brace Brackets
IDL-TBA-CPLG
$A_b = 0.606\ in^2$
$F_n = 120$ ksi A449 Grade 5
$R_n = 120\ ksi \times 0.606\ in^2 / 2 = 72\ kips > 10\ kips$ Required OK

Cross Brace Piers
Using pier 2 3/8" OD x 0.154" with a 10-12x3/8" Helix Configuration

The top 10-ft of brace pier are to have 2 7/8"x0.203" wall increased section to resist buckling through the unsupported length.

Geo-Hydro Project report Number 181281.20 dated May 10th, 2019 has SPT minimum blow counts of 3. However, with the exception of boring B-16 all the borings with SPT values less than 5 are all located at the windward parkway road crossing. The windward road crossing section is not a helical piered section. Boring B-16 is located near the boardwalk abutments and not the boardwalk bents. The minimum 1,500 fps seismic wave velocity along the boardwalk sections correspond to SPT values greater than 5 using "Guidelines for Estimation of Shear Wave Velocity Profiles" dated December 2012 and issued by the Pacific Earthquake Engineering Research center.

With SPT values of 5 or greater the ground is classified as firm for pier shaft bracing per section 3.11.2.1 of AC358 with effective date of July 1st, 2007.

Pier shafts are in air for 8" to 3' max. per detail 1/S501. Increasing to 4' max in air with concrete bent cap changing to steel bent cap.

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Pier shafts become braced 5 feet into firm soils per Section 1810.2.1 of the 2012 IBC.

Therefore, unbraced shaft length, Lu is 9' = 5' Firm soil + 4' in Air.

See Attachment A for 2 3/8" OD x 0.154" pier and helix plate checks. Minimum torque to be 2,360 ft-lbs per Attachment A.

Buckling check of the unsupported pier length.
Pier Shaft allowable capacity = 10.4 kips per ESR-3750 table 3A
10.4 kips > 10 kips Required OK

From ESR-3750

TABLE 3A—SHAFT ALLOWABLE CAPACITY (P2) FOR $2^7/_8$–INCH-DIAMETER PILE WITH COUPLER ECCENTRICITY[3,4,5] (kips)

SHAFT TYPE	UNBRACED SHAFT LENGTH, L_u (FT) [1]	(P2) ALLOWABLE CAPACITY (KIPS) FOR $2^7/_8$-INCH DIAMETER SHAFTS					
		COMPRESSION (KIPS)			TENSION (KIPS)	LATERAL SHEAR (KIPS)	BENDING MOMENT (KIPS-FT)
		0 Coupler	1 Coupler[2]	2 Couplers[2]			
$2^7/_8$-inch OD (0.203-inch wall thickness)	0	60.0	40.4	19.7	23.6	13.3	4.41
	5	25.4	20.8	13.5			
	10	11.4	10.4	8.2			
$2^7/_8$-inch OD (0.276-inch wall thickness)	0	60.0	60.0	30.3	34.1	18.6	6.05
	5	35.1	29.6	20.0			
	10	15.4	14.3	11.6			

For **SI:** 1 inch = 25.4 mm; 1 ft = 0.305 m; 1 kip (1000 lbf) = 4.48 kN.

[1] L_u=Total unbraced pile length per 2015, 2012 and 2009 IBC Section 1810.2.1 and 2006 IBC Section 1808.2.9.2, including the length in air, water or in fluid soils, and the embedment length into firm or soft soil (non-fluid soil). k = Effective length factor. kLu = total effective unbraced length of the pile, where kLu = 0 represent a fully braced condition in that the total pile length is fully embedded in firm or soft soil and the supported structure is braced in accordance 2015, 2012 and 2009 IBC Section 1810.2.2 (Section 1808.2.5 of the 2006 IBC).
[2] Number of couplings within L_u
[3] The capacities shown in Table 3A are for $2^7/_8$-inch-diameter pilings installed with a maximum 1 degree of inclination and the assumption that the pile shaft is concentrically loaded.
[4] Capacities based on two ¾-inch bolts with matching nuts installed complying with Section 3.3.6. The bolt threads are excluded from the connection shear plane.
[5] Allowable capacities are based on bare steel losing 0.036-inch (318 µm) steel thickness as indicated in Section 3.9 of AC358 for a 50-year service life.

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Conclusions

- Contact engineering if SPT values along the boardwalk sections drop below 5 blows / foot i.e. are soft per AC358.
- Install piers described below to exceed the minimum torques specified below per the manufacturer product literature.

Abutments

38 kip piers

2 7/8”x 0.276” with IDL-NCB-8x8.75 bracket
Modified with welded 3/4”x8” H.S.
Minimum Installed Torque 8,445 ft-lbs

35 kip piers

2 7/8”x 0.203” with IDL-NCB-8x8.75 bracket
Modified with welded 3/4”x8” H.S.
Minimum Installed Torque 7,778 ft-lbs

12 kip piers

2 7/8”x0.203” with IDL-NCB-8x8.75 bracket
Modified with welded 3/4”x8” H.S.
Minimum Installed Torque 2,667 ft-lbs

Bent Vertical 35 Kip Piers

Top 10-ft to be 3.5”x0.216” with 350BWB8.75x8x38BG bracket
Rest of pier 2 7/8” OD x 0.203” with single 12” helix plate
Minimum Installed Torque 7,800 ft-lbs

Cross Brace ±10 kip Piers

Top 10-ft to be 2 7/8”x0.203” with 238TBACS12G bracket
Rest of pier 2 3/8” x 0.154”
Minimum Installed Torque 2,360 ft-lbs

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PIER CUT SHEETS

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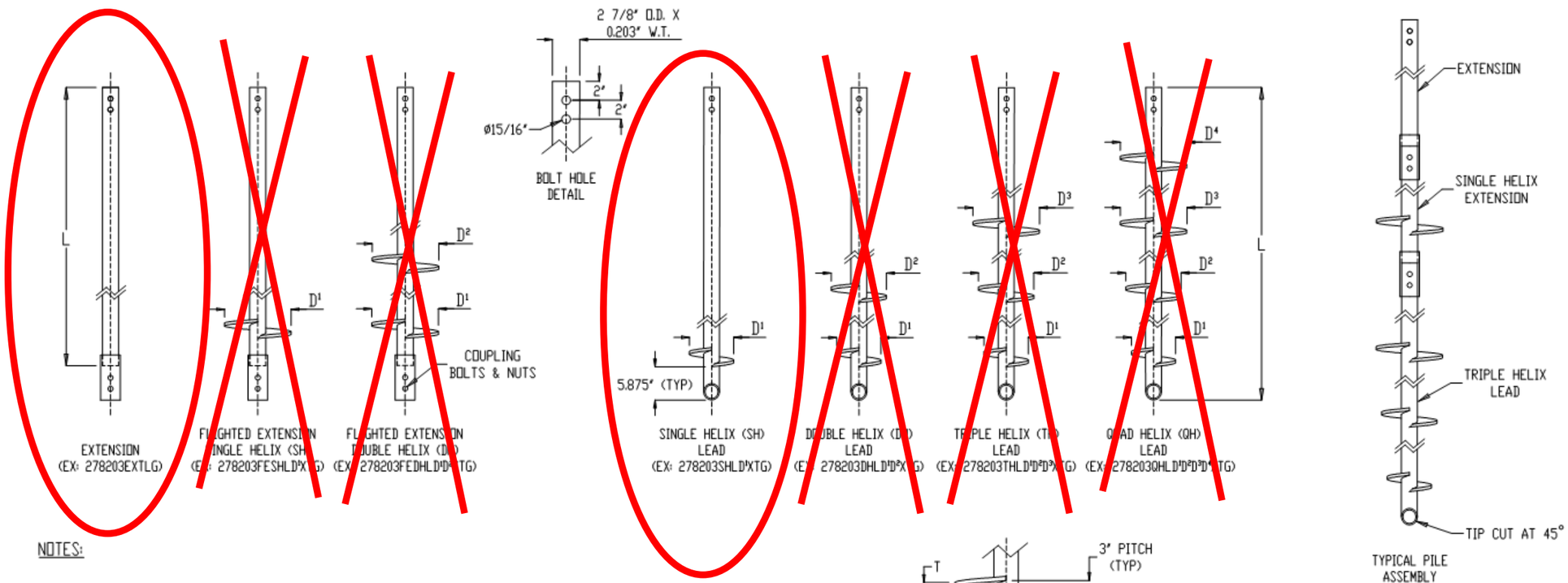
MAXIMUM TORQUE NOT TO EXCEED 8,000 FT LBS.
ULTIMATE CAPACITY IS 72 KIPS BASED ON A CAPACITY TO TORQUE RATIO OF K_t = 9 ft^{-1}.

2 7/8" O.D. X 0.203" W.T. HELICAL LEADS & EXTENSIONS
ICC-ES AC358 - REPORT #ESR-3750



NOTES:

1. SHAFT TO MEET OR EXCEED REQUIREMENTS OF ASTM A500, 80 KSI.
2. HELIX TO MEET OR EXCEED REQUIREMENTS OF ASTM A572/A1018/A656, 50 KSI.
3. ALL HELICES ARE FORMED BY PRESS DIE. LEADING EDGE OF HELICES ARE TAPERED TO IMPROVE INSTALLATION CAPABILITIES.
4. HELIX SPACING IS THREE (3) TIMES THE DIAMETER OF THE LOWER HELIX. SPACING OF LEADING HELIX ON FLIGHTED EXTENSIONS IS THREE (3) TIMES THE DIAMETER OF THE LAST HELIX ON THE PRECEEDING SHAFT.
5. STANDARD HELIX DIAMETERS ARE 8", 10", 12", & 14". STANDARD HELIX THICKNESS IS 3/8" OR 1/2".
6. ALL WELDING TO BE PERFORMED BY SHOP QUALIFIED WELDORS TO AWS D1.1 STRUCTURAL WELDING CODE - STEEL.
7. HOT DIP GALVANIZING PER ASTM A153/ASTM A123.
8. (2) 3/4" DIAMETER X 4 1/2" LONG GALVANIZED HEAVY HEX BOLT PER ASTM A325 AND (2) 3/4" GALVANIZED HEAVY HEX NUT PER ASTM A194 (GRADE 2H).
9. HELICAL PILE ASSEMBLIES MANUFACTURED IN ACCORDANCE WITH ICC-ES AC358 (IDEAL REPORT #ESR-3750) ACCEPTANCE CRITERIA FOR HELICAL FOUNDATION SYSTEMS AND DEVICES.

IDEAL PART # ABREVIATIONS:
278 = SHAFT DIAMETER
203 = SHAFT WALL THICKNESS
EXT = EXTENSION
FE = FLIGHTED EXTENSION
SH, DH, TH, QH = SINGLE, DOUBLE, TRIPLE, OR QUAD. HELIX
L = SHAFT LENGTH IN FEET (EXAMPLE: 7' = 7)
D = HELIX DIAMETER(S) IN INCHES (EXAMPLE: 10" = 10)
X = X (SEPARATES HELIX DIAMETER(S) AND HELIX THICKNESS)
T = HELIX THICKNESS (EXAMPLE: 1/2" = 12)
G = GALVANIZED

IDEAL Group

DRAWING NO.			
278203	IDEAL MANUFACTURING, INC. 808 PICTURE PARKWAY WEBSTER, NY 14580 800-789-4810		
DRAWN BY: DSS	DATED: 6/30/17	Rev	DO NOT SCALE DRAWING	SHEET 1 OF 1

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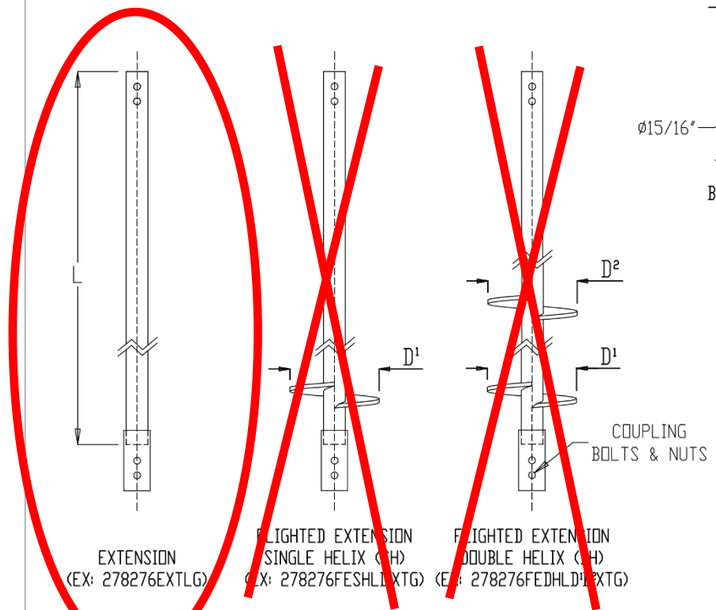
MAXIMUM TORQUE NOT TO EXCEED 10,000 FT LBS.
ULTIMATE CAPACITY IS 90 KIPS BASED ON A CAPACITY TO TORQUE RATIO OF K_t = 9 ft^{-1}.

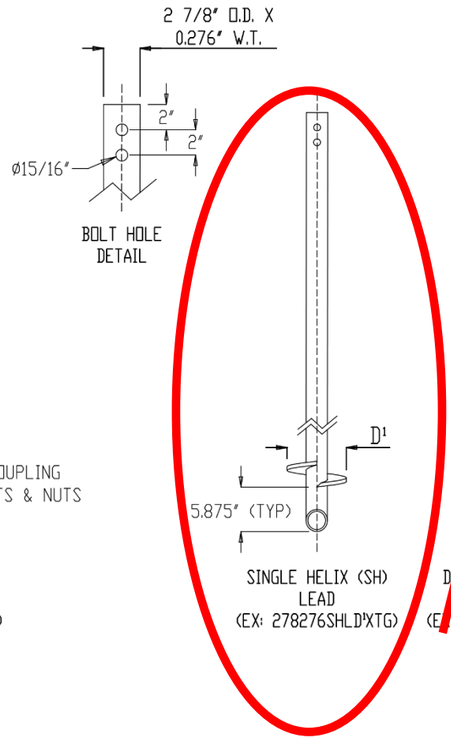
2 7/8" O.D. X 0.276" W.T. HELICAL LEADS & EXTENSIONS
ICC-ES AC358 - REPORT #ESR-3750



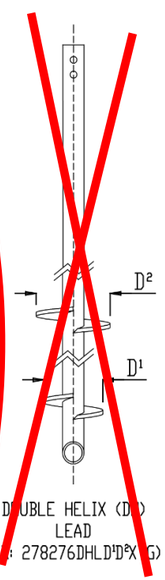
EXTENSION
(EX: 278276EXTLG)

FLIGHTED EXTENSION
SINGLE HELIX (SH)
(EX: 278276FESHLD1XTG)

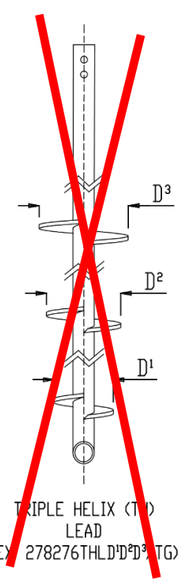
FLIGHTED EXTENSION
DOUBLE HELIX (DH)
(EX: 278276FEDHLD1D2XTG)



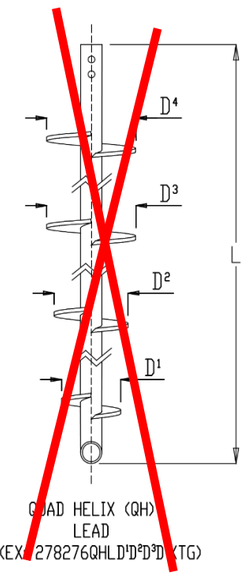
SINGLE HELIX (SH)
LEAD
(EX: 278276SHLD1XTG)



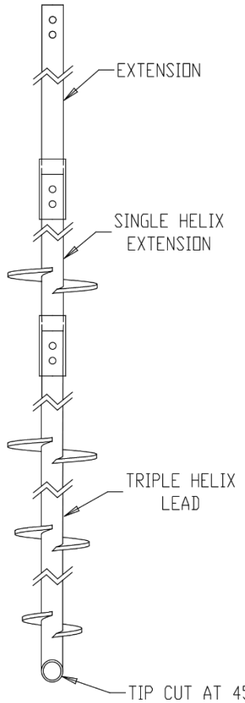
DOUBLE HELIX (DH)
LEAD
(EX: 278276DHLD1D2XTG)



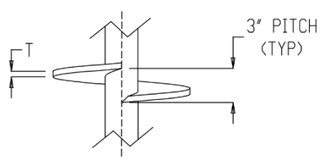
TRIPLE HELIX (TH)
LEAD
(EX: 278276THLD1D2D3XTG)



QUAD HELIX (QH)
LEAD
(EX: 278276QHLD1D2D3D4XTG)



TYPICAL PILE
ASSEMBLY



HELIX FORMED BY
PRESS DIE

NOTES:

1. SHAFT TO MEET OR EXCEED REQUIREMENTS OF ASTM A500, 80 KSI.
2. HELIX TO MEET OR EXCEED REQUIREMENTS OF ASTM A572/A1018/A656, 50 KSI.
3. ALL HELICES ARE FORMED BY PRESS DIE. LEADING EDGE OF HELICES ARE TAPERED TO IMPROVE INSTALLATION CAPABILITIES.
4. HELIX SPACING IS THREE (3) TIMES THE DIAMETER OF THE LOWER HELIX. SPACING OF LEADING HELIX ON FLIGHTED EXTENSIONS IS THREE (3) TIMES THE DIAMETER OF THE LAST HELIX ON THE PRECEEDING SHAFT.
5. STANDARD HELIX DIAMETERS ARE 8", 10", 12", 14". STANDARD HELIX THICKNESS IS 1/2".
6. ALL WELDING TO BE PERFORMED BY SHOP QUALIFIED WELDORS TO AWS D1.1 STRUCTURAL WELDING CODE - STEEL.
7. HOT DIP GALVANIZING PER ASTM A153/ASTM A123.
8. (2) 3/4" DIAMETER X 4 1/2" LONG GALVANIZED HEAVY HEX BOLT PER ASTM A325 AND (2) 3/4" GALVANIZED HEAVY HEX NUT PER ASTM A194 (GRADE 2H).
9. HELICAL PILE ASSEMBLIES MANUFACTURED IN ACCORDANCE WITH ICC-ES AC358 (IDEAL REPORT #ESR-3750) ACCEPTANCE CRITERIA FOR HELICAL FOUNDATION SYSTEMS AND DEVICES.

IDEAL PART # ABREVIATIONS:
278 = SHAFT DIAMETER
276 = SHAFT WALL THICKNESS
EXT = EXTENSION
FE = FLIGHTED EXTENSION
SH, DH, TH, QH = SINGLE, DOUBLE, TRIPLE, OR QUAD. HELIX
L = SHAFT LENGTH IN FEET (EXAMPLE: 7' = 7)
D = HELIX DIAMETER(S) IN INCHES (EXAMPLE: 10" = 10)
X = X (SEPARATES HELIX DIAMETER(S) AND HELIX THICKNESS)
T = HELIX THICKNESS (EXAMPLE: 1/2" = 12)
G = GALVANIZED

IDEAL Group

DRAWING NO.	IDEAL MANUFACTURING, INC.
278276	966 PICTURE PARKWAY WEBSTER, NY 14580 800-789-4810
DRAWN BY: DSS / DATE: 05/30/17 / Rev:	DO NOT SCALE DRAWING / SHEET 1 OF 1

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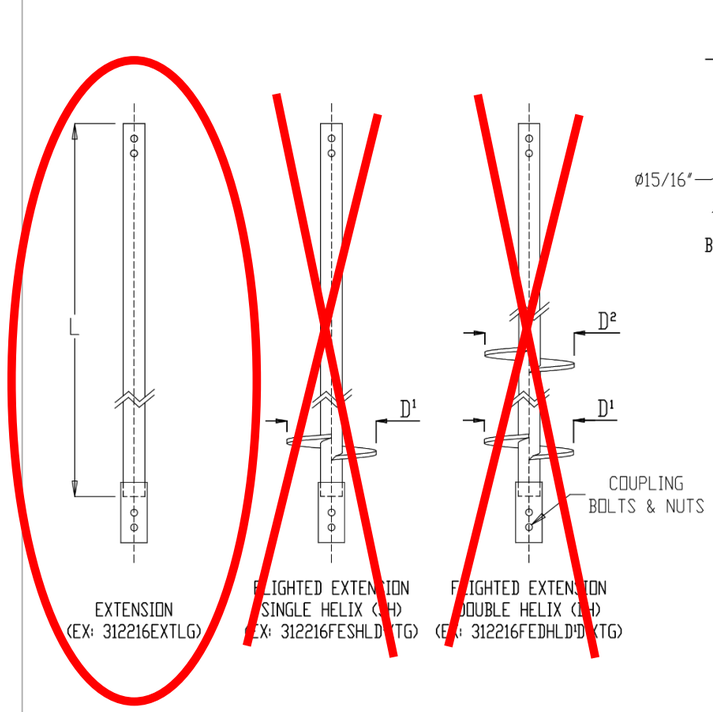
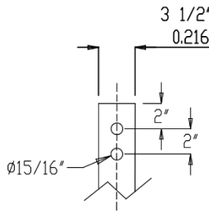
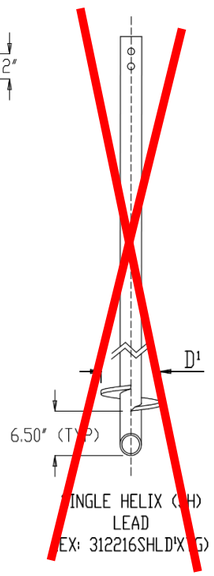
ofc. 678.290.1325 fax 770.956.7403 www.esogrepair.com

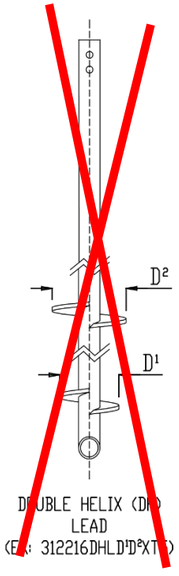
MAXIMUM TORQUE NOT TO EXCEED 13,000 FT LBS.
ULTIMATE CAPACITY IS 91 KIPS BASED ON A CAPACITY TO TORQUE RATIO OF K_t = 7 ft^{-1}.

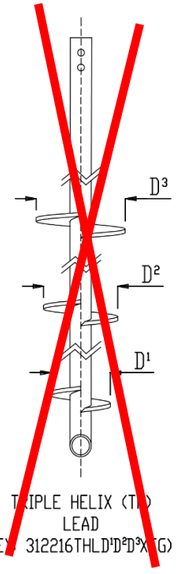
3 1/2" O.D. X 0.216" W.T. HELICAL LEADS & EXTENSIONS
ICC-ES AC358 - REPORT #ESR-3750

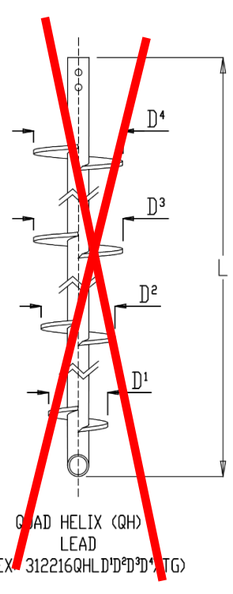


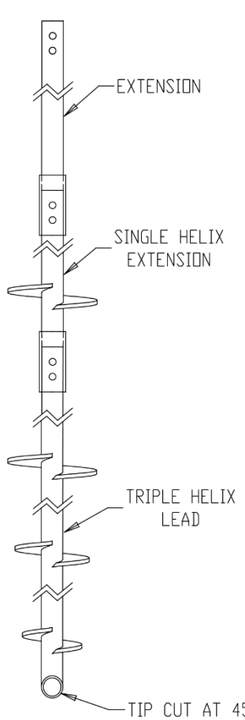




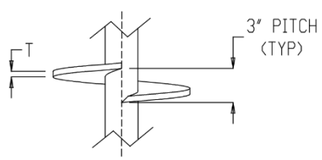








TYPICAL PILE ASSEMBLY



HELIX FORMED BY PRESS DIE

NOTES:

1. SHAFT TO MEET OR EXCEED REQUIREMENTS OF ASTM A500, 80 KSI.
2. HELIX TO MEET OR EXCEED REQUIREMENTS OF ASTM A572/A1018/A656, 50 KSI.
3. ALL HELICES ARE FORMED BY PRESS DIE. LEADING EDGE OF HELICES ARE TAPERED TO IMPROVE INSTALLATION CAPABILITIES.
4. HELIX SPACING IS THREE (3) TIMES THE DIAMETER OF THE LOWER HELIX. SPACING OF LEADING HELIX ON FLIGHTED EXTENSIONS IS THREE (3) TIMES THE DIAMETER OF THE LAST HELIX ON THE PRECEEDING SHAFT.
5. STANDARD HELIX DIAMETERS ARE ~~8", 10", 12", & 14"~~. STANDARD HELIX THICKNESS IS 3/8" OR 1/2".
6. ALL WELDING TO BE PERFORMED BY SHOP QUALIFIED WELDORS TO AWS D1.1 STRUCTURAL WELDING CODE - STEEL.
7. HOT DIP GALVANIZING PER ASTM A153/ASTM A123.
8. (2) 3/4" DIAMETER X 5 1/2" LONG GALVANIZED HEAVY HEX BOLT PER ASTM A325 AND (2) 3/4" GALVANIZED HEAVY HEX NUT PER ASTM A194 (GRADE 2H).
9. HELICAL PILE ASSEMBLIES MANUFACTURED IN ACCORDANCE WITH ICC-ES AC358 (IDEAL REPORT #ESR-3750) ACCEPTANCE CRITERIA FOR HELICAL FOUNDATION SYSTEMS AND DEVICES.

IDEAL PART # ABREVIATIONS:
312 = SHAFT DIAMETER
216 = SHAFT WALL THICKNESS
EXT = EXTENSION
FE = FLIGHTED EXTENSION
SH, DH, TH, QH = SINGLE, DOUBLE, TRIPLE, OR QUAD. HELIX
L = SHAFT LENGTH IN FEET (EXAMPLE: 7' = 7)
D = HELIX DIAMETER(S) IN INCHES (EXAMPLE: 10" = 10)
X = X (SEPARATES HELIX DIAMETER(S) AND HELIX THICKNESS)
T = HELIX THICKNESS (EXAMPLE: 1/2" = 12)
G = GALVANIZED

IDEAL Group

DRAWING NO.	IDEAL MANUFACTURING, INC. 999 PICTURE PARKWAY WEBSTER, NY 14580 800-789-4810	
312216		
DRAWN BY: DSS	DATE: 06/26/17	Rev:
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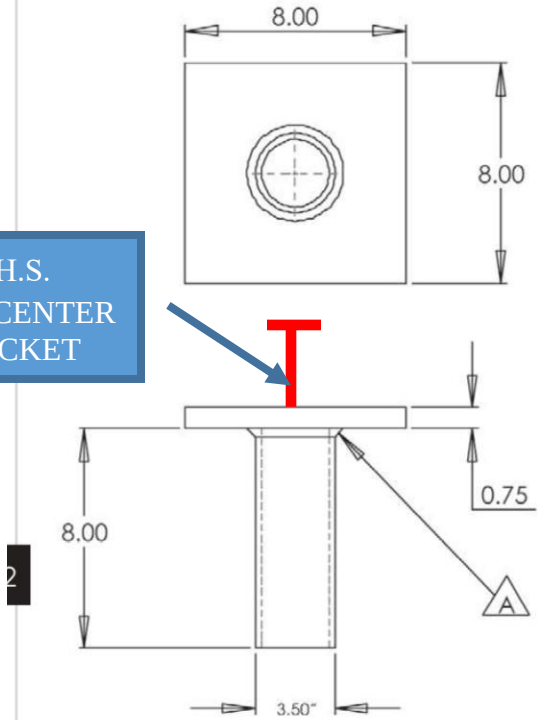
3/4"Ø x8" H.S.
WELDED TO CENTER
OF EA BRACKET

NEW CONSTRUCTION BRACKET 8x8x3/4"

PART #: IDL - NCB-8x8.75



5/16" ANSI/AWS W320/W321

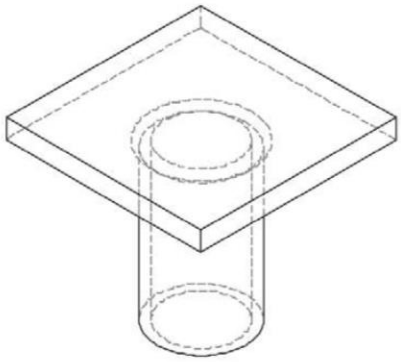
NOTES:

1) STRUCTURAL INTEGRITY OF PLATE TO CONFORM TO ASTM A36 AND CSA STANDARD W47.1

2) SHAFT TO EXCEED REQUIREMENTS ASTM A252

3) ALL WELDING TO BE PERFORMED BY SHOP QUALIFIED WELDER TO LATEST CSA STANDARD W59/ANSI A2.4-79 STANDARDS

4) BY IDEAL MANUFACTURING INC. 1-800-789-4810



IDEAL FOUNDATION SYSTEMS

IDEAL MANUFACTURING INC.
999 FICTURE PARKWAY
WEBSTER N.Y. 14580

	NAME	DATE
DRAWN	MEL	12/5/2005
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		
PROJECT:		

MATERIAL --
FINISH --
DO NOT SCALE DRAWING

SIZE A | DWG. NO. | REV.
SCALE:1:5 | WEIGHT: | SHEET 1 OF 1

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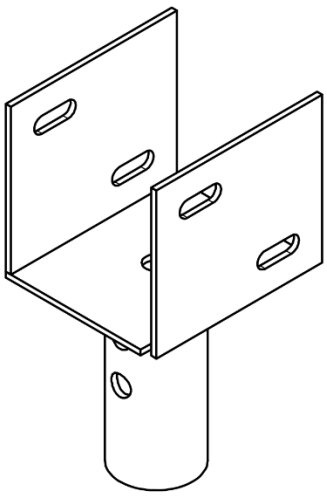
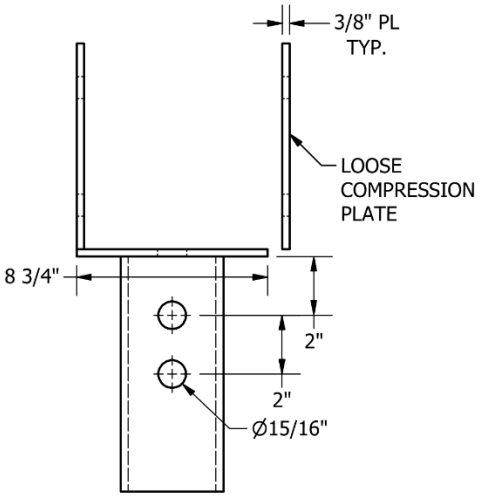
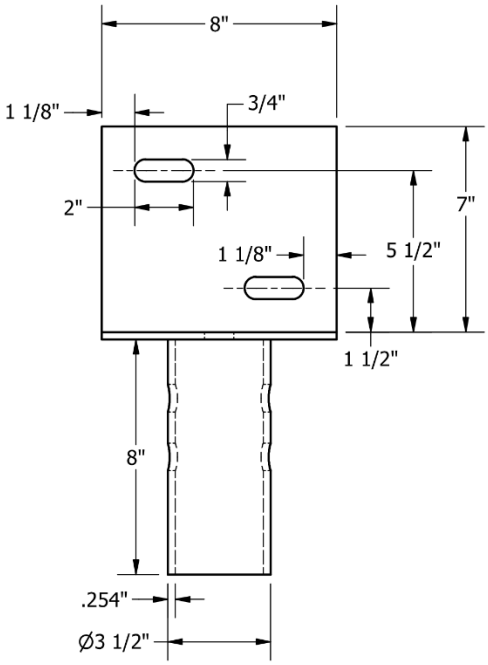
ofc. 678.290.1325 fax 770.956.7403 www.esogrepair.com

NOTES:
1. SLEEVE TO MEET OR EXCEED 65 KSI.
2. PLATE STEEL TO MEET OR EXCEED REQUIREMENTS OF ATSM A572, GRADE 50.
3. CAP SLEEVE TO FIT OVER 2 7/8" O.D. PILE.
4. ALL WELDING TO BE PERFORMED BY CERTIFIED WELDOR IN ACCORDANCE WITH AWS D1.1 STRUCTURAL WELDING CODE - STEEL.
5. SLOT PATTERN TO MATCH OPPOSITE PLATE.
6. ASSEMBLY TO BE HOT DIP GALVANIZED.
7. (2) 3/4" DIAMETER GALVANIZED HEAVY HEX BOLT A325 AND (2) 3/4" GALVANIZED HEX NUT TO BE INCLUDED.
8. ALLOWABLE COMPRESSION CAPACITY OF BRACKET IS 35 KIPS.



IDEAL TO MODIFY FOR
3.5"X0.216" PIERS





DRAWN BTJ 1/27/2020	IDEAL Group			PROPRIETARY AND CONFIDENTIAL
CHECKED LRS 1/27/2020				THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF IDEAL MANUFACTURING, INC. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT WRITTEN PERMISSION OF IDEAL MANUFACTURING, INC. IS PROHIBITED.
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NOT TO SCALE	SIZE A	DWG NO 278BWB8.75X8X38BG	REV 0	SHEET 1 OF 1

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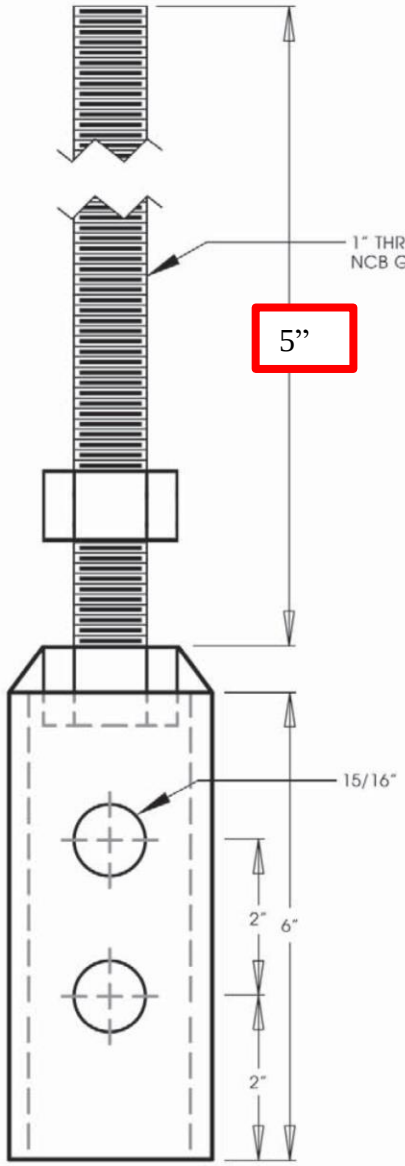
TIE BACK ADAPTER - SHAFT COUPLING

PART #: IDL - TBA-CPLG



NOTES:

1) COUPLER TO EXCEED REQUIREMENTS TO MINIMUM YIELD STRENGTH OF 55 KSI AND MINIMUM TENSILE STRENGTH OF 75 KSI

2) HARDWARE TO BE SAE J 429 GRADE 5 MINIMUM (2) 3/4"x5" PLATED WITH NUTS

3) ALL WELDING TO BE PERFORMED BY SHOP QUALIFIED WELDER TO LATEST CSA STANDARD W59/ANSI A2.4-79 STANDARDS

4) AWS D1.1 STRUCTURAL WELDING CODE - STEEL

5) GALVANIZING PER CSA G164-M/ASTM A 153/ASTM A123

6) BY IDEAL MANUFACTURING INC. 1 -800-789-4810

IDEAL FOUNDATION SYSTEMS

IDEAL MANUFACTURING INC.
999 PICTURE PARKWAY
WEBSTER N.Y. 14580

	NAME	DATE
DRAWN	MEL	11/29/2005
CHECKED		
ENG APPR.		
MFG APPR.		
Q.A.		
PROJECT:		

MATERIAL --
FINISH --
DO NOT SCALE DRAWING

SIZE A | DWG. NO. | REV.
SCALE:1:50 WEIGHT: SHEET 2 OF 2

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ofc. 678.290.1325 fax 770.956.7403 www.esogrepair.com

Attachment A

Preliminary design from Ideal Manufacturing, Inc.

Preliminary Design Prepared For:
Southeast Helical

Project:
Big Creek Greenway

Helical Pile
Foundation System

Ideal Manufacturing, Inc.
999 Picture Parkway
Webster, New York 14580
Tel: 1.800.789.4810
www.idl-grp.com

February 26, 2020

Included in Preliminary Design:

Vertical Piles (70k Ult.):
Preliminary Design Summary & Notes (1 Page)
Helical Pile Analysis (17 Pages)

Battered Piles (20k Ult.):
Preliminary Design Summary & Notes (1 Page)
Helical Pile Analysis (20 Pages)

Manufacturer Drawing (2 Pages)

PRELIMINARY DESIGN SUMMARY - VERTICAL PILES

Production Piles: 2 7/8” O.D. x 0.203” W.T. with a 10-12-14 X 3/8” Helix Configuration

The top 10-ft of the vertical piles are to have a 3.5" x .216 wall increased diameter top to resist buckling through the unsupported length.

Allowable geotechnical loads (FS=2):

- Compression: 35 Kips
- It is understood that the piles are not subject to tension or lateral loads at this project site.

PRELIMINARY DESIGN NOTES

- Preliminary design is based upon the loads and soil borings provided by SEH.
- Pile cutoff elevation (PCOE) is understood to be 4-ft above grade. Approximate pile length is 31-ft from PCOE.
- Contractor to verify pile count and PCOE.
- Required minimum installation torque (average torque over final 3-ft of installation) is 7,800 ft*lbs. Piles may need to be installed beyond the specified depth to achieve required torque.
- Torque not to exceed 8,000 ft*lbs.

HELIXPILE 2020: Report Output

Project: Big Creek Greenway

Company: IDEAL Manufacturing
Prepared by engineer: BTJ
File number: 1
Time: 2/26/2020 5:25:34 PM

File: D:\brett.johnson\Ideal Group\Design Team - Documents\DSN-SBMTL\SEH - Southeast Helical\2020 Designs\Big Creek Greenway\Preliminary Design - Big Creek Greenway - 02.24.20 - IDEAL.HELX

Project: Big Creek Greenway
Results for Design Section 0: 2 7/8"x.203" (10-12-14):
UL = 70k C

Analysis summary for design section: 2 7/8"x.203" (10-12-14): UL = 70k C

2 7/8"x.203" (10-12-14): UL = 70k C

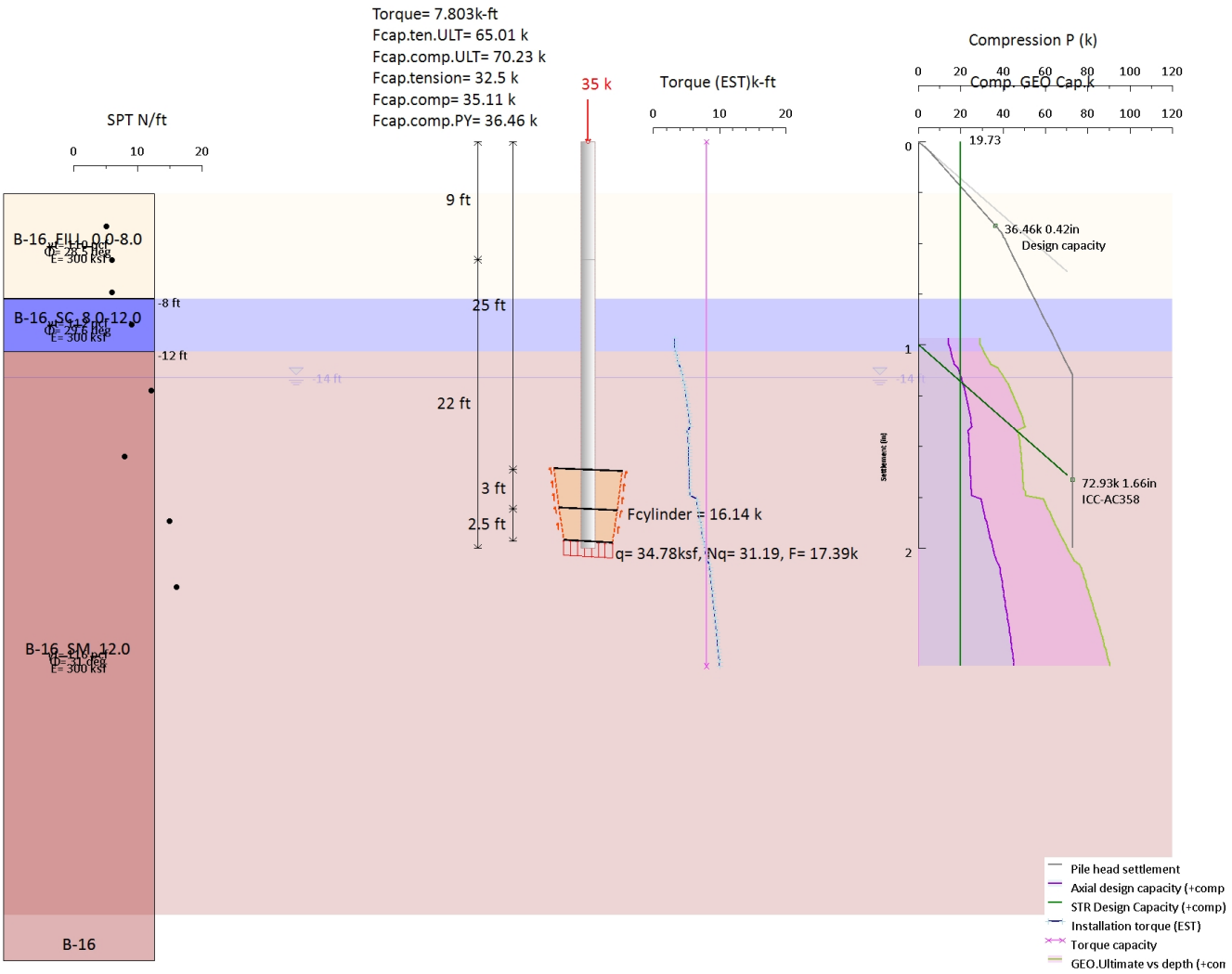


Table: Basic analysis assumptions Stage:Stage 0

Pile STR code	International Building Code 2015
Depth investigation	Max 40ft/0.25ft
Pile settlements P-y	Soil E, rM= 4, Aeff= 100%
PL install E factors	1/0.8/0.7/0.6
Steel Code: a= 0.5	AISC 360-10 ALL.
Concrete Code:	ACI 318-11/1.6
Ubraced length	5 ft+, k= 1
Drain State Clays	Default
Pile tip resistance	Included (plugged)
Bearing factors	Meyerhof/Hansen
Bearing equation	Helicap: Nc c' + Nq s'v
Bearing disturb reduce	1/0.8/0.7/0.6
Cylinder method	Mitsch-Clemence
Shaft friction	Ignored
Shaft/Cyl. Reduce c, αc	0.8, c1<= 1ksf, 0.5, c2<= 2ksf
Soil friction ΦSPT	PILOT database benchmark
Clays Su	Estimated from SPT
Soil elasticity	Estimated from SPT
Design life	75 years, ICC A358
FS bearing	2
FS shaft	2
Manufacturer	IDEAL Manufacturing
Helical pile	278203
Pile diameter O.D.	2.875 in
Helical plates	10S12S14S
Pile steel Area As	1.7 in^2
Yield strength shaft	136 k
Ultimate strength shaft	136 k
Zinc coated	4 mils
Torque cap. (yield)	8 k-ft

Table: Analysis summary for helical pile for critical stages

	Factored load	Factored load	CAP. compressi	CAP. tension	Structural cap.	LOAD/CAP	LOAD/CAP	LOAD/CAP
Critical	Compress. (k)	Tension (k)	GEO. (k)	GEO. (k)	(k)	RATIO	STRUCTURAL	GEOTECH
Stage	Stage 0	Stage 0	Stage 0	Stage 0	Stage 0	Stage 0	Stage 0	Stage 0
Stage 0	35	0	35.11	32.5	19.73	0.997	0	0.997

Table: Settlement analysis result summary

Stage	Ult. capacity	Settlement @ult. cap.	Design capacity	Settlement @des. cap.
Name	(k)	(in)	(k)	(in)
Stage 0	72.93	1.664	36.46	0.415

Table: Depth vs. capacity summary

Z	Q.Comp.Des	Q.Comp.Ult	Q.Tension.Des	Q.Tension.Ult	Est. Torque
(ft)	(k)	(k)	(k)	(k)	(k-ft)
15	14.39	29.23	11.16	22.33	3.25
15.25	14.39	29.23	11.16	22.33	3.25
15.5	14.39	29.23	11.16	22.33	3.25
15.75	14.79	30	11.58	23.17	3.33
16	15.18	30.77	12	24.01	3.42
16.25	15.57	31.54	12.42	24.85	3.5
16.5	15.97	32.32	12.85	25.69	3.59
16.75	16.49	33.34	13.27	26.54	3.7
17	16.9	34.14	13.69	27.38	3.79
17.25	18.58	37.54	14.14	28.28	4.17
17.5	19.07	38.5	14.62	29.23	4.28
17.75	19.56	39.46	15.1	30.2	4.38
18	20.05	40.43	15.58	31.16	4.49
18.25	20.54	41.39	16.07	32.15	4.6
18.5	21.04	42.35	16.57	33.13	4.71
18.75	21.43	43.12	17.06	34.12	4.79
19	21.78	43.8	18.88	37.77	4.87
19.25	22.12	44.45	19.35	38.71	4.94
19.5	22.46	45.1	19.82	39.64	5.01
19.75	22.8	45.74	20.29	40.57	5.08
20	23.14	46.38	20.75	41.49	5.15
20.25	23.48	47.01	21.2	42.41	5.22
20.5	23.81	47.64	21.66	43.32	5.29
20.75	24.13	48.26	22.11	44.22	5.36
21	24.44	48.87	22.56	45.11	5.43
21.25	24.74	49.48	23	46	5.5
21.5	24.86	49.72	23.44	46.88	5.52
21.75	25.16	50.31	23.88	47.76	5.59
22	23.36	46.73	24.27	48.54	5.19
22.25	23.56	47.11	24.62	49.25	5.23
22.5	23.74	47.49	24.97	49.94	5.28
22.75	23.87	47.74	27.08	54.16	5.3
23	23.97	47.94	27.38	54.75	5.33
23.25	24.07	48.13	27.66	55.32	5.35
23.5	24.15	48.3	27.94	55.88	5.37
23.75	24.23	48.46	28.21	56.41	5.38
24	24.3	48.6	28.46	56.93	5.4
24.25	24.36	48.73	28.58	57.15	5.41
24.5	24.43	48.85	28.69	57.37	5.43
24.75	24.49	48.98	28.79	57.59	5.44
25	24.55	49.09	28.9	57.8	5.45
25.25	24.6	49.21	29	58	5.47
25.5	24.66	49.32	29.1	58.2	5.48
25.75	24.71	49.42	29.2	58.4	5.49
26	24.76	49.52	29.29	58.59	5.5
26.25	24.81	49.62	29.39	58.77	5.51
26.5	24.85	49.71	29.48	58.96	5.52
26.75	25.27	50.53	29.57	59.13	5.61
27	25.31	50.62	29.65	59.31	5.62

27.25	29.52	59.04	29.82	59.64	6.56
27.5	29.84	59.67	27.23	54.45	6.63
27.75	30.19	60.37	27.58	55.15	6.71
28	30.54	61.08	27.93	55.86	6.79
28.25	30.9	61.8	28.29	56.58	6.87
28.5	31.26	62.52	28.65	57.3	6.95
28.75	31.63	63.26	29.02	58.04	7.03
29	32	64	29.39	58.78	7.11
29.25	32.38	64.75	29.76	59.53	7.19
29.5	32.75	65.51	30.14	60.29	7.28
29.75	33.14	66.28	30.53	61.06	7.36
30	33.53	67.05	30.92	61.83	7.45
30.25	33.92	67.84	31.31	62.61	7.54
30.5	34.31	68.63	31.7	63.4	7.63
30.75	34.71	69.42	32.1	64.2	7.71
31	35.11	70.23	32.5	65.01	7.8
31.25	35.52	71.04	32.91	65.82	7.89
31.5	35.93	71.86	33.32	66.64	7.98
31.75	36.41	72.81	33.74	67.47	8.09
32	36.83	73.65	34.15	68.31	8.18
32.25	37.92	75.85	34.59	69.18	8.43
32.5	38.38	76.76	35.04	70.08	8.53
32.75	38.66	77.33	41.18	82.37	8.59
33	38.9	77.79	41.45	82.89	8.64
33.25	39.13	78.26	41.71	83.42	8.7
33.5	39.36	78.72	41.97	83.94	8.75
33.75	39.59	79.19	42.23	84.47	8.8
34	39.83	79.66	42.5	85	8.85
34.25	40.06	80.13	42.76	85.52	8.9
34.5	40.3	80.59	43.03	86.05	8.95
34.75	40.53	81.07	43.29	86.58	9.01
35	40.77	81.54	43.56	87.12	9.06
35.25	41.01	82.01	43.82	87.65	9.11
35.5	41.24	82.48	44.09	88.18	9.16
35.75	41.48	82.96	44.36	88.71	9.22
36	41.72	83.43	44.62	89.25	9.27
36.25	41.96	83.91	44.89	89.79	9.32
36.5	42.19	84.39	45.16	90.32	9.38
36.75	42.43	84.87	45.43	90.86	9.43
37	42.67	85.35	45.7	91.4	9.48
37.25	42.91	85.83	45.97	91.94	9.54
37.5	43.15	86.31	46.24	92.48	9.59
37.75	43.37	86.74	47.43	94.86	9.64
38	43.57	87.15	47.67	95.34	9.68
38.25	43.78	87.56	47.91	95.82	9.73
38.5	43.98	87.97	48.15	96.3	9.77
38.75	44.19	88.38	48.39	96.78	9.82
39	44.39	88.78	48.63	97.25	9.86
39.25	44.6	89.19	48.87	97.73	9.91
39.5	44.8	89.6	49.1	98.21	9.96
39.75	45.01	90.01	49.34	98.68	10

40	45.21	90.42	49.58	99.16	10.05

Helical anchor section data

Section	Fy	Fu	Dp	tP	Ap	I	Sxx	Zxx	J	rx	Tel	Tpl	Qy	Qult	Numbe
Name	(ksi)	(ksi)	(in)	(in)	(in^2)	(in4)	(in3)	(in3)	(in4)	(in)	(k-ft)	(k-ft)	(k)	(k)	Helix
278203	80	120	2.88	0.2	1.7	1.53	1.06	1.5	3.1	0.95	8	8	136	136	3

Helical anchor: 278203, uses different plate sizes.

Plate	Dhel	Shel	Ahel	Qhel
Number	(in)	(ft)	(ft2)	(k)
1	10	2	0.5	100
2	12	2.5	0.74	100
3	14	3	1.024	100

Manufacturer: IDEAL Manufacturing
Torque rating method parameters for helical anchor.
Torque rating (by Manufacturer) Tel= 8 k-ft
Torque installation factor kT = 9/k
Fy=fyk = Characteristic yield strength for steel
Fu=fu = Ultimate steel strength
Dp = Shaft (pipe) diameter
tP = Shaft thickness (pipe thickness)
Ap = Effective shaft area (pipe area)
I = Shaft moment of inertia
Sxx = Shaft elastic section modulus
Zxx = Shaft plastic section modulus
J = Torsional moment of inertia for shaft
rx = Radius of gyration for shaft
Tel = Elastic torsional resistance for shaft
Tpl = Plastic torsional resistance for shaft
Qy = Yield tensile strength of shaft
Qult = Ultimate tensile strength of shaft
Dhel = Helix plate diameter
Shel = Horizontal helical plate spacing
Ahel = Effective helix area (used for bearing capacity calculations)
Qhel = Ultimate helix structural capacity in tension

Table: Helical pile analysis summary for all stages (Design values)

Paramete	Factored	Factored	Capacity	Capacity	Capacity	Comp.	Comp.	Tension	Tension	Settleme	Settleme	Settleme	Settleme
	Load	Load	GEO.	GEO.	Struct.	Cylinder	Plate	Cylinder	Plate	GEO.Ult	GEO.ult y	GEO.Des	GEO.Des
Stage	Comp. (k)	Tension (	Comp. (k)	Tension (	(k)	(k)	(k)	(k)	(k)	Comp. (k)	(in)	Comp. (k)	(in)
Stage 0	35	0	35.11	32.5	19.73	35.11	54.82	32.5	53.24	72.93	1.664	36.46	0.415

Table: Helical pile analysis summary for all stages (Ultimate values)

Parameter	Capacity	Capacity	Capacity	Comp.Ult	Comp.Ult	Tension.Ult	Tension.Ult
	GEO.Ult	GEO.Ult	Struct.Ult	Cylinder	Plate	Cylinder	Plate
Stage	Comp. (k)	Tension (k)	(k)	(k)	(k)	(k)	(k)
Stage 0	70.23	65.01	19.73	70.23	109.64	65.01	106.48

Table: Individual plate results stage for compression: Stage 0

Plate	Area	X	El.	Nspt	Φ	c' or Su	Nq	σ'v	Qult	QultTension
Number	(ft2)	(ft)	(ft)	/ft	(deg)	(psf)		(ksf)	(k)	(k)
3	1.024	0	-21	N/A	32.15	0	23.59	1.935	32.72	32.72
2	0.74	0	-24	N/A	34.53	0	31.411	2.096	38.98	38.98
1	0.5	0	-26.5	N/A	34.47	0	31.19	2.23	34.78	34.78
Tip	0.045	0	-27	N/A	34.46	0	31.147	2.257	3.17	3.17

Table: Corrosion loss results

	Design	Thickness loss	Thickness loss	Steel loss	Other
Stage	Life (years)	Protection (mils)	Steel (in)	%	Warning
Stage 0	75	4	0.04	17.7	N/A

SOIL BORINGS

Top Elev= superior SOil level
Soil type=type of the soil (sand , clay , etc)
OCR=overconsolidation ratio
K0=at rest coefficient

Name: B-16, pos: (50, 0)

Top elev.	Soil type	OCR	Ko
0	B-16_FILL_0.0-	1	0.52
-8	B-16_SC_8.0-1	1	0.51
-12	B-16_SM_12.0	1	0.48

Summary of loads on pile head

Summary of stage assumptions

Load: Live load, type: DL: Dead load (AASHTO DC)

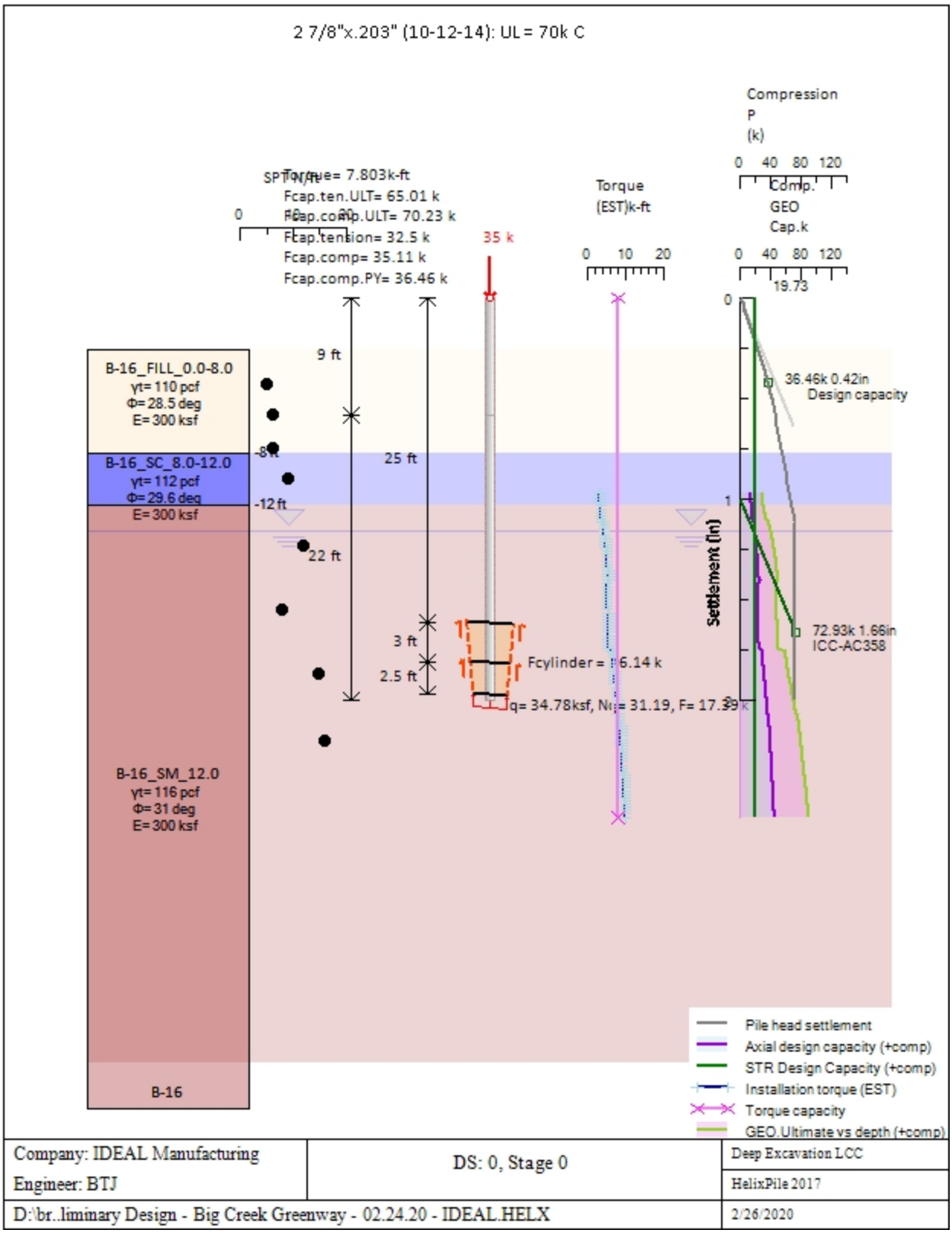
Table: Load Live load data

Stage	Load is	Axial load	F.xx	F.yy	M.xx	M.yy
Number	Active	(k)	(k)	(k)	(k-ft)	(k-ft)
0	Yes	35	0	0	0	0

Note: Positive loads = compression, Negative loads= Tension

MODEL STAGES

A sequence of figures for each excavation stage is reported


2 7/8"x.203" (10-12-14): UL = 70k C
SPT N/ft
0
20
Torque= 7.803k-ft
Fcap.ten.ULT= 65.01 k
Fcap.comp.ULT= 70.23 k
Fcap.tension= 32.5 k
Fcap.comp= 35.11 k
Fcap.comp.PY= 36.46 k
35 k
Torque
(EST)k-ft
0
10
20
Compression
P
(k)
0
40
80
120
Comp.
GEO
Cap.k
0
40
80
120
19.73
0
36.46k 0.42in
Design capacity
1
2
Settlement (in)
72.93k 1.66in
ICC-AC358
9 ft
25 ft
22 ft
3 ft
2.5 ft
Fcylinder = 16.14 k
q= 34.78ksf, N
= 31.19, F= 17.39 k
B-16_FILL_0.0-8.0
γt= 110 pcf
Φ= 28.5 deg
E= 300 ksf
-8 ft
B-16_SC_8.0-12.0
γt= 112 pcf
Φ= 29.6 deg
E= 300 ksf
-12 ft
B-16_SM_12.0
γt= 116 pcf
Φ= 31 deg
E= 300 ksf
B-16
Pile head settlement
Axial design capacity (+comp)
STR Design Capacity (+comp)
Installation torque (EST)
Torque capacity
GEO.Ultimate vs depth (+comp)
Company: IDEAL Manufacturing
Engineer: BTJ
DS: 0, Stage 0
Deep Excavation LCC
HelixPile 2017
D:\br..liminary Design - Big Creek Greenway - 02.24.20 - IDEAL.HELX
2/26/2020

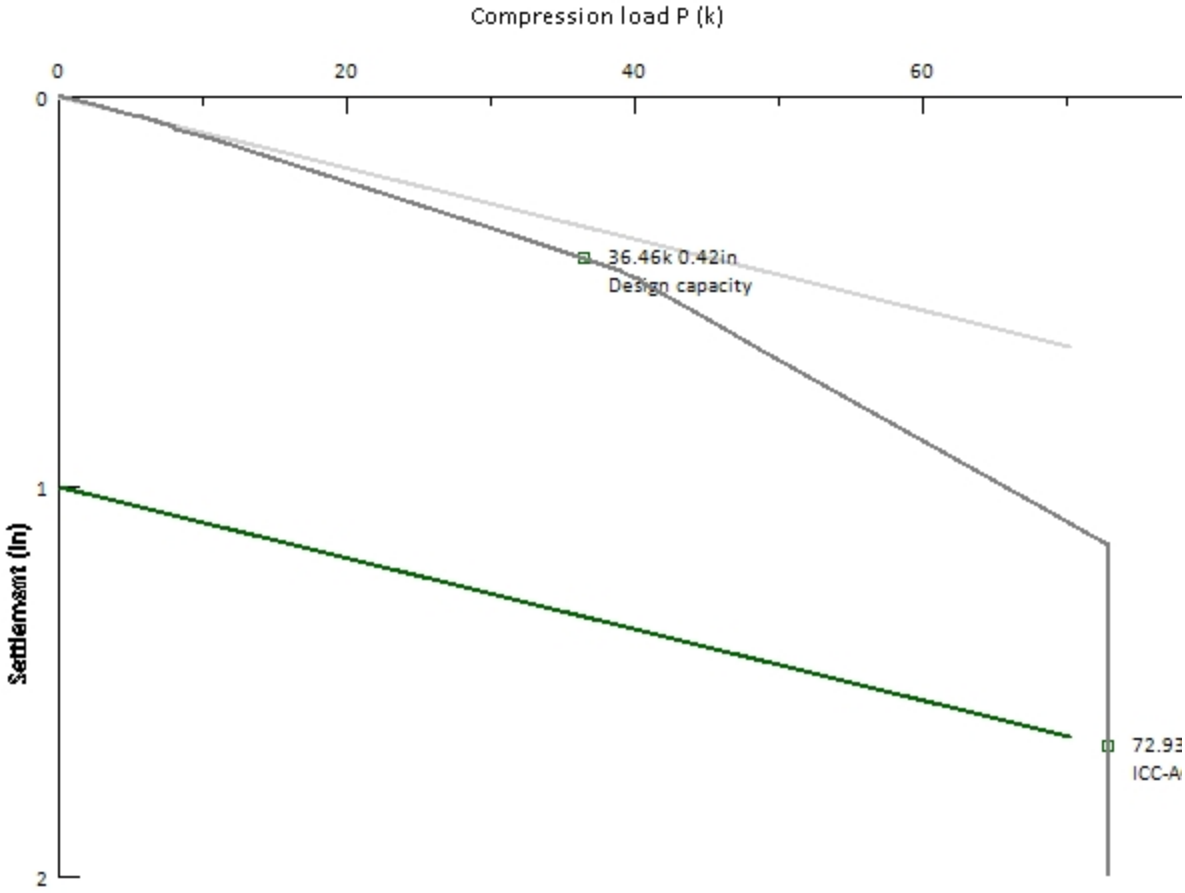
Summary of settlement acceptance criteria methods 2 7/8"x.203" (10-12-14): UL = 70k C

Stage	Elastic	ICC-AC358	ICC-AC358	ICC-AC358	ICC-AC358
Name	P method	Pult (k)	Yult (in)	Pdes (k)	Ydes (in)
Stage 0	N/A	72.93	1.664	36.46	0.415

Settlement response for helical pile, stage Stage 0

Point	Load P	Settlement y
	(k)	(in)
0	0	0
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	0	0
18	0	0
19	0	0
20	0	0
21	0	0
22	0	0
23	0	0
24	0	0
25	0	0
26	0	0
27	0	0
28	0	0
29	0.33	0.002
30	2.14	0.016
31	3.05	0.024
32	5.57	0.05
33	5.78	0.053
34	5.82	0.053
35	5.99	0.055
36	6.03	0.056
37	6.09	0.056
38	6.14	0.057
39	6.17	0.057
40	6.22	0.058
41	6.28	0.059
42	6.54	0.062
43	6.67	0.063

44	6.75	0.064
45	6.78	0.064
46	6.96	0.067
47	7.06	0.068
48	7.22	0.07
49	7.3	0.07
50	7.34	0.071
51	7.37	0.071
52	7.47	0.072
53	7.6	0.074
54	7.75	0.076
55	7.94	0.078
56	8.07	0.079
57	8.09	0.08
58	10.71	0.11
59	31.59	0.355
60	38.97	0.447
61	39.79	0.459
62	39.84	0.46
63	40.04	0.465
64	40.2	0.468
65	40.23	0.469
66	40.45	0.473
67	40.62	0.477
68	41.76	0.501
69	45.22	0.573
70	48.67	0.645
71	52.13	0.717
72	55.58	0.79
73	59.04	0.862
74	62.49	0.934
75	65.95	1.007
76	69.4	1.079
77	71.13	1.115
78	72.86	1.151
79	72.97	2



Support 0
Installation torque (estimate) design section: 0

Depth	Est. Torque	Design Comp.	Ultimate Com
(ft)	(k-ft)	(k)	(k)
15	3.25	14.39	29.23
15.25	3.25	14.39	29.23
15.5	3.25	14.39	29.23
15.75	3.33	14.79	30
16	3.42	15.18	30.77
16.25	3.5	15.57	31.54
16.5	3.59	15.97	32.32
16.75	3.7	16.49	33.34
17	3.79	16.9	34.14
17.25	4.17	18.58	37.54
17.5	4.28	19.07	38.5
17.75	4.38	19.56	39.46
18	4.49	20.05	40.43
18.25	4.6	20.54	41.39
18.5	4.71	21.04	42.35
18.75	4.79	21.43	43.12
19	4.87	21.78	43.8
19.25	4.94	22.12	44.45
19.5	5.01	22.46	45.1
19.75	5.08	22.8	45.74
20	5.15	23.14	46.38
20.25	5.22	23.48	47.01
20.5	5.29	23.81	47.64
20.75	5.36	24.13	48.26
21	5.43	24.44	48.87
21.25	5.5	24.74	49.48
21.5	5.52	24.86	49.72
21.75	5.59	25.16	50.31
22	5.19	23.36	46.73
22.25	5.23	23.56	47.11
22.5	5.28	23.74	47.49
22.75	5.3	23.87	47.74
23	5.33	23.97	47.94
23.25	5.35	24.07	48.13
23.5	5.37	24.15	48.3
23.75	5.38	24.23	48.46
24	5.4	24.3	48.6
24.25	5.41	24.36	48.73
24.5	5.43	24.43	48.85
24.75	5.44	24.49	48.98
25	5.45	24.55	49.09
25.25	5.47	24.6	49.21
25.5	5.48	24.66	49.32
25.75	5.49	24.71	49.42

26	5.5	24.76	49.52
26.25	5.51	24.81	49.62
26.5	5.52	24.85	49.71
26.75	5.61	25.27	50.53
27	5.62	25.31	50.62
27.25	6.56	29.52	59.04
27.5	6.63	29.84	59.67
27.75	6.71	30.19	60.37
28	6.79	30.54	61.08
28.25	6.87	30.9	61.8
28.5	6.95	31.26	62.52
28.75	7.03	31.63	63.26
29	7.11	32	64
29.25	7.19	32.38	64.75
29.5	7.28	32.75	65.51
29.75	7.36	33.14	66.28
30	7.45	33.53	67.05
30.25	7.54	33.92	67.84
30.5	7.63	34.31	68.63
30.75	7.71	34.71	69.42
31	7.8	35.11	70.23
31.25	7.89	35.52	71.04
31.5	7.98	35.93	71.86
31.75	8.09	36.41	72.81
32	8.18	36.83	73.65
32.25	8.43	37.92	75.85
32.5	8.53	38.38	76.76
32.75	8.59	38.66	77.33
33	8.64	38.9	77.79
33.25	8.7	39.13	78.26
33.5	8.75	39.36	78.72
33.75	8.8	39.59	79.19
34	8.85	39.83	79.66
34.25	8.9	40.06	80.13
34.5	8.95	40.3	80.59
34.75	9.01	40.53	81.07
35	9.06	40.77	81.54
35.25	9.11	41.01	82.01
35.5	9.16	41.24	82.48
35.75	9.22	41.48	82.96
36	9.27	41.72	83.43
36.25	9.32	41.96	83.91
36.5	9.38	42.19	84.39
36.75	9.43	42.43	84.87
37	9.48	42.67	85.35
37.25	9.54	42.91	85.83

37.5	9.59	43.15	86.31
37.75	9.64	43.37	86.74
38	9.68	43.57	87.15
38.25	9.73	43.78	87.56
38.5	9.77	43.98	87.97
38.75	9.82	44.19	88.38
39	9.86	44.39	88.78
39.25	9.91	44.6	89.19
39.5	9.96	44.8	89.6
39.75	10	45.01	90.01
40	10.05	45.21	90.42

PRELIMINARY DESIGN SUMMARY - BATTERED PILES

Production Piles: 2 3/8” O.D. x 0.154” W.T. with a 10-12 X 3/8” Helix Configuration.

The top 10-ft of the battered piles are to have a 2 7/8" x .203 wall increased diameter section to resist buckling through the unsupported length.

Allowable geotechnical loads (FS=2):

- Compression: 10 Kips
- Tension: 10 Kips
- It is understood that the piles are not subject to lateral loads at this project site.

PRELIMINARY DESIGN NOTES

- Preliminary design is based upon the loads and soil borings provided by SEH.
- Pile cutoff elevation (PCOE) is understood to be 4-ft above grade. Approximate pile length is 22-ft from PCOE.
- Contractor to verify pile count and PCOE.
- Required minimum installation torque (average torque over final 3-ft of installation) is 2,360 ft*lbs. Piles may need to be installed beyond the specified depth to achieve required torque.
- Torque not to exceed 5,000 ft*lbs.

Project: Big Creek Greenway
Results for Design Section 1: 2 3/8"x.118" (10-12): UL = 20k C | 20k T

Analysis summary for design section: 2 3/8"x.118" (10-12): UL = 20k C | 20k T

Fcap.comp.ULT= 23.41 k
Fcap.tension= 11.26 k
Fcap.comp= 11.7 k
Fcap.comp.PY= 11.99 k

2 3/8"x.118" (10-12): UL = 20k C | 20k T

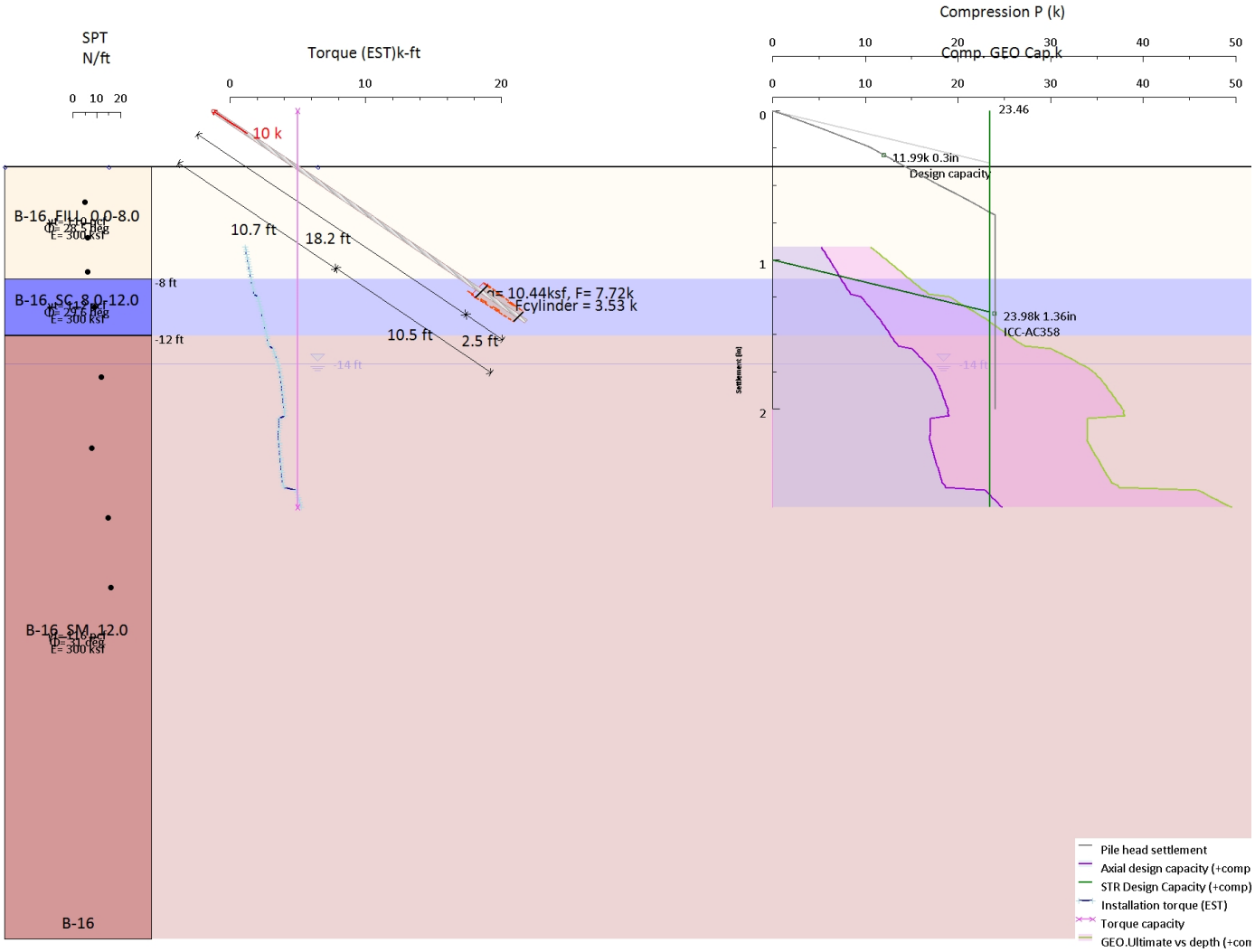


Table: Basic analysis assumptions Stage:Stage 1

Pile STR code	International Building Code 2015
Depth investigation	Max 40ft/0.25ft
Pile settlements P-y	Soil E, rM= 4, Aeff= 100%
PL install E factors	1/0.8/0.7/0.6
Steel Code: a= 0.5	AISC 360-10 ALL.
Concrete Code:	ACI 318-11/1.6
Ubraced length	5 ft+, k= 1
Drain State Clays	Default
Pile tip resistance	Included (plugged)
Bearing factors	Meyerhof/Hansen
Bearing equation	Helicap: Nc c' + Nq s'v
Bearing disturb reduce	1/0.8/0.7/0.6
Cylinder method	Mitsch-Clemence
Shaft friction	Ignored
Shaft/Cyl. Reduce c, αc	0.8, c1<= 1ksf, 0.5, c2<= 2ksf
Soil friction ΦSPT	PILOT database benchmark
Clays Su	Estimated from SPT
Soil elasticity	Estimated from SPT
Design life	75 years, ICC A358
FS bearing	2
FS shaft	2
Manufacturer	IDEAL Manufacturing
Helical pile	238118
Pile diameter O.D.	2.375 in
Helical plates	10S12S
Pile steel Area As	0.84 in^2
Yield strength shaft	67.2 k
Ultimate strength shaft	67.2 k
Zinc coated	4 mils
Torque cap. (yield)	5 k-ft

Table: Analysis summary for helical pile for critical stages

	Factored load	Factored load	CAP. compressi	CAP. tension	Structural cap.	LOAD/CAP	LOAD/CAP	LOAD/CAP
Critical	Compress. (k)	Tension (k)	GEO. (k)	GEO. (k)	(k)	RATIO	STRUCTURAL	GEOTECH
Stage	Stage 0	Stage 1	Stage 0	Stage 1	Stage 1	Stage 1	Stage 1	Stage 1
Stage 1	10	10	11.7	11.26	23.46	0.888	0	0.888

Table: Settlement analysis result summary

Stage	Ult. capacity	Settlement @ult. cap.	Design capacity	Settlement @des. cap.
Name	(k)	(in)	(k)	(in)
Stage 0	23.98	1.357	11.99	0.295
Stage 1	23.98	1.357	11.99	0.295

Table: Depth vs. capacity summary

Z	Q.Comp.Des	Q.Comp.Ult	Q.Tension.Des	Q.Tension.Ult	Est. Torque
(ft)	(k)	(k)	(k)	(k)	(k-ft)
13.7	5.22	10.55	4.26	8.52	1.12
13.95	5.4	10.9	4.44	8.89	1.15
14.2	5.57	11.23	4.81	9.62	1.19
14.45	5.74	11.56	4.99	9.98	1.22
14.7	5.91	11.89	5.17	10.35	1.26
14.95	6.09	12.21	5.35	10.71	1.29
15.2	6.26	12.54	5.53	11.07	1.33
15.45	6.43	12.86	5.71	11.42	1.36
15.7	6.59	13.19	5.89	11.78	1.4
15.95	6.76	13.51	6.07	12.14	1.43
16.2	6.92	13.83	6.25	12.49	1.46
16.45	7.08	14.15	6.42	12.84	1.5
16.7	7.24	14.47	6.6	13.2	1.53
16.95	7.4	14.79	6.77	13.55	1.57
17.2	7.56	15.11	6.95	13.9	1.6
17.45	7.71	15.43	7.12	14.25	1.63
17.7	7.88	15.75	7.3	14.6	1.67
17.95	8.04	16.07	7.47	14.94	1.7
18.2	8.25	16.51	7.64	15.29	1.75
18.45	8.41	16.83	7.82	15.63	1.78
18.7	9.54	19.07	8.01	16.02	2.02
18.95	9.75	19.5	8.22	16.44	2.07
19.2	9.97	19.93	8.43	16.86	2.11
19.45	10.18	20.37	8.64	17.28	2.16
19.7	10.4	20.81	8.85	17.71	2.2
19.95	10.62	21.24	9.07	18.14	2.25
20.2	10.84	21.68	9.29	18.57	2.3
20.45	11.06	22.13	9.51	19.01	2.34
20.7	11.29	22.57	9.73	19.45	2.39
20.95	11.51	23.02	9.95	19.89	2.44
21.2	11.7	23.41	11.26	22.51	2.48
21.45	11.89	23.77	11.45	22.91	2.52
21.7	12.07	24.13	11.65	23.3	2.56
21.95	12.25	24.49	11.85	23.7	2.59
22.2	12.43	24.85	12.04	24.09	2.63
22.45	12.61	25.21	12.24	24.48	2.67
22.7	12.79	25.57	12.44	24.87	2.71
22.95	12.97	25.93	12.63	25.27	2.75
23.2	13.15	26.29	12.83	25.66	2.78
23.45	13.41	26.81	13.02	26.05	2.84
23.7	13.59	27.18	13.22	26.44	2.88
23.95	15.06	30.12	13.44	26.87	3.19
24.2	15.31	30.61	13.68	27.36	3.24
24.45	15.56	31.11	13.93	27.85	3.29
24.7	15.81	31.62	14.17	28.34	3.35
24.95	16.06	32.12	14.42	28.84	3.4
25.2	16.32	32.63	14.67	29.34	3.46
25.45	16.57	33.15	14.92	29.84	3.51
25.7	16.83	33.65	15.17	30.35	3.56

25.95	17.08	34.16	15.43	30.87	3.62
26.2	17.27	34.53	15.69	31.38	3.66
26.45	17.41	34.82	17.4	34.8	3.69
26.7	17.53	35.06	17.61	35.23	3.71
26.95	17.65	35.3	17.82	35.65	3.74
27.2	17.76	35.53	18.03	36.06	3.76
27.45	17.88	35.75	18.24	36.47	3.79
27.7	17.98	35.97	18.44	36.87	3.81
27.95	18.09	36.17	18.63	37.26	3.83
28.2	18.19	36.37	18.82	37.64	3.85
28.45	18.28	36.56	19.01	38.02	3.87
28.7	18.38	36.75	19.11	38.23	3.89
28.95	18.47	36.94	19.22	38.43	3.91
29.2	18.56	37.13	19.32	38.64	3.93
29.45	18.66	37.32	19.42	38.84	3.95
29.7	18.75	37.51	19.52	39.04	3.97
29.95	18.85	37.69	19.62	39.25	3.99
30.2	18.94	37.88	19.73	39.45	4.01
30.45	18.91	37.82	19.83	39.66	4
30.7	19	38.01	19.93	39.86	4.02
30.95	17.01	34.02	19.99	39.99	3.6
31.2	17.01	34.03	20.01	40.03	3.6
31.45	17.02	34.03	20.03	40.07	3.6
31.7	17.01	34.03	20.05	40.1	3.6
31.95	17.01	34.02	20.07	40.13	3.6
32.2	17.01	34.02	20.08	40.16	3.6
32.45	17	34	20.09	40.18	3.6
32.7	16.99	33.99	20.1	40.2	3.6
32.95	16.98	33.96	20.11	40.22	3.6
33.2	16.97	33.94	20.11	40.23	3.59
33.45	17.02	34.05	17.76	35.52	3.6
33.7	17.1	34.2	17.85	35.69	3.62
33.95	17.18	34.36	17.93	35.87	3.64
34.2	17.26	34.52	18.02	36.04	3.66
34.45	17.34	34.68	18.1	36.21	3.67
34.7	17.42	34.84	18.19	36.38	3.69
34.95	17.5	34.99	18.27	36.55	3.71
35.2	17.58	35.15	18.36	36.72	3.72
35.45	17.65	35.31	18.44	36.89	3.74
35.7	17.73	35.47	18.53	37.06	3.76
35.95	17.81	35.62	18.62	37.23	3.77
36.2	17.89	35.78	18.7	37.4	3.79
36.45	17.97	35.94	18.79	37.57	3.81
36.7	18.05	36.1	18.87	37.74	3.82
36.95	18.13	36.25	18.96	37.91	3.84
37.2	18.21	36.41	19.04	38.08	3.86
37.45	18.28	36.57	19.13	38.25	3.87
37.7	18.61	37.23	19.21	38.42	3.94
37.95	18.69	37.39	19.29	38.59	3.96
38.2	22.93	45.86	19.46	38.91	4.86
38.45	23.18	46.36	19.7	39.4	4.91

38.7	23.44	46.88	19.94	39.89	4.96
38.95	23.7	47.4	20.19	40.39	5.02
39.2	23.96	47.93	20.45	40.89	5.07
39.45	24.23	48.46	20.7	41.41	5.13
39.7	24.5	49.01	20.96	41.93	5.19
39.95	24.78	49.56	21.23	42.46	5.25

Helical anchor section data

Section	Fy	Fu	Dp	tP	Ap	I	Sxx	Zxx	J	rx	Tel	Tpl	Qy	Qult	Numbe
Name	(ksi)	(ksi)	(in)	(in)	(in^2)	(in4)	(in3)	(in3)	(in4)	(in)	(k-ft)	(k-ft)	(k)	(k)	Helix
238118	80	120	2.38	0.12	0.84	0.53	0.45	0.6	1.1	0.79	5	5	67.2	67.2	2

Helical anchor: 238118, uses different plate sizes.

Plate	Dhel	Shel	Ahel	Qhel
Number	(in)	(ft)	(ft2)	(k)
1	10	2	0.5	100
2	12	2.5	0.74	100

Manufacturer: IDEAL Manufacturing
Torque rating method parameters for helical anchor.
Torque rating (by Manufacturer) Tel= 5 k-ft
Torque installation factor kT = 10/k
Fy=fyk = Characteristic yield strength for steel
Fu=fu = Ultimate steel strength
Dp = Shaft (pipe) diameter
tP = Shaft thickness (pipe thickness)
Ap = Effective shaft area (pipe area)
I = Shaft moment of inertia
Sxx = Shaft elastic section modulus
Zxx = Shaft plastic section modulus
J = Torsional moment of inertia for shaft
rx = Radius of gyration for shaft
Tel = Elastic torsional resistance for shaft
Tpl = Plastic torsional resistance for shaft
Qy = Yield tensile strength of shaft
Qult = Ultimate tensile strength of shaft
Dhel = Helix plate diameter
Shel = Horizontal helical plate spacing
Ahel = Effective helix area (used for bearing capacity calculations)
Qhel = Ultimate helix structural capacity in tension

Table: Helical pile analysis summary for all stages (Design values)

Paramete	Factored	Factored	Capacity	Capacity	Capacity	Comp.	Comp.	Tension	Tension	Settleme	Settleme	Settleme	Settleme
	Load	Load	GEO.	GEO.	Struct.	Cylinder	Plate	Cylinder	Plate	GEO.Ult	GEO.ult y	GEO.Des	GEO.Des
Stage	Comp. (k)	Tension (	Comp. (k)	Tension (	(k)	(k)	(k)	(k)	(k)	Comp. (k)	(in)	Comp. (k)	(in)
Stage 0	10	0	11.7	11.26	4.87	11.7	15.9	11.26	15.41	23.98	1.357	11.99	0.295
Stage 1	0	10	11.7	11.26	23.46	11.7	15.9	11.26	15.41	23.98	1.357	11.99	0.295

Table: Helical pile analysis summary for all stages (Ultimate values)

Parameter	Capacity	Capacity	Capacity	Comp.Ult	Comp.Ult	Tension.Ult	Tension.Ult
	GEO.Ult	GEO.Ult	Struct.Ult	Cylinder	Plate	Cylinder	Plate
Stage	Comp. (k)	Tension (k)	(k)	(k)	(k)	(k)	(k)
Stage 0	23.41	22.51	4.87	23.41	31.79	22.51	30.82
Stage 1	23.41	22.51	46.92	23.41	31.79	22.51	30.82

Table: Individual plate results stage for compression: Stage 0

Plate	Area	X	El.	Nspt	Φ	c' or Su	Nq	σ'v	Qult	QultTension
Number	(ft2)	(ft)	(ft)	/ft	(deg)	(psf)		(ksf)	(k)	(k)
2	0.74	12.869	-8.869	N/A	33.19	0	26.695	0.977	15.45	15.45
1	0.5	14.637	-10.637	N/A	33.02	0	26.154	1.175	15.37	15.37
Tip	0.031	14.991	-10.991	N/A	32.99	0	26.058	1.215	0.97	0.97

Table: Individual plate results stage for tension: Stage 1

Plate	Area	X	El.	Nspt	Φ	c' or Su	Nq	σ'v	Qult	QultTension
Number	(ft2)	(ft)	(ft)	/ft	(deg)	(psf)		(ksf)	(k)	(k)
2	0.74	12.869	-8.869	N/A	33.19	0	26.695	0.977	15.45	15.45
1	0.5	14.637	-10.637	N/A	33.02	0	26.154	1.175	15.37	15.37
Tip	0.031	14.991	-10.991	N/A	32.99	0	26.058	1.215	0.97	0.97

Table: Corrosion loss results

	Design	Thickness loss	Thickness loss	Steel loss	Other
Stage	Life (years)	Protection (mils)	Steel (in)	%	Warning
Stage 0	75	4	0.04	30.46	N/A
Stage 1	75	4	0.04	30.46	N/A

SOIL BORINGS

Top Elev= superior SOil level
Soil type=type of the soil (sand , clay , etc)
OCR=overconsolidation ratio
K0=at rest coefficient

Name: B-16, pos: (50, 0)

Top elev.	Soil type	OCR	Ko
0	B-16_FILL_0.0-	1	0.52
-8	B-16_SC_8.0-1	1	0.51
-12	B-16_SM_12.0	1	0.48

Summary of loads on pile head

Summary of stage assumptions

Load: Live load, type: DL: Dead load (AASHTO DC)

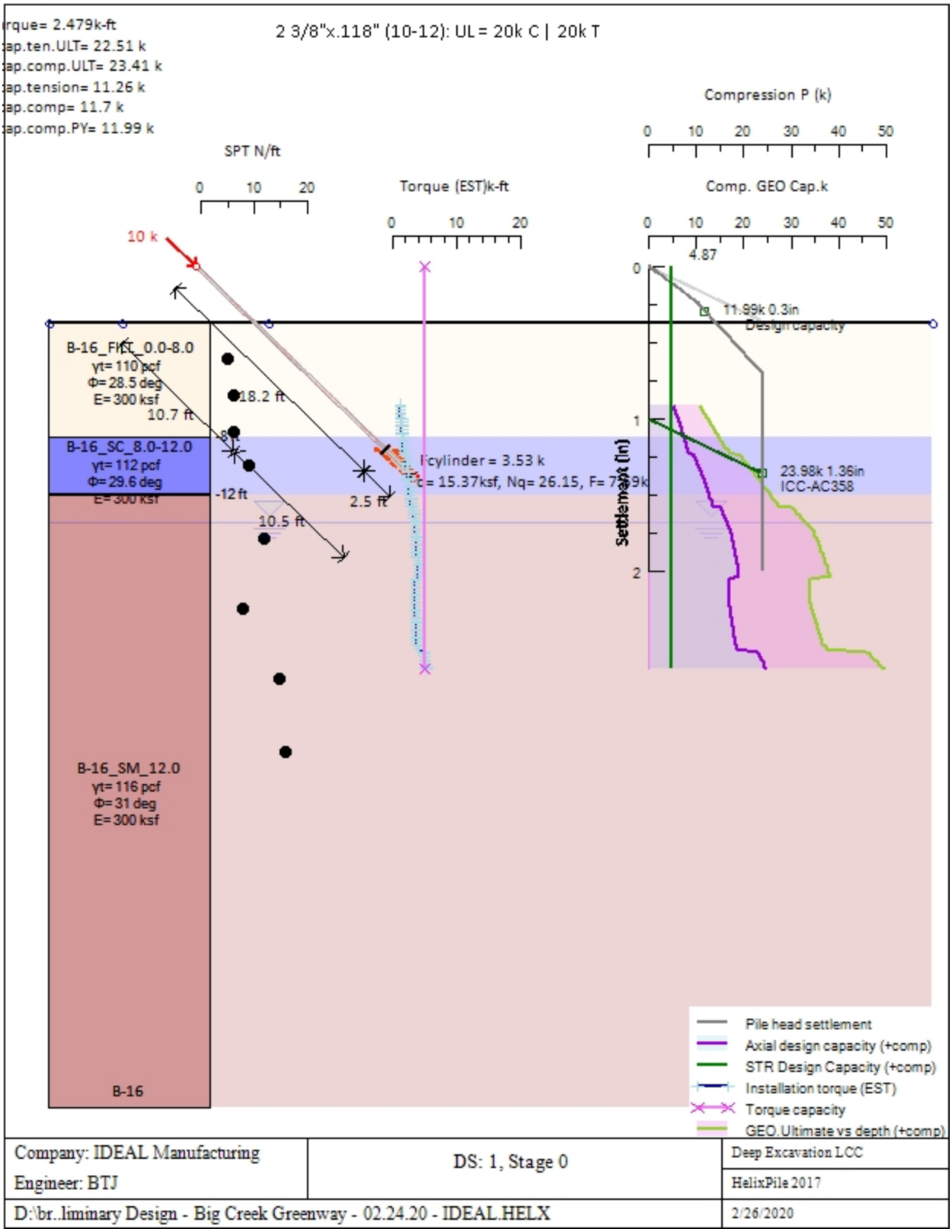
Table: Load Live load data

Stage	Load is	Axial load	F.xx	F.yy	M.xx	M.yy
Number	Active	(k)	(k)	(k)	(k-ft)	(k-ft)
0	Yes	10	0	0	0	0
1	Yes	-10	0	0	0	0

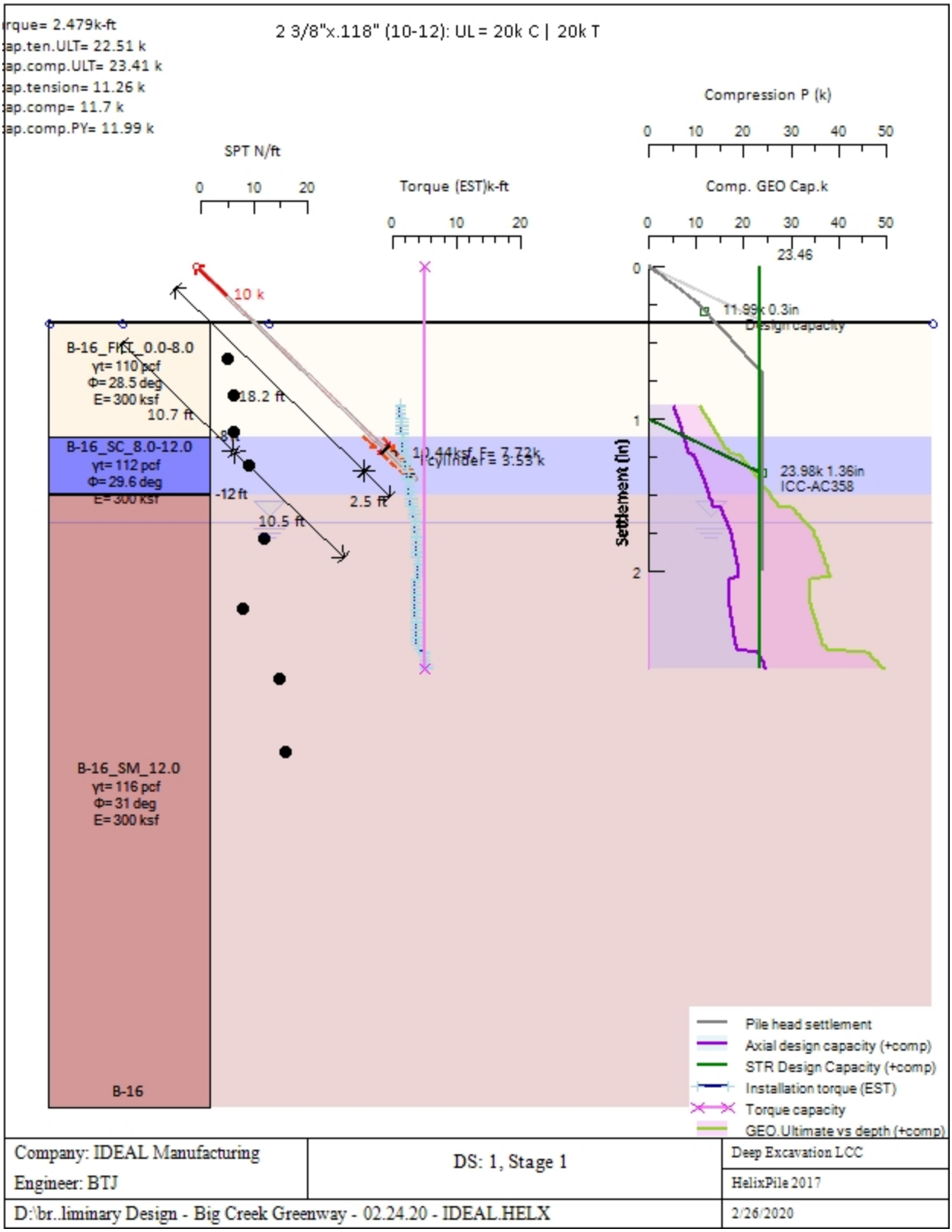
Note: Positive loads = compression, Negative loads= Tension

MODEL STAGES

A sequence of figures for each excavation stage is reported



Company: IDEAL Manufacturing Engineer: BTJ	DS: 1, Stage 0	Deep Excavation LCC HelixPile 2017
D:\br..liminary Design - Big Creek Greenway - 02.24.20 - IDEAL.HELX		2/26/2020



Company: IDEAL Manufacturing Engineer: BTJ	DS: 1, Stage 1	Deep Excavation LCC HelixPile 2017
D:\br..liminary Design - Big Creek Greenway - 02.24.20 - IDEAL.HELX		2/26/2020

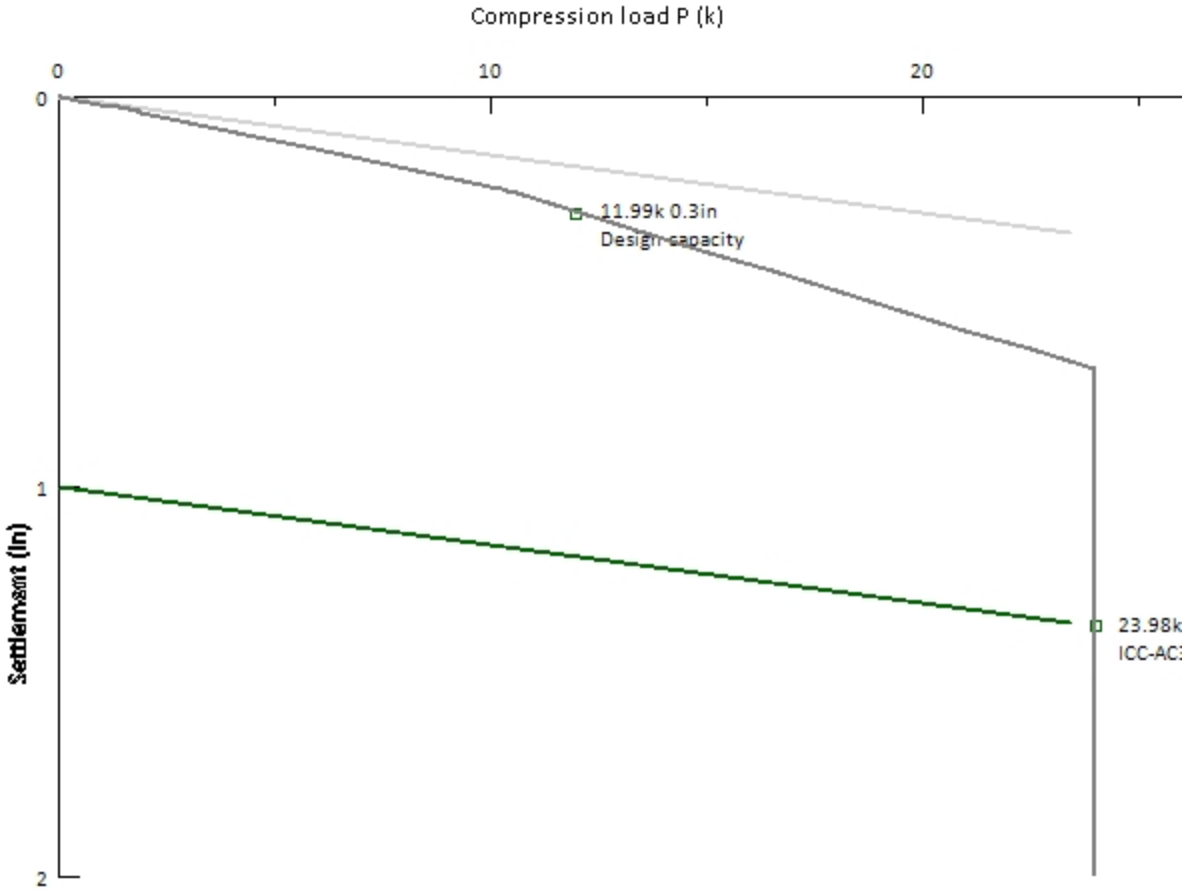
Summary of settlement acceptance criteria methods 2 3/8"x.118" (10-12): UL = 20k C | 20k T

Stage	Elastic	ICC-AC358	ICC-AC358	ICC-AC358	ICC-AC358
Name	P method	Pult (k)	Yult (in)	Pdes (k)	Ydes (in)
Stage 0	N/A	23.98	1.357	11.99	0.295
Stage 1	N/A	23.98	1.357	11.99	0.295

Settlement response for helical pile, stage Stage 0

Point	Load P	Settlement y
	(k)	(in)
0	0	0
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	0	0
18	0	0
19	0	0
20	0	0
21	0	0
22	0	0
23	0	0
24	0	0
25	0	0
26	0	0
27	0	0
28	0	0
29	0	0
30	0.03	0
31	0.26	0.005
32	0.47	0.008
33	1.2	0.023
34	1.3	0.026
35	1.36	0.027
36	1.39	0.028
37	1.41	0.028
38	1.51	0.031
39	1.59	0.032
40	1.63	0.033
41	1.66	0.034
42	1.71	0.035
43	1.81	0.037

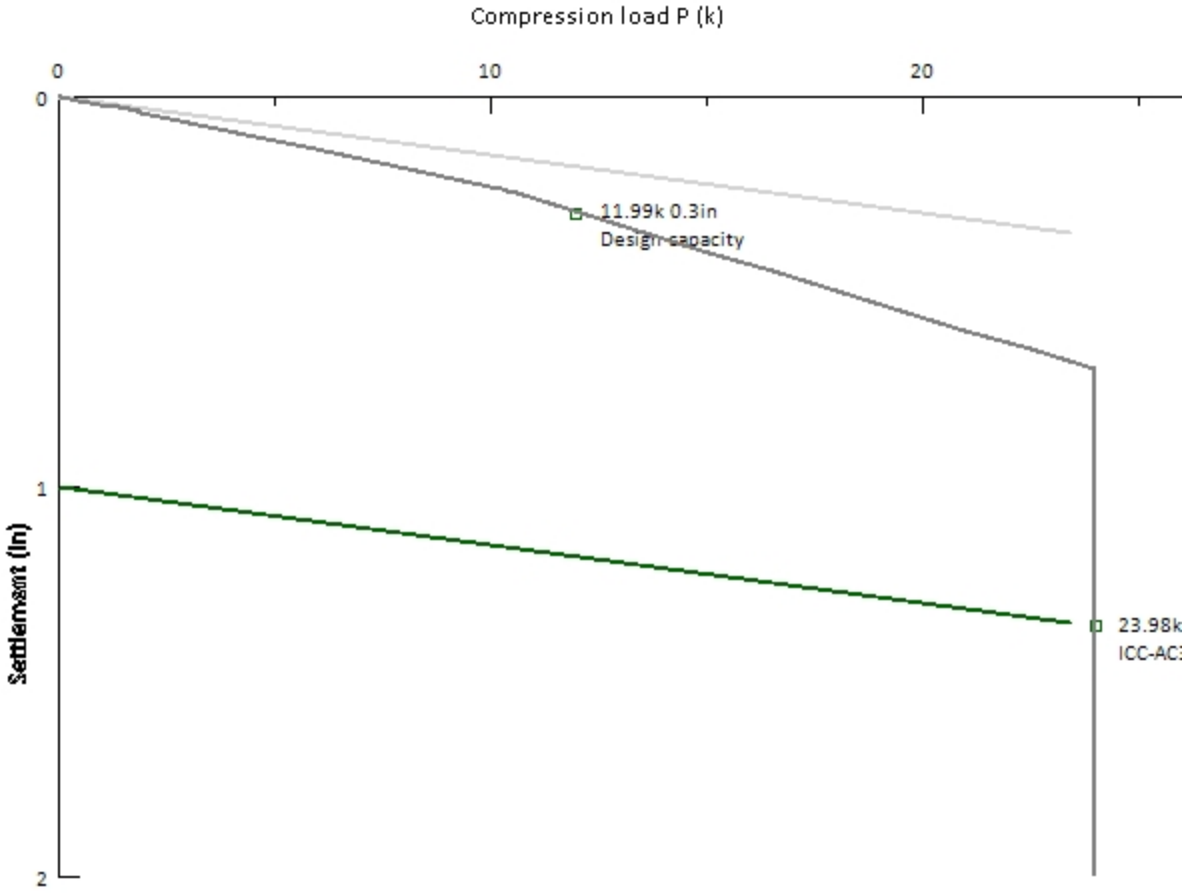
44	1.84	0.038
45	1.86	0.039
46	1.9	0.039
47	4.34	0.095
48	5.5	0.122
49	9.98	0.229
50	10.29	0.238
51	10.38	0.241
52	10.45	0.244
53	10.59	0.248
54	12.07	0.298
55	13.56	0.348
56	15.05	0.398
57	16.53	0.448
58	18.02	0.498
59	19.51	0.548
60	20.99	0.598
61	22.48	0.648
62	23.22	0.673
63	23.96	0.698
64	24	2



Settlement response for helical pile, stage Stage 1

Point	Load P	Settlement y
	(k)	(in)
0	0	0
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	0	0
18	0	0
19	0	0
20	0	0
21	0	0
22	0	0
23	0	0
24	0	0
25	0	0
26	0	0
27	0	0
28	0	0
29	0	0
30	0.03	0
31	0.26	0.005
32	0.47	0.008
33	1.2	0.023
34	1.3	0.026
35	1.36	0.027
36	1.39	0.028
37	1.41	0.028
38	1.51	0.031
39	1.59	0.032
40	1.63	0.033
41	1.66	0.034
42	1.71	0.035
43	1.81	0.037

44	1.84	0.038
45	1.86	0.039
46	1.9	0.039
47	4.34	0.095
48	5.5	0.122
49	9.98	0.229
50	10.29	0.238
51	10.38	0.241
52	10.45	0.244
53	10.59	0.248
54	12.07	0.298
55	13.56	0.348
56	15.05	0.398
57	16.53	0.448
58	18.02	0.498
59	19.51	0.548
60	20.99	0.598
61	22.48	0.648
62	23.22	0.673
63	23.96	0.698
64	24	2



Support 1
Installation torque (estimate) design section: 1

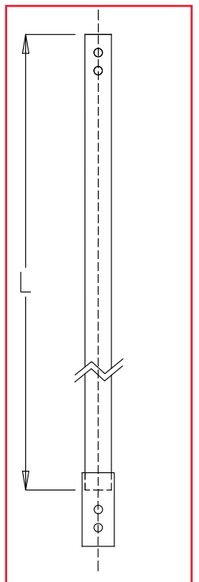
Depth	Est. Torque	Design Comp.	Ultimate Com
(ft)	(k-ft)	(k)	(k)
13.7	1.12	5.22	10.55
13.95	1.15	5.4	10.9
14.2	1.19	5.57	11.23
14.45	1.22	5.74	11.56
14.7	1.26	5.91	11.89
14.95	1.29	6.09	12.21
15.2	1.33	6.26	12.54
15.45	1.36	6.43	12.86
15.7	1.4	6.59	13.19
15.95	1.43	6.76	13.51
16.2	1.46	6.92	13.83
16.45	1.5	7.08	14.15
16.7	1.53	7.24	14.47
16.95	1.57	7.4	14.79
17.2	1.6	7.56	15.11
17.45	1.63	7.71	15.43
17.7	1.67	7.88	15.75
17.95	1.7	8.04	16.07
18.2	1.75	8.25	16.51
18.45	1.78	8.41	16.83
18.7	2.02	9.54	19.07
18.95	2.07	9.75	19.5
19.2	2.11	9.97	19.93
19.45	2.16	10.18	20.37
19.7	2.2	10.4	20.81
19.95	2.25	10.62	21.24
20.2	2.3	10.84	21.68
20.45	2.34	11.06	22.13
20.7	2.39	11.29	22.57
20.95	2.44	11.51	23.02
21.2	2.48	11.7	23.41
21.45	2.52	11.89	23.77
21.7	2.56	12.07	24.13
21.95	2.59	12.25	24.49
22.2	2.63	12.43	24.85
22.45	2.67	12.61	25.21
22.7	2.71	12.79	25.57
22.95	2.75	12.97	25.93
23.2	2.78	13.15	26.29
23.45	2.84	13.41	26.81
23.7	2.88	13.59	27.18
23.95	3.19	15.06	30.12
24.2	3.24	15.31	30.61
24.45	3.29	15.56	31.11

24.7	3.35	15.81	31.62
24.95	3.4	16.06	32.12
25.2	3.46	16.32	32.63
25.45	3.51	16.57	33.15
25.7	3.56	16.83	33.65
25.95	3.62	17.08	34.16
26.2	3.66	17.27	34.53
26.45	3.69	17.41	34.82
26.7	3.71	17.53	35.06
26.95	3.74	17.65	35.3
27.2	3.76	17.76	35.53
27.45	3.79	17.88	35.75
27.7	3.81	17.98	35.97
27.95	3.83	18.09	36.17
28.2	3.85	18.19	36.37
28.45	3.87	18.28	36.56
28.7	3.89	18.38	36.75
28.95	3.91	18.47	36.94
29.2	3.93	18.56	37.13
29.45	3.95	18.66	37.32
29.7	3.97	18.75	37.51
29.95	3.99	18.85	37.69
30.2	4.01	18.94	37.88
30.45	4	18.91	37.82
30.7	4.02	19	38.01
30.95	3.6	17.01	34.02
31.2	3.6	17.01	34.03
31.45	3.6	17.02	34.03
31.7	3.6	17.01	34.03
31.95	3.6	17.01	34.02
32.2	3.6	17.01	34.02
32.45	3.6	17	34
32.7	3.6	16.99	33.99
32.95	3.6	16.98	33.96
33.2	3.59	16.97	33.94
33.45	3.6	17.02	34.05
33.7	3.62	17.1	34.2
33.95	3.64	17.18	34.36
34.2	3.66	17.26	34.52
34.45	3.67	17.34	34.68
34.7	3.69	17.42	34.84
34.95	3.71	17.5	34.99
35.2	3.72	17.58	35.15
35.45	3.74	17.65	35.31
35.7	3.76	17.73	35.47
35.95	3.77	17.81	35.62

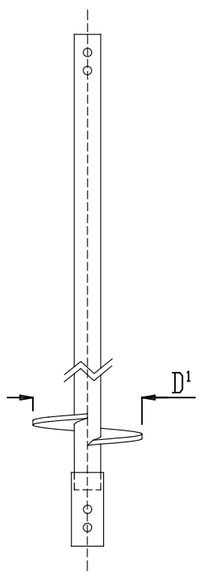
36.2	3.79	17.89	35.78
36.45	3.81	17.97	35.94
36.7	3.82	18.05	36.1
36.95	3.84	18.13	36.25
37.2	3.86	18.21	36.41
37.45	3.87	18.28	36.57
37.7	3.94	18.61	37.23
37.95	3.96	18.69	37.39
38.2	4.86	22.93	45.86
38.45	4.91	23.18	46.36
38.7	4.96	23.44	46.88
38.95	5.02	23.7	47.4
39.2	5.07	23.96	47.93
39.45	5.13	24.23	48.46
39.7	5.19	24.5	49.01
39.95	5.25	24.78	49.56

MAXIMUM TORQUE NOT TO EXCEED 5,000 FT LBS.
ULTIMATE CAPACITY IS 50 KIPS BASED ON A CAPACITY TO TORQUE RATIO OF K_t = 10 ft^{-1}.

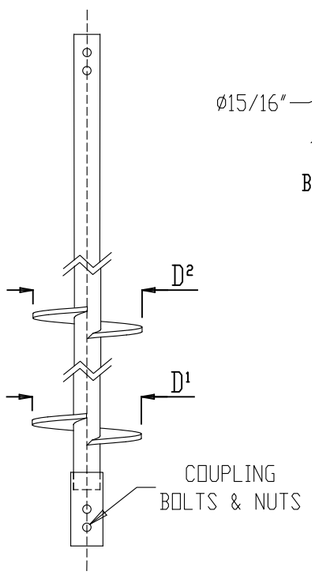
2 3/8" O.D. X 0.154" W.T. HELICAL LEADS & EXTENSIONS



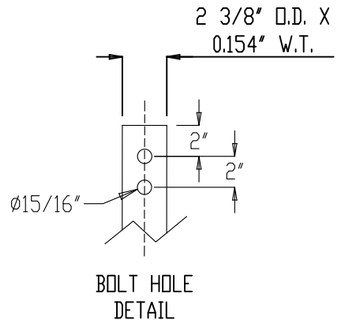
EXTENSION
(EX: 238154EXTLG)



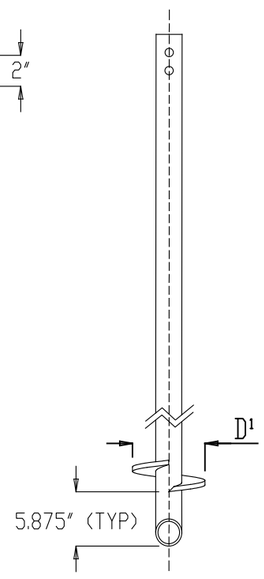
FLIGHTED EXTENSION
SINGLE HELIX (SH)
(EX: 238154FESHLD1XTG)



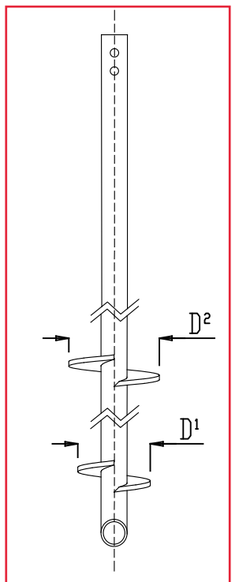
FLIGHTED EXTENSION
DOUBLE HELIX (DH)
(EX: 238154FEDHLD1D2XTG)



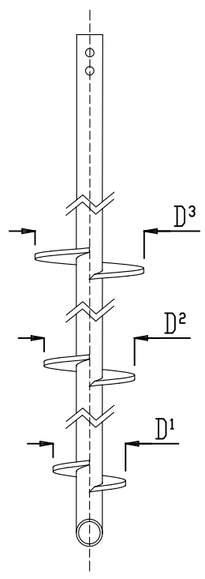
BOLT HOLE
DETAIL



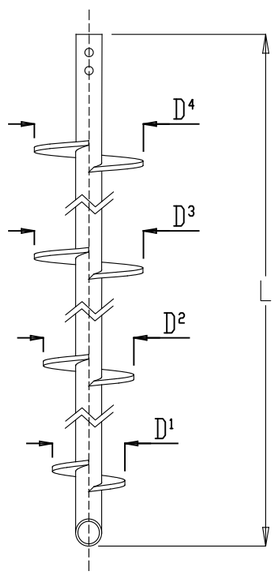
SINGLE HELIX (SH)
LEAD
(EX: 238154SHLD1XTG)



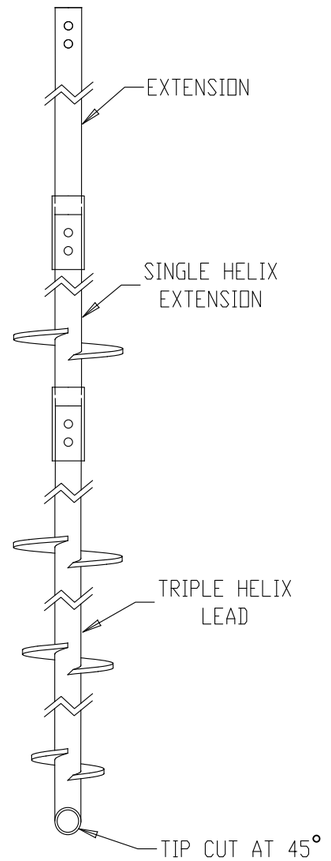
DOUBLE HELIX (DH)
LEAD
(EX: 238154DHLD1D2XTG)



TRIPLE HELIX (TH)
LEAD
(EX: 238154THLD1D2D3XTG)



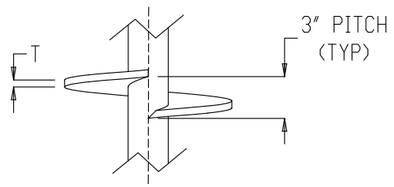
QUAD HELIX (QH)
LEAD
(EX: 238154QHLD1D2D3D4XTG)



TYPICAL PILE
ASSEMBLY

NOTES:

1. SHAFT TO MEET OR EXCEED 55 KSI MIN YEILD.
2. HELIX TO MEET OR EXCEED REQUIREMENTS OF ASTM A572/A1018/A656, 50 KSI.
3. ALL HELICES ARE FORMED BY PRESS DIE. LEADING EDGE OF HELICES ARE TAPERED TO IMPROVE INSTALLATION CAPABILITIES.
4. HELIX SPACING IS THREE (3) TIMES THE DIAMETER OF THE LOWER HELIX. SPACING OF LEADING HELIX ON FLIGHTED EXTENSIONS IS THREE (3) TIMES THE DIAMETER OF THE LAST HELIX ON THE PRECEEDING SHAFT.
5. STANDARD HELIX DIAMETERS ARE 6", 8", 10", & 12". STANDARD HELIX THICKNESS IS 3/8".
6. ALL WELDING TO BE PERFORMED BY SHOP QUALIFIED WELDORS TO AWS D1.1 STRUCTURAL WELDING CODE - STEEL.
7. HOT DIP GALVANIZING PER ASTM A153/ASTM A123.
8. (2) 3/4" DIAMETER X 4" LONG GALVANIZED HEAVY HEX BOLT PER ASTM A325 AND (2) 3/4" GALVANIZED HEAVY HEX NUT PER ASTM A194 (GRADE 2H).
9. HELICAL PILE ASSEMBLIES MANUFACTURED IN ACCORDANCE WITH ICC-ES AC358 ACCEPTANCE CRITERIA FOR HELICAL FOUNDATION SYSTEMS AND DEVICES.



HELIX FORMED BY
PRESS DIE

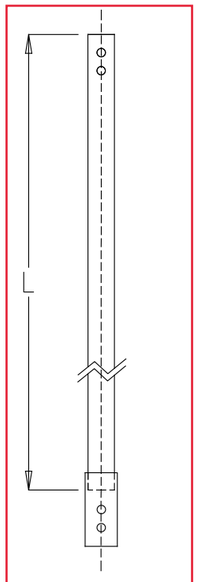
IDEAL PART # ABREVIATIONS:
238 = SHAFT DIAMETER
154 = SHAFT WALL THICKNESS
EXT = EXTENSION
FE = FLIGHTED EXTENSION
SH, DH, TH, QH = SINGLE, DOUBLE, TRIPLE, OR QUAD. HELIX
L = SHAFT LENGTH IN FEET (EXAMPLE: 7' = 7)
D = HELIX DIAMETER(S) IN INCHES (EXAMPLE: 10" = 10)
X = X (SEPARATES HELIX DIAMETER(S) AND HELIX THICKNESS)
T = HELIX THICKNESS (EXAMPLE: 3/8" = 38)
G = GALVANIZED

IDEAL Group

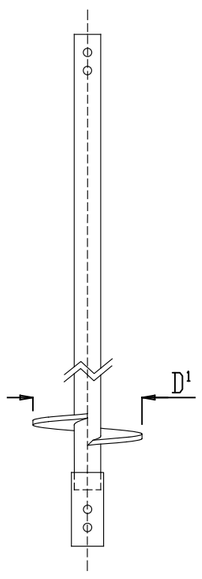
DRAWING NO.			IDEAL MANUFACTURING, INC. 999 PICTURE PARKWAY WEBSTER, NY 14580 800-789-4810	
238154				
DRAWN BY: LRS	DATE: 07/02/19	Rev:	DO NOT SCALE DRAWING	SHEET 1 OF 1

MAXIMUM TORQUE NOT TO EXCEED 8,000 FT LBS.
ULTIMATE CAPACITY IS 72 KIPS BASED ON A CAPACITY TO TORQUE RATIO OF K_t = 9 ft^{-1}.

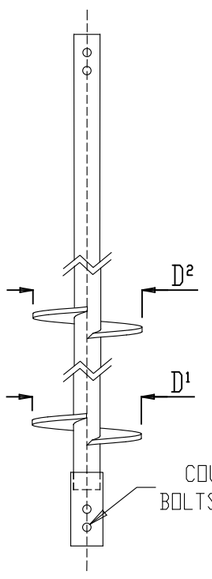
2 7/8" O.D. X 0.203" W.T. HELICAL LEADS & EXTENSIONS
ICC-ES AC358 - REPORT #ESR-3750



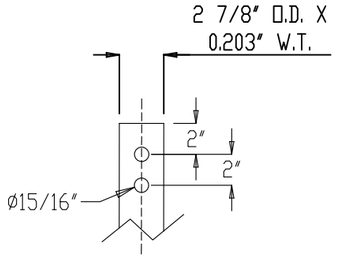
EXTENSION
(EX: 278203EXTLG)



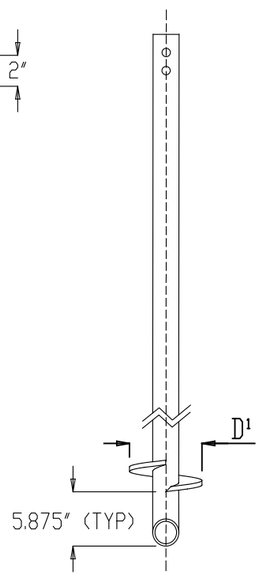
FLIGHTED EXTENSION
SINGLE HELIX (SH)
(EX: 278203FESHLD1XTG)



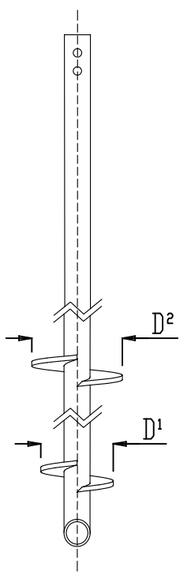
FLIGHTED EXTENSION
DOUBLE HELIX (DH)
(EX: 278203FEDHLD1D2XTG)



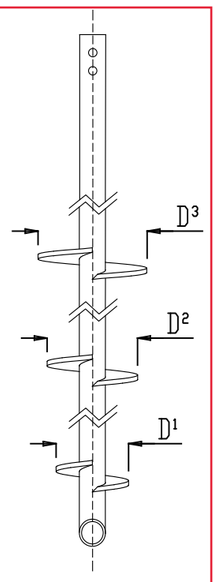
BOLT HOLE
DETAIL



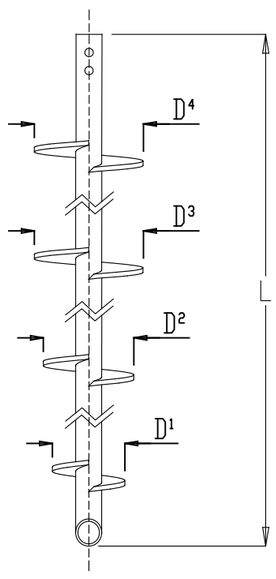
SINGLE HELIX (SH)
LEAD
(EX: 278203SHLD1XTG)



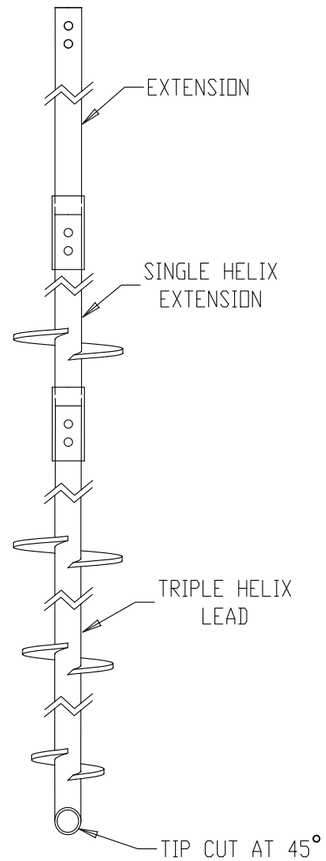
DOUBLE HELIX (DH)
LEAD
(EX: 278203DHLD1D2XTG)



TRIPLE HELIX (TH)
LEAD
(EX: 278203THLD1D2D3XTG)



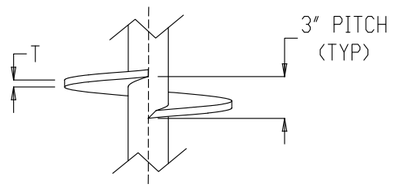
QUAD HELIX (QH)
LEAD
(EX: 278203QHLD1D2D3D4XTG)



TYPICAL PILE
ASSEMBLY

NOTES:

1. SHAFT TO MEET OR EXCEED REQUIREMENTS OF ASTM A500, 80 KSI.
2. HELIX TO MEET OR EXCEED REQUIREMENTS OF ASTM A572/A1018/A656, 50 KSI.
3. ALL HELICES ARE FORMED BY PRESS DIE. LEADING EDGE OF HELICES ARE TAPERED TO IMPROVE INSTALLATION CAPABILITIES.
4. HELIX SPACING IS THREE (3) TIMES THE DIAMETER OF THE LOWER HELIX. SPACING OF LEADING HELIX ON FLIGHTED EXTENSIONS IS THREE (3) TIMES THE DIAMETER OF THE LAST HELIX ON THE PRECEEDING SHAFT.
5. STANDARD HELIX DIAMETERS ARE 8", 10", 12", & 14". STANDARD HELIX THICKNESS IS 3/8" OR 1/2".
6. ALL WELDING TO BE PERFORMED BY SHOP QUALIFIED WELDORS TO AWS D1.1 STRUCTURAL WELDING CODE - STEEL.
7. HOT DIP GALVANIZING PER ASTM A153/ASTM A123.
8. (2) 3/4" DIAMETER X 4 1/2" LONG GALVANIZED HEAVY HEX BOLT PER ASTM A325 AND (2) 3/4" GALVANIZED HEAVY HEX NUT PER ASTM A194 (GRADE 2H).
9. HELICAL PILE ASSEMBLIES MANUFACTURED IN ACCORDANCE WITH ICC-ES AC358 (IDEAL REPORT #ESR-3750) ACCEPTANCE CRITERIA FOR HELICAL FOUNDATION SYSTEMS AND DEVICES.



HELIX FORMED BY
PRESS DIE

IDEAL PART # ABREVIATIONS:
278 = SHAFT DIAMETER
203 = SHAFT WALL THICKNESS
EXT = EXTENSION
FE = FLIGHTED EXTENSION
SH, DH, TH, QH = SINGLE, DOUBLE, TRIPLE, OR QUAD. HELIX
L = SHAFT LENGTH IN FEET (EXAMPLE: 7' = 7)
D = HELIX DIAMETER(S) IN INCHES (EXAMPLE: 10" = 10)
X = X (SEPARATES HELIX DIAMETER(S) AND HELIX THICKNESS)
T = HELIX THICKNESS (EXAMPLE: 1/2" = 12)
G = GALVANIZED

IDEAL Group

DRAWING NO.		IDEAL MANUFACTURING, INC. 999 PICTURE PARKWAY WEBSTER, NY 14580 800-789-4810	
278203			
DRAWN BY: DSS	DATE: 05/30/17	Rev:	DO NOT SCALE DRAWING	SHEET 1 OF 1

ENGINEERED SOLUTIONS of Georgia
Foundation Repair & Waterproofing

A Lifetime of Support

2260 Northwest Parkway Suite E Marietta, GA 30067
ofc. 678.290.1325 fax 770.956.7403 www.esogrepair.com

Attachment B

Check Top Vertical Bent Pier Section for Buckling

Pier OD =	3.5	in	
Pier Wall =	0.216	in	
Design Wall Thickness =	0.201	in, Table 1-13 of 13th ed AISC	
Corrosion Loss =	0.013	in, AC358 Section 3.9	
Design Wall Thickness =	0.188	in	
Design OD =	3.487	in	
Design ID =	3.111	in	

Area =	1.948	Ix =	2.659
Weight =		Sx =	1.525
Depth =	3.487	Rx =	1.168
Width =	3.487	Zx =	2.048
Flange Thick =	0.203	Iy =	2.659
Web Thick =	0.188	Sy =	1.525
		Ry =	1.168

Title Block Line 1
You can change this area
using the "Settings" menu item
and then using the "Printing &
Title Block" selection.
Title Block Line 6

Project Title:
Engineer:
Project ID:
Project Descr:

Printed: 27 FEB 2020, 9:47AM

Steel Column

File = P:\Chuck Irby\ACTIVE COMMERCIAL JOBS\ICAN Big Creek\Engineering\Analysis\Bent Sizing.ec6 .

Lic. # : KW-06012736 — Engineered Solutions of Georgia, Inc.

DESCRIPTION: Pier 3.5"x0.216" Lu = 9

Code References

Calculations per AISC 360-10, IBC 2012, CBC 2013, ASCE 7-10
Load Combinations Used : IBC 2006

General Information

Steel Section Name :
Analysis Method : Allowable Strength
Steel Stress Grade
Fy : Steel Yield 80.0 ksi
E : Elastic Bending Modulus 29,000.0 ksi

Overall Column Height 9.0 ft
Top & Bottom Fixity Top Pinned, Bottom Fixed
Brace condition for deflection (buckling) along columns :
X-X (width) axis :
Unbraced Length for buckling ABOUT Y-Y Axis = 9 ft, K = 0.80
Y-Y (depth) axis :
Unbraced Length for buckling ABOUT X-X Axis = 9 ft, K = 0.80

Applied Loads

Service loads entered. Load Factors will be applied for calculations.

Column self weight included : 0.0 lbs * Dead Load Factor
AXIAL LOADS . . .
Axial Load at 9.0 ft, L = 35.0 k

DESIGN SUMMARY

Bending & Shear Check Results

PASS Max. Axial+Bending Stress Ratio = 0.7114 : 1
Load Combination +D+L
Location of max.above base 0.0 ft
At maximum location values are . . .
Pa : Axial 35.0 k
Pn / Omega : Allowable 49.198 k
Ma-x : Applied 0.0 k-ft
Mn-x / Omega : Allowable 8.176 k-ft
Ma-y : Applied 0.0 k-ft
Mn-y / Omega : Allowable 8.176 k-ft

PASS Maximum Shear Stress Ratio = 0.0 : 1
Load Combination 0.0
Location of max.above base 0.0 ft
At maximum location values are . . .
Va : Applied 0.0 k
Vn / Omega : Allowable 0.0 k

Maximum Load Reactions . .
Top along X-X 0.0 k
Bottom along X-X 0.0 k
Top along Y-Y 0.0 k
Bottom along Y-Y 0.0 k

Maximum Load Deflections . . .
Along Y-Y 0.0 in at 0.0 ft above base
for load combination :
Along X-X 0.0 in at 0.0 ft above base
for load combination :

Load Combination Results

Load Combination	Maximum Axial + Bending Stress Ratios: Stress Ratio	Status	Location	Cbx	Cby	KxLx/Rx	KyLy/Ry	Maximum Shear Ratios: Stress Ratio	Status	Location
D Only	0.000	PASS	0.00 ft	0.00	0.00	0.00	0.00	0.000	PASS	0.00 ft
+D+L	0.711	PASS	0.00 ft	1.00	1.00	73.97	73.97	0.000	PASS	0.00 ft
+D+0.750L	0.534	PASS	0.00 ft	1.00	1.00	73.97	73.97	0.000	PASS	0.00 ft
+0.60D	0.000	PASS	0.00 ft	1.00	1.00	73.97	73.97	0.000	PASS	0.00 ft

Maximum Reactions

Note: Only non-zero reactions are listed.

Load Combination	Axial Reaction @ Base	X-X Axis Reaction @ Base	X-X Axis Reaction @ Top	k	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Mx - End Moments @ Base	Mx - End Moments @ Top	k-ft	My - End Moments @ Base	My - End Moments @ Top
D Only											
+D+L	35.000										
+D+0.750L	26.250										
+0.60D											
L Only	35.000										

Extreme Reactions

Item	Extreme Value	Axial Reaction @ Base	X-X Axis Reaction @ Base	X-X Axis Reaction @ Top	k	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Mx - End Moments @ Base	Mx - End Moments @ Top	k-ft	My - End Moments @ Base	My - End Moments @ Top
Axial @ Base	Maximum	35.000										
"	Minimum											

Steel Column

Lic. # : KW-06012736
Engineered Solutions of Georgia, Inc.

DESCRIPTION: Pier 3.5"x0.216" Lu = 9

Extreme Reactions

Item	Extreme Value	Axial Reaction @ Base	X-X Axis Reaction @ Base	X-X Axis Reaction @ Top	k	Y-Y Axis Reaction @ Base	Y-Y Axis Reaction @ Top	Mx - End Moments @ Base	Mx - End Moments @ Top	k-ft	My - End Moments @ Base	My - End Moments @ Top
Reaction, X-X Axis Base	Maximum											
"	Minimum											
Reaction, Y-Y Axis Base	Maximum											
"	Minimum											
Reaction, X-X Axis Top	Maximum											
"	Minimum											
Reaction, Y-Y Axis Top	Maximum											
"	Minimum											
Moment, X-X Axis Base	Maximum											
"	Minimum											
Moment, Y-Y Axis Base	Maximum											
"	Minimum											
Moment, X-X Axis Top	Maximum											
"	Minimum											
Moment, Y-Y Axis Top	Maximum											
"	Minimum											

Maximum Deflections for Load Combinations

Load Combination	Max. X-X Deflection		Distance		Max. Y-Y Deflection		Distance	
D Only	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+D+0.750L	0.0000	in	0.000	ft	0.000	in	0.000	ft
+0.60D	0.0000	in	0.000	ft	0.000	in	0.000	ft
L Only	0.0000	in	0.000	ft	0.000	in	0.000	ft

Steel Section Properties :

Depth	=	3.487 in	I xx	=	2.66 in^4	J	=	0.000 in^4
Design Thick	=	0.000 in	S xx	=	1.53 in^3			
Diameter	=	3.487 in	R xx	=	1.168 in			
Wall Thick	=	0.203 in	Zx	=	2.048 in^3			
Area	=	1.948 in^2	I yy	=	2.659 in^4	C	=	0.000 in^3
Weight	=	0.000 plf	S yy	=	1.525 in^3			
			R yy	=	1.168 in			
Ycg	=	0.000 in						

Steel Column

Lic. # : KW-06012736
Engineered Solutions of Georgia, Inc.

DESCRIPTION: Pier 3.5"x0.216" Lu = 9

Sketches