Modern Helical Piles and Helical Anchors

TOGETHER TO TAKE YOU FURTHER





- History of Hubbell and CHANCE®
- History and Value Proposition of Helical Piles
- Helical Pile Shaft Type/Optimization
- Helical Pile Design
 - Bearing and Side Resistance
 - Torque Correlation
- Design Examples
 - New Construction
 - Remedial Repair



History of Hubbell

Founded by Harvey Hubbell in 1888 Hubbell received at least 45 patents including:

- Pull-chain electrical light socket (1896)
- U.S. electrical power plug (1904)





Hubbell [publicly held] now serves eight major market segments with close to 100 brands



History of CHANCE

- Albert Bishop Chance founded CHANCE in Centralia, Missouri ٠ in 1907
- An ice storm wiped out the telephone lines he managed ٠ which led to the necessity of his new invention – the first practical earth anchor - which could be installed in the frozen ground and keep the telephone poles erect.
- CHANCE anchors were engineered and developed into helical ٠ piles, the first foundation stabilization system designed for remedial repair



CHANCE was manufacturing practical helical anchors forty years before any other major competitor



CHANCE

Helical Piles: 183 Years New





CHANCE

WHO WE ARE

Hubbell Power Systems, Inc. (HPS) manufactures a wide variety of transmission, distribution, substation, OEM and telecommunications products used by utilities. In addition, HPS products are used in the civil construction, transportation, gas and water industries. Products include construction and switching products, tools, insulators, arresters, pole line hardware, cable accessories, test equipment, transformer bushings and polymer precast enclosures and equipment pads.





Value Proposition: Helical Piles

- Limited area disruption | disturbance
- Low impact | No vibration
- No spoils
- Ideal where site restrictions exist; including limited overhead clearance
- Overall time and cost reduction
- Quality Control: Field measurable Torque
- Relatively low cost with immediate load carrying capacity
- Scalability





HELICAL PILE COMPONENTS



Pile Shaft Optimization

- Four Different Shaft Types for Helical Piles
- Type 1 Square Shaft
- Type 2 Pipe Shaft
- Type 3 Combo Pile
- Type 4 Grouted Shaft Helical Displacement Pile
 - A.k.a. Helical Pulldown Micropile







Shaft Type 1 – Square Shaft

- Applications: Guying, New Construction, Foundation Repair, Earth Retention
- Size range: 1-1/2" to 2-1/4"
- <u>Solid</u> Round Cornered Square (RCS), Grade 70 or Grade 90



Photo by Walder Foundation Products, Virginia



Shaft Type 1 – Square Shaft

- Ultimate compression/tension axial capacity: 55 to 200 kip
- Lower Section Properties
- Relatively Large Cross-Sectional area



Photo by EBS Geostructural, Ontario



Shaft Type 1 – Square Shaft

Advantages:

- Highest torque Correlation Factor (K_t)
- Small installation equipment
- Efficient installation, better penetration in dense soil
- End-Bearing load transfer at pile tip (via helix plates)
- <u>Cost efficient</u> lowest cost per kip at load ranges 50 kip or less

Disadvantages:

- Low passive lateral capacity
- Buckling concern in very soft soils



Photo by Dynamic Helical, Alaska



Type 2 - Pipe Shaft (Round Shaft)



Shaft Type 2 – Pipe Shaft – Low Displacement

- Applications: New Construction, Foundation Repair, Substation, Transmission
- Size range: 2-7/8" to 4.5" OD
- Structural Grade HSS Grade 50 or Grade 65
- Ultimate compression/tension axial capacity: 63 to 150 kip
- Ultimate passive lateral capacity: 1 to 6 kip
- Higher Section Properties
- Larger Cross-Sectional area





Shaft Type 2 – Pipe Shaft – Low Displacement

Advantages:

- Lateral Load Resistance
- End-Bearing load transfer at pile tip (via helix plates)
- Stability against columnar buckling or unsupported length

Disadvantages:

- Reduced penetration in firm/hard/dense soils
- Torque Correlation Factor (K_t) inversely related to shaft diameter





Shaft Type 2 – Pipe Shaft – Medium Displacement



Photo by Walder Foundation Products, Virginia

- Applications: New construction, solar, substation, transmission
- Size range: > 4.5" to 8" OD
- Structural Grade HSS Grade 50 or API Grade 80
- Ultimate compression/tension axial capacity: 150 to 400 kip
- Ultimate passive lateral capacity: 3 to 15 kip

Advantages:

- Higher axial capacity
- End-Bearing load transfer at pile tip (via helix plates)
- Side resistance via skin friction on shaft
- High lateral resistance increased via battered piles

Disadvantages:

- Large installation equipment required (up to 35-ton machines)
- Reduced penetration in firm/hard/dense soils
- Higher cost per kip
- Torque Correlation not as well defined for sizes > 4.5" OD

Shaft Type 2 – Pipe Shaft – Large Displacement

- Applications: New construction, solar, substation, transmission ٠
- Size range: > 8" OD ٠
- Structural Grade HSS Grade 50 or API Grade 80 ٠
- Ultimate compression/tension axial capacity: 300 to 600 kip ٠
- Ultimate passive lateral capacity: 20 to 70 kip ٠

Advantages:

- Higher axial capacity
- End-Bearing load transfer at pile tip (via helix plates)
- Side resistance via skin friction on shaft
- High passive lateral capacity
- Generally one-piece piles

Disadvantages:

- Large installation equipment required (up to 50-ton machines)
- Reduced penetration in firm/hard/dense soils
- Highest cost per kip ٠
- Torque Correlation ???







Photo by Helical Concepts, Texas

Ballistic Barriers



Photos by Helical Concepts, Texas



CHANCE

Shaft Type 3 – Combo Pile

- Applications: New Construction, Foundation Repair, Substation, Transmission
- Combines the advantages of Square Shaft and Pipe Shaft
- Square Shaft Lead and Pipe Shaft Extension

Advantages:

- Increases Correlation Factor (K_t) [See Tables]
- Used in soil profiles with soft/loose overburden

Disadvantages

• Torque strength limited by lowest rated element

Combo Pile Length Less than 30'-0

COMBO PILE TYPE	SAND	CLAY	COMBINED
SS5/150/RS2875	10	9.5	10
SS175/RS3500	9.5	9	9
SS200/RS3500	9.5	9	9

Combo Pile Length Greater than 30'-0

COMBO PILE TYPE	SAND	CLAY	COMBINED
SS5/150/RS2875	9.5	9.5	9.5
SS175/RS3500	9	8.5	8.5
SS200/RS3500	8.5	8	8



Shaft Type 4 – Grouted Shaft Helical Displacement Pile

- Applications: New Construction, Foundation Repair, Substation, Transmission
- Central Shaft:
 - 1-1/2" to 2-1/2" RCS Shaft (commonly used)
 - 2-7/8" to 4-1/2" OD Pipe Shaft (not common)
- Ultimate compression/tension axial capacity: 55 to 430 kip
- Ultimate passive lateral capacity with steel casing: 3 to 15 kip
- Composite Grout & Steel Section





Advantages:

- Prevent Columnar Buckling in very soft soil
- Increases axial capacity
- End-Bearing load transfer at pile tip (via helix plates)
- Side resistance via skin friction on shaft
- Increases axial stiffness of pile shaft
- Cost efficient lowest cost per kip in most situations with Capacity 50 kip and greater.
- Side resistance via skin friction
 - Reduces Pile Length
 - Enables use of Smaller Shaft and Therefore Smaller **Install Equipment**
 - Achieve Required Capacity when End-Bearing not Enough.
- Corrosion resistance

Disadvantages:

- Refusal in dense soil or obstructions
- Labor and cost of grout







Photo by Foundation Technologies, Georgia

STANDARD HELIX DIAMETERS





TERMINATIONS







Grillage: Pile to structure



Bracket: Pile to footing

New construction cap: Pile to concrete pad



HELICAL PILE DESIGN



Pile Shaft Design

Pile Installation <u>MUST</u> be considered in the design process

Installation Condition	Square Shaft	Pipe Shaft	Combo	Pulldown
Axial End-Bearing Capacity (Soils with Nspt > 4)	*			
Penetration into desired geologic strata	*		*	
Bucking Concerns (Soils with Nspt \leq 4)		*	*	*
Lateral Loading		*	*	*
Corrosion Potential	\checkmark		\checkmark	*
Tension Only Loads	*			
Reversing Loads		\checkmark		*
Load Deflection Response	\checkmark		\checkmark	*

★ = Excellent \checkmark = Good



Helical Pile Capacity

Two Limit States Criteria

- 1. Ultimate Resistance
 - Limit state based on the structural strength or the geotechnical capacity of the helical pile.
 - Defined as the point at which no additional load can be applied without failure.
- 2. Serviceability Limit
 - Behavior of a helical pile at a particular load that is less than the ultimate resistance.
 - Limiting the deflection or displacement of the pile at a specified service load.





Helical Pile Capacity

IBC 2012, 2015 & 2018 Section 1810.3.3.1.9 States There Are Three Ways To Determine Axial Capacity.

- Method 1: Sum Of The Areas Of The Helical Bearing Plates Times The Ultimate Bearing Capacity Of The Soil Or Rock Comprising The Bearing Stratum.
- Method 2: Ultimate Capacity Determined From Well Documented Correlations With Installation Torque.
- Method 3: Ultimate Capacity Determined From Load Tests.

Axial Capacity Shall Not Exceed The Allowable Strength Of The Pile's Structural Elements; Including The Pile Connection To Structure, Pile Shaft, Pile Shaft Couplings, And The Helical Bearing Plates.



Helical Pile Design – Technical Design Manual, 4th Edition

Geotechnical Design (P4)

Section 2 – Soil Mechanics

Section 5 – Design Methodology

- Axial Capacity
- Lateral Capacity
- Installation Torque Check

Structural Design (P1, P2, P3)

Section 7 – Product Ratings

Geotechnical Design (P4)

Section 6 – Torque Correlation Appendix B – Load Tests





HeliCAP[®] v3.0 Helical Capacity Design Software

- Web-based helical capacity design software
- Collaborators can view or edit shared jobs
- Input up to 10 soil profiles in a single job



Proper Descent R	
www.HPSapps.com/Helicap	
HeliCAP Summary Roport	

Create an Account

A HUBBELL COMPANY I OUR BRANDS I C	HANCE	
HeliCAP		
	LOGIN	
	Email Address	
	Plasmint.	
	Forgot Password?	
	CREATE AN ACCOUNT	
	Click Here to Learn More About HeliCAP* Software	



CHANCE

CHANCE Torque Indicator with Wireless Smart Device App Connectivity

- C3031836
- Bluetooth[®] connection to smart devices up to 50 ft away for remote monitoring and logging of torque data
- Transmits data to multiple smart devices simultaneously
- Integral temperature sensor (temperature readings are transmitted with torque readings)
- Large ON/OFF and MODE push buttons on front face are easy to press while wearing gloves
- Extended run time when using two 9V batteries (will operate with one 9V battery)



Torque Correlation – AC358

Section 3.13.2 Torque Correlation Verification

Conforming Systems

- 1.5" & 1.75" Square Shaft Kt = 10
- 2-7/8 OD Pipe Shaft Kt = 9
- 3" OD Pipe Shaft Kt = 8
- 3-1/2" OD Pipe Shaft Kt = 7
- 4-1/2" OD Pipe Shaft Kt = 5.6
- Verification Requires 14 Full-Scale Load Tests in Soil

Non-Conforming Systems

• Verification Requires 28 Full-Scale Load Tests in Soil



Energy Efficiency – Torque Correlation

PRODUCT SERIES	DESCRIPTION	EVALUATED PER AC358	Kt	Capacity (kip)
SS125	1.25" ROUND CORNERED SQUARE BAR		10	40
SS5	1.50" ROUND CORNERED SQUARE BAR	YES	10	57
SS150	1.50" ROUND CORNERED SQUARE BAR		10	70
SS175	1.75" ROUND CORNERED SQUARE BAR	YES	10	105
SS200	2.00" ROUND CORNERED SQUARE BAR		10	160
SS225	2.25" ROUND CORNERED SQUARE BAR		10	210
RS2875.203	2.875" OD, 0.203 WALL PIPE	YES	9	63
RS2875.276	2.875" OD, 0.276 WALL PIPE	YES	9	80.1
RS3500.300	3.500" OD, 0.300 WALL PIPE	YES	7	91
RS4500.237	4.500" OD, 0.237 WALL PIPE		6	108
RS4500.337	4.500" OD, 0.337 WALL PIPE	YES	5.6	150
RS6625	6.625" OD, VARYING WALL PIPE		5	200
RS8625	8.625" OD, VARYING WALL PIPE		4	300
RS1075	10.750" OD, VARYING WALL PIPE		2-3	400



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DESIGN EXAMPLES

		EXAV	IPLE #2	
permutation and parts	olotif; - mismeriti		albetton GA	LOG OF BORING B-07
Diffing Co.:		TTU Project No.	100613076	Remarke: Advantage of the second second
Driller:		Date Drilled:	\$3703	
Logged by:		Boring Depth:	33.5.6/	1.1
Ecopment:	CIVE 85	Boring Elevation:	542 ies.	
lanmer Type	Reare earl Cadmen	Goordinates: Not Av	alonio	
Drilling Method:	Holder Alexa Algert	66		





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Summary Report

Inh Name: Innovations in Pillon V	Job Number, C21081	Contact Cary Hanoon
the mine in como a riving i	See Herrise Conten	Connect Con y Concerne
Start Date: 2/26/2021	Email: cary@foundationtechnologies.com	Address: Example 2
Country UCA	Chatal	City Oter
Jounity. USM	June.	Cityizip.

B-7 Example 2: COMPRESSION

Helical Pile Number: 1	Produi	dt. \$85	Installation Torque	Effective Torque:	
Length: 20.0 ft	Angle: 90.0 degree	Datum Depth: 0.0 ft	4137 ft-lb	3889 ft lb	
Helix Diameter (in)	Helix Depth (ft)	Ultimate Helix Geotechnical Capacity (qu) (kip)	Nominal Hallx Strength (kip)	Ultimate Helix Recommended Capacity (qx) (kip)	
12	15.0	12.9t 19.2c	44.2	12.9t 19.2c	
10	17.5	15.2t 16.8c	47.7	15.2t 16.8c	
8	19.5	11.3t 16.0c	57.3	11.1t 16.0c	
Total Ultin Geotechnical Ca	nate Helix pacity (Qs) (kip)	39.3t 52.0c			
Total Ultin Recommended Ca	nate Helix apacity (QR) (kip)		ĵ.	39.3t 52.0c	







Helical Pile Data Summary

Pile Type:	CHANCE®	Square Shaft Helical Pile
Shaft Materials:		SS5 (1.5"x1.5" solid square shaft)
Helical Configuratio	on:	8"x10"x12" helices
Bid Length:		21'
Required Capacity:	20 kips w	orking / 40 kips ultimate
Min. Inst. Torque:	4,000 ft-l	bs.









Summary Report

Job Name: Innovations in Piling V	Job Number: C21081	Contact: Cary Hannon
Start Date: 2/26/2021	Email: cary@foundationtechnologies.com	Address: Example 2
Country: USA	State:	City/Zip

B-2 Example 3: COMPRESSION

Helical Pile Number: 1	Product: R	S2675.203	Installation Torque:	Effective Torque	
Length: 27.0 ft	Angle: 90.0 degree	Datum Depth: 0.0 ft	4507 作16	3660 % lb	
Helix Diameter (in)	Helix Depth (ft)	Ultimate Helix Geotechnical Capacity (go) (kip)	Nominal Helix Strength (kip)	Ultimate Hellx Recommended Capacity (q#) (kip)	
12	24.0	16.0t 24.0c	75.6	16.0t 24.0c	
10	26.5	17.0t 18.3c	73.6	17.0t 18.3c	
Total Ultin Geotechnical Ca	sale Helix pacity (Qo) (kip)	33.1t 42.3c			
Total Ultin Recommended C	nate Helix apacity (QR) (kip)			33.1t 42.3c	







Helical Pile Data Summary

Pile Type:	CHANCE®	Round Shaft Helical Pile	
Shaft Materials:		RS2875.203 (2-7/8" O.D. pipe shaft w/ 0.203" wall)	
Helical Configuration	on:	10"x12" helices	
Bid Length:		28'	
Required Capacity: 20 kips working / 40 kips ultimate			
Min. Inst. Torque:	4,500 ft-ll	os.	







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Summary Report

Job Name: Innovations in Pling V	Job Number: G21081	Contact: Cary Hannon	
Start Date: 2/26/2021	Email: cary@loundationtechnologies.com	Address: Example 2	
Country: USA	State:	City/Zip:	

B-3 Example 4: COMPRESSION

				-
Helical Pile Number, 1	Product: \$\$175 / R\$3500.300		Installation Torque:	Effective Torque:
Length: 33.0 ft	Angle: 90.0 degree	Datum Depth: 0.0 ft	12523 A-Ib	10338 ft 45
Helix Diameter (in)	Helix Depth (ft)	Ultimate Helix Geotechnical Capacity (qs) (kip)	Nominal Hellx Strength (kip)	Ultimate Helix Recommended Capacity (ge) (kip)
12	28.0	28.3t 30.4c	67.5	28.3t 30.4c
10	30.5	29.3) 47.0c	66.1	29.3: 47.0c
8	32.6	30.7t 32.3c	123.3	30.7t 32.3c
Total Ultin Geotechnicel Ca	iato Hellx pacity (Qo) (kip)	88.4t 109.7c		
Total Ultimate Helix Recommended Capacity (QR) (kip)				66.4t 109.7c





Helical Pile Data Summary

Pile Type:	CHANCE [®]	HANCE [®] Combo Shaft Helical Pile		
Shaft Materials:		Lead Section: SS175 (1.75"x1.75" solid square shaft)		
Extensions:		RS3500.300 (3.5" O.D. Pipe shaft w/ 0.300" wall)		
Helical Configuration	on:	8"x10"x12" helices		
Bid Length:		35'		
Required Capacities:		45 kips working / 90 kips ultimate – Compression		
		45 kips working / 90 kips ultimate - Tension		
Min Inst Torque	10 500 ft	lbc		

Min. Inst. Torque: 10,500 ft-lbs.











CHANCE

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B-4 & 4A Example 5: COMPRESSION

Felical Pile Number: 1	Produ	ct 555	Installation Torque:	Effective Torque:
Fingth: 25.0.8	Angle: \$0.0 degree	Datum Depthy 0.0 ft	5255 i) D	4901 615
Friction Type: Graid	Analysis Method: US Navy			
	e	Grout Diamater (in)	Grout Length (%)	
		30	23.0	
Palte Diametar (In)	Helix Depth (N)	Ulfinate Hells Geolechnicel Capacity (qu) (kip)	Norsinal Holix Strongth (kip)	Utimate Helts Recommended Capacity tod (op
12	30.0	20.90 34.65	44.2	20.91 34.6c
50	22.5	17.1L 17.7c	47.3	17.11
Б	24.5	11.4	57.5	11.41 17.0c
Total Ultin Geotechnical Ca	nato Holls pacity (Co) ((cp)	49.41 39.10	3	
Total Ultimate Hells: Recommanded Capacity (Civi) (Mp)				49.3) 39.1c
Total Ultimate Prictic	n Capacity (Qr) (kip)	22.162		
Total UE. C Geolechnical Ca	Combined sectly (Cloc) (kip)	71.59 81.2c		
Total UK. Combined Recommended Capacity (Dec) (Up)		()		71.5) 81.2c







Helical Pile Data Summary

Pile Type:	CHANCE [®]	Helical Pulldown [®] Micropile (HPM)
Shaft Material:		SS5 (1.5"x1.5" solid square shaft)
Helical Configuration	on:	8"x10"x12" helices
Minimum Length:	30 ft	
Bid Length:		35 ft
Grout Size:		5" Ø
Required Capacities	5:	80 kips ultimate – Compression
		30 kips ultimate - Tension

Min. Inst. Torque: 5,500 ft-lbs.



CHANCE[®] Helical Anchors/Piles

ICC-ES ESR-2794

- CHANCE Type SS5 and SS175 Square Shaft Helical Piles
- CHANCE Type RS2875.276 and RS3500 Pipe Shaft Helical Piles
- CHANCE Type SS175/RS3500 Combo Pile
- CHANCE Type RS2875.203 Pipe Shaft Helical Piles
- CHANCE Type RS4500.337 Pipe Shaft Helical Piles
- Includes Seismic Design Categories D, E, & F

CCMC ER-13193-R (Canada)

• CHANCE Type SS175 Helical Piles



CHANCE has the most ICC-ESR evaluated products in the industry



Buy America(n) Programs

For Hubbell Power Systems Customers:

Programs that HPS (*potentially*) certify to:

- **FTA** Federal Transit Administration
- **FHWA** Federal Highway Administration
- **BAN 1933** Buy American Act of 1933
- **TAA** Trade Agreement Act of 1979
- **AIP** Airport Improvement Program







Helical Pile Advantages

- Vibration Free Installation
- No Excavation Spoils
- Immediate Loading
- Low Mobilization Costs
- Install in Limited Access
- Any Weather Installation
- Minimal Site Preparation
- Manufacturer and Local Distributor Engineering Support
- Certified Installing Contractors

- Torque to Capacity Correlation
- Solution for:
 - Restricted Access Sites
 - High Water Table
 - Weak Surface Soils
- Environmentally Friendly
 - No Vibration
 - No spoils to Remove
- Easy Field Modification







