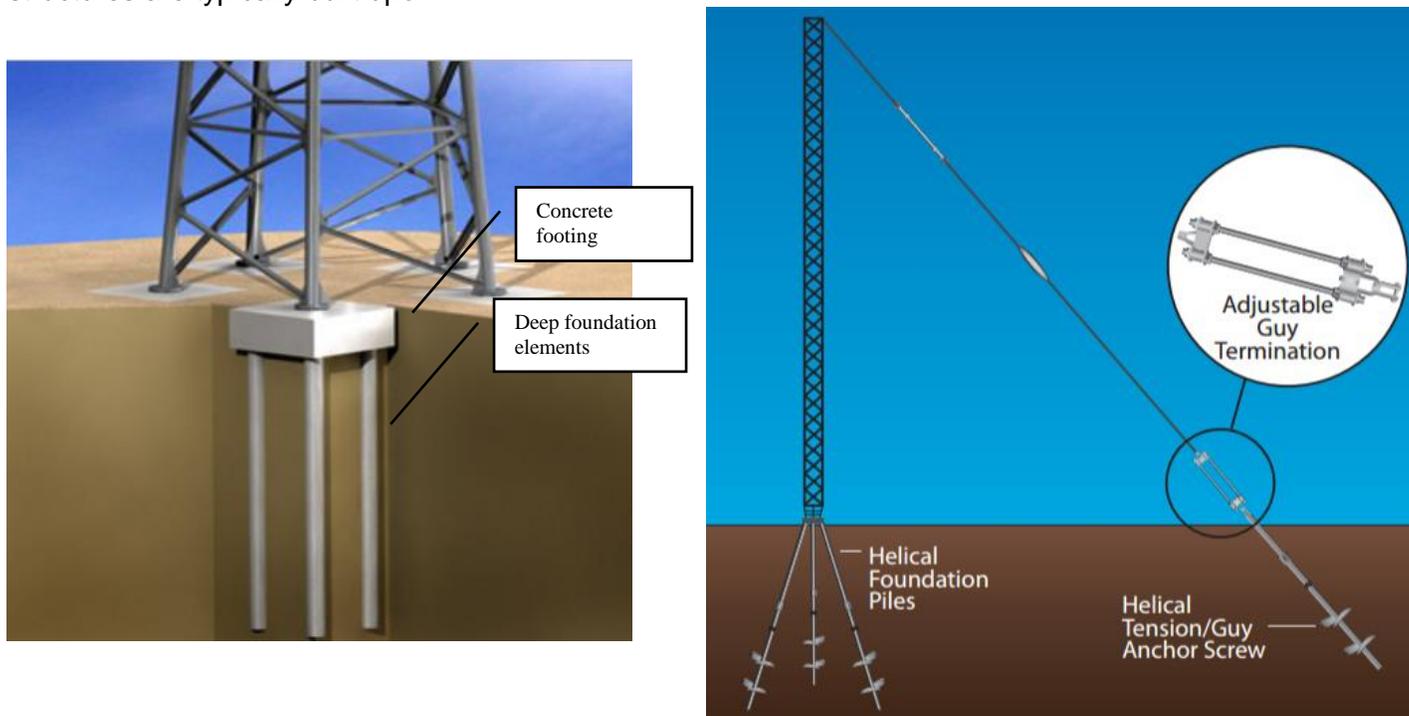


Transmission Helical Piles

Helical anchors are commonly used in tension applications (guying) in both distribution and transmission service lines. However helical piles are utilized in heavy commercial construction to resist tension, compression, lateral, and moment loading. The same helical piles can easily be modified to resist similar type loadings for use in transmission and substation structure foundations. Helical piles can be installed instead of other more costly and time consuming deep foundation elements (caissons, driven piles, etc.) Helical piles can be directly attached to the structure or incorporated into the concrete pads transmission structures are typically built upon.



In some cases they can completely eliminate the need for dealing with concrete. On the left you can see a typical concrete pad with multiple caissons at the base of a lattice structure. The right shows a foundation solution where helical piles have eliminated the vast majority of concrete needed.

Helical piles hold a measurable advantage over traditional deep foundations by:

- Eliminating the need for excavation and disposal of potentially hazardous soil spoils
- Eliminating the needs for expensive rebar placement
- No wait time for concrete to cure
- Reducing the need for large equipment on the site (no crane)
- Easily be adjustable to project needs, as piles can be removed and re-installed

Transmission Helical Piles

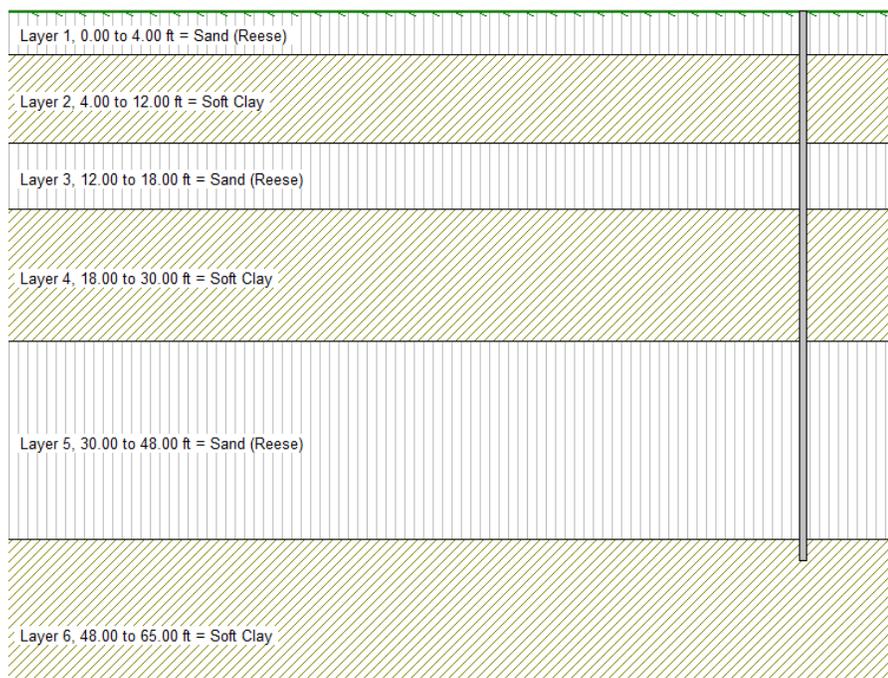
Helical piles are installed in similar fashion to helical anchors. Both are turned into the ground using a torque motor to a predetermined depth and/or applied installation torque. Helical piles, being larger than helical anchors, require greater installation depth and larger installation torques requiring larger equipment. Both anchors and piles are installed in-line with the load they are to resist. In the case of piles, which means they are typically installed vertically, or at a slight batter angle (no more than 5° from vertical). Once the piles are installed to the specified torque and/or depth, the pile can be loaded immediately with no wait time for concrete or pile setup. With a typical installation rate of 5 feet installed every 10 to 15 minutes, helical piles become the best tool for accommodating accelerated construction schedules.

| Preliminary Helical Pile Capacity Calculations | | | | | | | | | | | | | | | | | | | | | |
|---|----------------|--|------------------------|---|----------------------------|--|------------------|------|-----|---------|----------------|---|-----------------|--------|---|--------------------------|--------|---|------------|-------------|---|
| Project Name: | | Utility Sample | |  | | | | | | | | | | | | | | | | | |
| Project Number: | | 112817 | | | | | | | | | | | | | | | | | | | |
| Project Address: | | | | | | | | | | | | | | | | | | | | | |
| Date: Tue Nov 28 2017 14:56:36 GMT-0600 (CST) | | | | | | | | | | | | | | | | | | | | | |
| SOIL BORING DATA | | | Water Level at 12 Feet | | REQUIRED LOADS (Allowable) | | | | | | | | | | | | | | | | |
| Boring ID: B-1 | | | Unit Weight (pcf) | Cohesion (psf) | Friction Angle (degrees) | Required Compression Load: 0 kips | | | | | | | | | | | | | | | |
| Depth (ft) | Soil Type | Helical Pile Diagram | | | | Required Tension Load: 75 kips | | | | | | | | | | | | | | | |
| | | | | | | Required Lateral Load: 0 kips, 0 ft eccentric | | | | | | | | | | | | | | | |
| 4 | SAND |  | 97.2 | 0 | 29.79 | HELICAL PILE CONFIGURATION 2.00" Round Corner Square extension shaft to a depth of 28 feet, followed by a 2.00" Round Corner Square lead shaft to a depth of 35 feet with a batter angle of 0 degrees. The pile is affixed to the structure using a NCB101006P45-1 bracket. Helix 6: 14 inches located at 20.5 feet Helix 5: 14 inches located at 24 feet Helix 4: 14 inches located at 27.5 feet Helix 3: 12 inches located at 30.5 feet Helix 2: 10 inches located at 33 feet Helix 1: 8 inches located at 35 feet | | | | | | | | | | | | | | | |
| 5 | SAND | | 97.2 | 0 | 29.79 | | | | | | | | | | | | | | | | |
| 6 | SAND | | 97.2 | 0 | 29.79 | | | | | | | | | | | | | | | | |
| 7 | SAND | | 97.2 | 0 | 29.79 | | | | | | | | | | | | | | | | |
| 8 | SAND | | 97.2 | 0 | 29.79 | | | | | | | | | | | | | | | | |
| 9 | SAND | | 102 | 0 | 31.65 | | | | | | | | | | | | | | | | |
| 10 | SAND | | 102 | 0 | 31.65 | | | | | | | | | | | | | | | | |
| 11 | SAND | | 102 | 0 | 31.65 | | | | | | | | | | | | | | | | |
| 12 | SAND | | 102 | 0 | 31.65 | | | | | | | | | | | | | | | | |
| 13 | SAND | | 102 | 0 | 31.65 | | | | | | | | | | | | | | | | |
| 14 | SAND | | 102 | 0 | 31.65 | | | | | | | | | | | | | | | | |
| 15 | SAND | | 102 | 0 | 31.65 | | | | | | | | | | | | | | | | |
| 16 | SAND | | 102 | 0 | 31.65 | | | | | | | | | | | | | | | | |
| 17 | SAND | | 104.4 | 0 | 32.58 | | | | | | | | | | | | | | | | |
| 18 | SAND | | 104.4 | 0 | 32.58 | | | | | | | | | | | | | | | | |
| 19 | SAND | | 104.4 | 0 | 32.58 | | | | | | | | | | | | | | | | |
| 20 | SAND | | 104.4 | 0 | 32.58 | | | | | | | | | | | | | | | | |
| 21 | SAND | | 104.4 | 0 | 32.58 | | | | | | | | | | | | | | | | |
| 22 | SAND | | 104.4 | 0 | 32.58 | | | | | | | | | | | | | | | | |
| 23 | SAND | | 104.4 | 0 | 32.58 | | | | | | | | | | | | | | | | |
| 24 | SAND | | 104.4 | 0 | 32.58 | | | | | | | | | | | | | | | | |
| 25 | SAND | | 109.2 | 0 | 34.44 | | | | | | | | | | | | | | | | |
| 26 | SAND | | 109.2 | 0 | 34.44 | | | | | | | | | | | | | | | | |
| 27 | SAND | | 109.2 | 0 | 34.44 | | | | | | | | | | | | | | | | |
| 28 | SAND | | 109.2 | 0 | 34.44 | | | | | | | | | | | | | | | | |
| 29 | SAND | | 109.2 | 0 | 34.44 | | | | | | | | | | | | | | | | |
| 30 | SAND | | 109.2 | 0 | 34.44 | | | | | | | | | | | | | | | | |
| 31 | SAND | | 109.2 | 0 | 34.44 | | | | | | | | | | | | | | | | |
| 32 | SAND | | 109.2 | 0 | 34.44 | | | | | | | | | | | | | | | | |
| 33 | SAND | | 109.2 | 0 | 34.44 | | | | | | | | | | | | | | | | |
| 34 | SAND | | 109.2 | 0 | 34.44 | | | | | | | | | | | | | | | | |
| 35 | SAND | | 109.2 | 0 | 34.44 | | | | | | | | | | | | | | | | |
| 36 | SAND | | 109.2 | 0 | 34.44 | | | | | | | | | | | | | | | | |
| SAFETY FACTORS APPLIED Compression: 2 Tension: 2 Lateral: 2 Buckling: 2 | | | | | | | | | | | | | | | | | | | | | |
| CALCULATION RESULTS Ultimate Bearing Capacity: 186.8 kips > 0 kips PASS Ultimate Tension Capacity: 164.8 kips > 150 kips PASS Mechanical Compression Capacity of Shaft: 150 kips > 0 kips PASS Mechanical Tension Capacity of Shaft: 150 kips > 150 kips PASS Required Depth for Lateral Capacity: 35 feet > 0 feet PASS Bending Strength for Lateral Capacity: 10.9 ft-kips > 0 ft-kips PASS Buckling Strength: 150 kips > 0 kips PASS Torque Capacity (based on Kt = 10): 15000 ft-lbs > 15000 ft-lbs PASS | | | | | | | | | | | | | | | | | | | | | |
| NOTES Due to helix spacing requirements, the catalog number for this configuration needs to be evaluated by Maclean Dixie. This helical pile configuration is based on industry standard design methodologies. If your project requires ICC-ES AC 308 evaluated product, please contact MacLean Dixie at www.macleandixie.com. Prior to final pile design, preliminary tests, conducted with the proposed pile configuration, are recommended. | | | | | | | | | | | | | | | | | | | | | |
| CATALOG NUMBERS <table border="1"> <thead> <tr> <th>Item Description</th> <th>ID #</th> <th>Qty</th> </tr> </thead> <tbody> <tr> <td>Bracket</td> <td>NCB101006P45-1</td> <td>1</td> </tr> <tr> <td>Extension Shaft</td> <td>D15E84</td> <td>3</td> </tr> <tr> <td>Extension Shaft w/ helix</td> <td>Custom</td> <td>1</td> </tr> <tr> <td>Lead Shaft</td> <td>D1584T81012</td> <td>1</td> </tr> </tbody> </table> Prepared By: MPS Engineers | | | | | | | Item Description | ID # | Qty | Bracket | NCB101006P45-1 | 1 | Extension Shaft | D15E84 | 3 | Extension Shaft w/ helix | Custom | 1 | Lead Shaft | D1584T81012 | 1 |
| Item Description | ID # | Qty | | | | | | | | | | | | | | | | | | | |
| Bracket | NCB101006P45-1 | 1 | | | | | | | | | | | | | | | | | | | |
| Extension Shaft | D15E84 | 3 | | | | | | | | | | | | | | | | | | | |
| Extension Shaft w/ helix | Custom | 1 | | | | | | | | | | | | | | | | | | | |
| Lead Shaft | D1584T81012 | 1 | | | | | | | | | | | | | | | | | | | |

MacLean Real Time Design, discussed on the next page, is a free-to-use design software used to determine the anticipated axial capacities of the pile based on the helix configuration and soil boring information provided.

Transmission Helical Piles

Helical piles are designed per each project's specific needs to offer the most economic and practical deep foundation solution. MacLean Power Systems' (MPS) anchor product team can utilize our groundbreaking MacLean Real Time Design online software and ENSOFT Inc.'s LPILE software to provide a design recommendation submittal packet for your design professional's review. Our team can also conduct lunch and learn seminars on the design and use of helical piles for your organization.



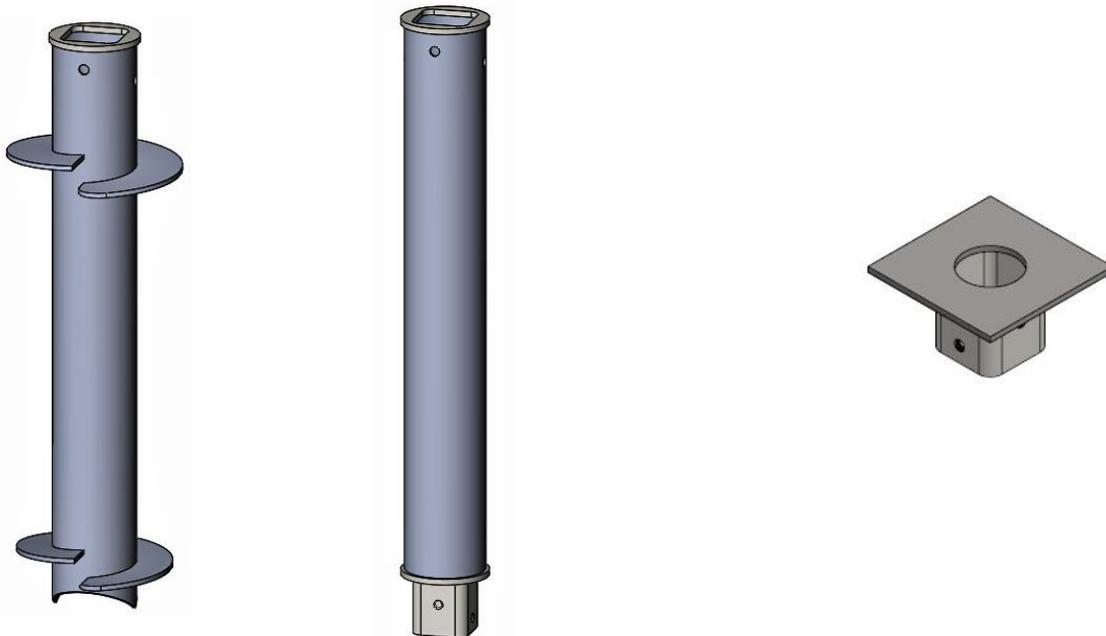
ENSOFT Inc.'s LPILE is used to model the pile's shear and moment capacities based on the subsurface conditions. It greatly aids in pile design in areas with swampy or poor soil conditions.

The MPS transmission and substation foundation product lines provides multiple product offerings to meet you project specific foundation specifications. Our F86 (8.625" pipe) and R45H (4.5" pipe) pipe pile products offer excellent axial, lateral and moment load resistance with ease of installation. Our 2" round corner square (RCS) products provide 150 kips (150,000 lbs.) of axial load resistance for guy and smaller foundation applications.

Transmission Helical Piles

F86

8.625" diameter pipe pile. Available in two wall thicknesses, 0.188" and 0.250". Used in cases where poor subsoil conditions and in large loading conditions. Wall thickness is determined by soil conditions and loading requirements. Features a double cut nose for ease of installation as well as an internal coupling system with threaded bolt holes to ensure a snug fit between pieces of pipe. Helixes available from 14-24" in 2" increments.



| 0.188" Wall Thickness | | 0.250" Wall Thickness | |
|-----------------------|------------|-----------------------|------------|
| Leads | Extensions | Leads | Extensions |
| F86L120T162024 | F86LE120 | F86M120T162024 | F86ME120 |
| F86L60T1416 | F86LE84 | F86M60T1416 | F86ME84 |
| F86L60T16 | F86LE60 | F86M60T16 | F86ME60 |

| Installation Tool | Mounting Bracket |
|-------------------|------------------|
| R86TL300 | NCB121204R86 |

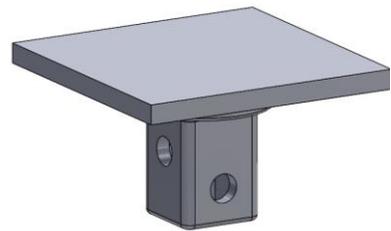
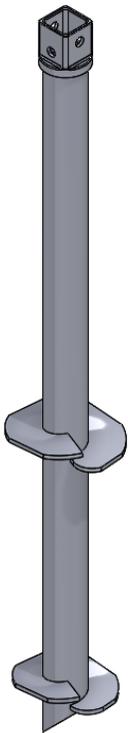
| Ultimate Capacities – 0.188" Wall | | Ultimate Capacities – 0.250" Wall | |
|-----------------------------------|-------------|-----------------------------------|-------------|
| 200,000 Lbs. | Compression | 300,000 Lbs. | Compression |
| 150,000 Lbs. | Tension | 175,000 Lbs. | Tension |
| 40,000 Ft-Lbs. | Torque | 40,000 Ft-Lbs. | Torque |

Kt Factor = 5

Transmission Helical Piles

R45H

4.50" diameter pipe pile with a wall thicknesses of 0.337". Used when the loading requirements are less than that of the F86. Can be grouted to increase lateral capacity of the pile. These piles feature our patented Strength Squared™ coupling system eliminate wasted time trying to turn the pipe to get the bolt holes to line up and enable faster connection between sections of pipe during installation.



| Leads | Extensions |
|----------------|----------------|
| R45H64T810 | R45HE64 |
| R45H64T1012 | R45HE64T14S29 |
| R45H84T81012 | R45HE84 |
| R45H84T101214 | R45HE84U |
| R45H84T101214U | R45HE84T142S29 |
| | R45HE124 |

| Installation Tool | Mounting Bracket |
|-------------------|------------------|
| IT-45-7625 | NCB101006P45 |

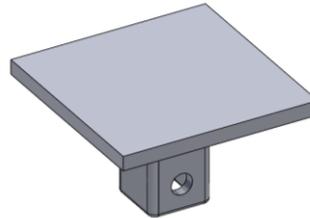
| Ultimate Capacities |
|----------------------------------|
| 156,000 Lbs. Tension/Compression |
| 26,000 Ft-Lbs. Torque |

Kt Factor = 6

Transmission Helical Piles

S15

2.00" round corner solid square pile. Used when lateral loads are relatively small. Can be grouted to increase lateral capacity of the pile. Due to this anchors small profile it is able to penetrate into tougher soils than the larger pipe piles. It can also be used as the lead section of the pile with the R45H extensions. Giving you the benefits of the increased penetrating power as well as the increased lateral support that pipe piles offer.



| Leads | Extensions |
|--------------|---------------|
| S1560T810 | S15E60 |
| S1560T1012 | S15E84 |
| S1584T81012 | S15E84T142S29 |
| S1584T101214 | |

| Installation Tool | Mounting Bracket |
|-------------------|------------------|
| IT-45-7625 | NCB101006P45-1 |

| Ultimate Capacities | |
|---------------------|---------------------|
| 150,000 Lbs. | Tension/Compression |
| 15,000 Ft-Lbs. | Torque |

| |
|----------------|
| Kt Factor = 10 |
|----------------|