May 14, 2025

Mr. Joshua Griffin

Alpha Foundations

850.630.0053

RE: Primary Recommendation 51425FL- Panama City Beach, Florida

Dear Mr. Griffin,

Introduction

We received your request for a preliminary design recommendation for helical piles to support the Laguna Beach Chapel in Panama City Beach, Florida. According to C. Todd Walker, P.E., the anticipated maximum column load, or working load for helical piles, is 55 kips per pile. Using a safety factor of 2.0, our ultimate load is therefore 110 kips, or 110,000 lbs. per pile.

The geotechnical report, courtesy of Magnum Engineering Inc. Geotechnical Engineering Consultants, contained five soil borings at the site to provide a generalized look at the subsurface strata. According to the boring logs and descriptions in the geotechnical report, the soil is generally “loose to very loose sands… to approximately 12 feet below existing grade (BG) underlain by loose to medium dense clean fine sands and silty fine sands to roughly 18 feet” (BG). Below this the soil is “loose to dense silty fine sands and clayey fine sands… to the boring termination depth of 40 feet below existing grade”. The target embedment depth will be within the dense silty fine sand at 40 feet below grade (BG).

Helical Configuration

To begin, we know the ultimate load for the helical piles will be 110 kips and our target depth will be at a depth of 40 feet BG. The ambiguity of the soil means that helical piles may fully develop the required minimum torque before this depth, or slightly after. Given this, and that the soil is both cohesive and cohesionless, we can solve for the sum of the area of our helixes using the following equation from Karl Terzaghi:

$$P_u = \Sigma A_h * [\alpha * q * N_q + \beta * c * N_c]$$

Where:

P_u = Ultimate Compression Capacity (lbs.)

ΣA_h = Required Helical Bearing Plate Area (ft^2)

q = soil overburden pressure (psf)

N_q = Cohesionless Bearing Capacity Factor

α = % of soil that is cohesionless

β = % of soil that is cohesive

c = undrained shear strength (psf)

N_c = Cohesive Bearing Capacity Factor = 9 (constant)

We can predict what percentage of embedding soil is cohesive and what percentage is cohesionless from the descriptions in the soil boring logs. Based on the descriptions of the soil throughout the boring logs and geotechnical report, roughly 20% of the soil we want to embed within is cohesive clay, and 80% is cohesionless sand. Our equation then can be restructured as the following:

$$P_u = \Sigma A_h * (.80 * q * N_q + .20 * c * N_c)$$

The soil overburden pressure (q) is the sum of the density of each soil layer multiplied by the thickness, and is represented by the following expression:

$$q = \Sigma\,(\gamma * h)$$

Where:

γ = density of strata (lb/ft^3)

h = thickness of layer (feet)

To solve for the soil overburden pressure, we can use the average blow count at every depth to find the average density of the soil. The dry densities were found by interpolating Table 7., properties of cohesionless soil from Chapter one of the *ECP Design and Technical Service Manual* shown below.

Table 7.	Properties of Cohesionless Soil				
Soil Density Description	SPT Blow Count "N"	Friction Angle "ϕ"	Bearing Capacity Factor "N_q"	Density "γ" lb/ft³ Moist Soil	Submerged
Very Loose	≤ 2	28°	12	70 – 100	45 - 62
	3 – 4	28°	13		
Loose	5 – 7	29°	14 – 15	90 – 115	52 - 65
	8 – 10	30°	15 – 16		
Medium Dense	11 – 15	30° - 32°	17 - 19	110 –130	68 - 90
	16 – 19	32° - 33°	20 – 22		
	20 – 23	33° - 34°	23 – 25		
	24 – 27	34° - 35°	26 – 29		
	28 – 30	35° - 36°	30 – 32		
Dense	31 – 34	36° - 37°	34 - 37	110 – 140	80 - 97
	35 – 38	37° - 38°	39 – 43		
	39 – 41	38° - 39°	45 – 48		
	42 – 45	39° - 40°	50 – 56		
	46 – 50	40° - 41°	59 – 68		
Very Dense	> 50	> 42°	End Bearing	140+	> 85

The average groundwater across the borings is just under 7 feet BG. The unit weight of water (62.4 pcf) must be subtracted from the densities below the water table when solving to account for its buoyancy effect on the soils when saturated.

Solving:

$$q = \left(95.\overline{3}\ \frac{lb}{ft^3} * 2'\right) + \left(88.\overline{6}\ \frac{lb}{ft^3} * 2'\right) + \left(78\ \frac{lb}{ft^3} * 2'\right) + \left(87.\overline{3}\ \frac{lb}{ft^3} * 1'\right) + \left(24.9\overline{3}\ \frac{lb}{ft^3} * 1'\right) + \left(30.9\overline{3}\ \frac{lb}{ft^3} * 2'\right) + \left(54.1263\ \frac{lb}{ft^3} * 5'\right) + \left(15.6\ \frac{lb}{ft^3} * 5'\right) + \left(48.6526\ \frac{lb}{ft^3} * 5'\right) + \left(52.8632\ \frac{lb}{ft^3} * 5'\right) + \left(63.6\ \frac{lb}{ft^3} * 5'\right) + \left(77.4\ \frac{lb}{ft^3} * 5'\right)$$

$$q = \left(190.\overline{6}\frac{lb}{ft^2}\right) + \left(177.\overline{3}\frac{lb}{ft^2}\right) + \left(156\frac{lb}{ft^2}\right) + \left(87.\overline{3}\frac{lb}{ft^2}\right) + \left(24.9\overline{3}\frac{lb}{ft^2}\right) + \left(61.8\overline{6}\frac{lb}{ft^2}\right) + \left(270.6316\frac{lb}{ft^2}\right) + \left(78\frac{lb}{ft^2}\right) + \left(243.2632\frac{lb}{ft^2}\right) + \left(264.3158\frac{lb}{ft^2}\right) + \left(318\frac{lb}{ft^2}\right) + \left(387\frac{lb}{ft^2}\right)$$

$$q = 2{,}259.344\ \frac{lb}{ft^2}$$

Cohesionless Bearing Capacity Factors (N_q) is a dimensionless empirical value based upon the Standard Penetration Testing (SPT) N value of the stratum. Embedding within the soil at 40 feet below grade the average N value is 49.6. Therefore, the corresponding N_q value is 67.1 for the Cohesionless Bearing Capacity. (Cohesionless Bearing Capacity Values found via interpolation of Table 7. from Chapter 1 of the *ECP Design and Technical Service Manual* shown above.)

The undrained shear strength of the soil is also directly related to SPT Blow Count. The average blow-count from the boring log is an N value of 49.6 at 40 feet below grade. The corresponding undrained shear strength is 6,200 lb./ft^2 (Undrained Shear Strength found from Chapter 1 of the ECP Design and Technical Service Manual, interpolating Table 5. Properties of Cohesive Soil, shown below)

Table 5. Properties of Cohesive Soil

Soil Density Description	SPT Blow Count - "N"	Undrained Shear Strength "c" – lb/ft^2	Unconfined Compressive Strength lb/ft^2
Very Soft	0 – 2	< 250	< 500
Soft	2 – 4	250–500	500—1,000
Firm	4 – 8	500–1,000	1,000—2,000
Stiff	8 – 15	1,000–2,000	2,000—4,000
Very Stiff	15 – 32	2,000–4,000	4,000—8,000
Hard	32 – 48	4,000–6,000	8,000—12,000
Very Hard	> 48	> 6,000	> 12,000

Solving:

$$P_u = \Sigma A_h * \left(0.8 * q * N_q + 0.2 * c * N_c\right)$$

$$P_u = \Sigma A_h * \left(0.8 * 2{,}259.344 \frac{lb}{ft^2} * 67.1 + 0.2 * 6{,}200 \frac{lb}{ft^2} * 9\right)$$

$$P_u = \Sigma A_h * \left(121{,}281.6 \frac{lb}{ft^2} * + 11{,}160 \frac{lb}{ft^2}\right)$$

$$P_u = \Sigma A_h * \left(132{,}441.6 \frac{lb}{ft^2}\right)$$

$$\Sigma A_h = \frac{110{,}000\ lbs.}{132{,}441.6\ {}^{lb}/_{ft^2}}$$

$$\Sigma A_h = 0.830555\ ft^2$$

This means the piles will require a projected helical area greater than 0.831 square feet. Therefore, I recommend an 8-10-12 helical configuration to provide the required helical bearing area. The optimum product is the TAF-30S-120-8-10-12. A 3" round corner square (RCS) 0.375" thick tube shaft lead, with three 3/8" thick helices. The projected area of the 8-10-12 helical plates is 1.49 square feet of bearing capacity area, sufficiently larger than the required minimum area.

The helices for this product are 3/8” thick. The mechanical capacity of the 3/8” thick plate is 40 kips each, meaning they are viable to use. The service mechanical capacity of the 3” RCS tube shaft is 165 kips in both compression and tension, sufficient for the anticipated loading.

Minimum Installation Spacing

To fully develop the bearing capacity, industry standard dictates the piles require a minimum center to center spacing of 3 times the maximum helix diameter. All the helical piles have the same helical plate configuration; therefore, all piles have the same spacing requirement.

$$s_{min1} = 3 * \ d_{helix} = 3 * 12" = 36" = 3\ ft$$

Installation Torque

As the helical pile is installed, the soil resists the rotation of the shaft and helices. This frictional resistance is associated with the torque required to advance the pile through the soil. The capacity of the pile/soil interaction is estimated using the installation torque. ECP only relies on the helical plates in estimating the bearing capacity of a pile. While we do not include skin friction in our capacity estimate, the shaft rotating through the soil does produce frictional resistance. In order to mitigate the frictional resistance of the shaft and concentrate on the force applied to the plates, ECP uses an empirical torque factor in the torque capacity equation. Each unique shaft profile is assigned an empirical torque factor. This aids to estimate the amount of energy being applied to the bearing plates and the ultimate bearing capacity of the helices/soil interaction. The torque factor ranges have been developed over decades of industry research and testing. These factors are influenced by the product profile and soil conditions and are not dependent on the pile manufacturer. The conversion from torque to bearing capacity is calculated via the following expression.

$$P_u = \tau * k$$

Where the Greek letter tau represents installation torque, and k is the empirical torque factor.

Solving:

$$\tau_1 = \frac{110{,}000\ lbs}{10\ ft^{-1}} = 11{,}000\ \ ft.lbs.$$

This number is below the ultimate torsional limit of the 3” RCS 0.375” thick shaft (19,000 ft-lbs.) and is therefore viable.

To help assure the helical piles are being installed into competent soil, ECP recommends that the target installation torque be achieved as an average value over the final three feet of installation. This average is to be observed around the expected or desired helical seating depth. Observing the torque as an average over a set travel distance will provide a greater assurance that the helical plates have been fully installed into the competent seating soil.

Note: The helical piles will be embedded into dense hard stratum which could cause the piles to quickly reach installation torque or “spin out”. Use caution to not over torque the helical piles. When end-bearing soil is met, torques can decrease or spike. Slow down revolutions per minute when nearing install depth to avoid a spike. If the piles “spin out”, installation should be stopped to avoid weakening the bearing soil.

Helical Pile Summary

Lead: TAF-30S-120-8-10-12. This pile is manufactured from a 3” round corner square 0.375” thick tube and is 10’ long. The 8-10-12 inch helices are 3/8” thick each. The helices provide 1.49 square feet of bearing area, sufficient for the required loads. The service mechanical capacity of the shaft is 165 kips in compression and tension. The lead is also offered in a 60” or 84” long option, but flight configuration may need to continue onto the extensions.

Extensions: TAE-30S-120. These extensions are fabricated from 3” round corner square 0.375” thick tube to match the lead sections. The extensions are attached to the proceeding section by way of SAE J429, Grade 8 hardware. ECP recommends using the longest extension section the site conditions and installation equipment allow. The shaft is also offered in lengths of 60” or 84” options.

Cap: TAB-30S-NC. This pile cap works with the 3” round corner square 0.375” thick tube. If the need to satisfy tensile loading persists, hardware can be included to ensure the cap can handle tension loading as well.

Helical Pile Installation Summary

Estimated Embedment Depth:	40 feet below grade.
Minimum Embedment Depth:	6 feet below grade.
Minimum Pile Spacing:	3 feet.
Target Installation Torque:	T = 11,000 ft-lbs. (average over final 3 feet).
Maximum Torque Capacity:	19,000 ft-lbs.

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Please review the above and call me if you have any questions.

Respectfully Submitted,

Garrett D Roberts

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