PanGEO INCORPORATED
Geotechnical & Earthquake Engineering Consultants

April 21, 2022
Project No. 22-111

Ms. Cheryl McConnell
c/o **Heliotrope Architects**
5140 Ballard Avenue NW, Suite B
Seattle, WA 98107
Mr. Mike Mora, AIA

Subject: Geotechnical Report Addendum
Pin Piles
7845 Southeast 62nd Street, Mercer Island, Washington

Dear Mr. Mora:

This geotechnical report addendum provides recommendations for driven pin pile foundations. We understand that pin piles will be used to minimize the size of footing excavation, as a mean to protect an existing tree. The recommendations outlined in this addendum should be used in conjunction with our geotechnical report dated April 14, 2022 (updated April 18, 2022).

Small diameter driven pipe piles (pin piles) are typically 2- to 4- inches in diameter. However, larger diameter 6- and 8-inch piles may also be used, which have a higher vertical capacity. Two-inch pin piles are typically installed using portable, handheld equipment and are suited for areas where limited site access exists, or in low headroom areas (i.e., inside a basement). Three- to 8-inch diameter pin piles are typically installed using small to large hammers (600 to 4,700 lbs) mounted on small to medium-sized excavators.

Pin Pile Axial Capacity

The number of piles required depends on the magnitude of the design load. An allowable axial compression capacity of 3 tons (6 kips) may be used per 2-inch diameter pile, 6 tons (12 kips) per 3-inch diameter pile, 10 tons (20 kips) per 4-inch diameter piles, and 15 tons (30 kips) for 6-inch diameter piles, with an approximate factor of safety of at least 2.0. Penetration resistance required to achieve the capacities will be determined based on the hammer used to install the pile. The tensile capacity of pin piles should be ignored in design calculations.

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It is our experience that the driven pipe pile foundations should provide adequate support with total settlements on the order of ½-inch or less.

Pin Pile Specifications

We recommend that the following specifications be included on the foundation plan:

1. 2-inch diameter piles should consist of Schedule-80, ASTM A-53 Grade "A" pipe.

2. 3-inch, 4-inch, and 6-inch diameter piles should consist of Schedule-40, ASTM A-53 Grade "A" pipe.

3. 2-inch piles shall be driven to refusal with a minimum 90-lb jackhammer. Refusal is defined as no more than 1 inch of penetration for 1 minute of continuous driving.

4. 3-inch piles shall be driven to refusal with a minimum 600-lb hydraulic hammer. We recommend the following refusal criteria based on the size of hammer utilized:

Hammer Size	Blow per Minute	Refusal Criteria (3-inch pile)
600 lbs	1000	12 seconds per inch
850 lbs	900	10 seconds per inch
1100 lbs	900	6 seconds per inch

   The driving criteria recommended in the table above will be verified by a static load test program (see discussion in Item 8).

5. 4-inch piles shall be driven to refusal with a minimum 850-lb hydraulic hammer. We recommend the following refusal criteria based on the size of hammer utilized:

Hammer Size	Blow per Minute	Refusal Criteria (4-inch pile)
850 lbs	900	16 seconds per inch
1100 lbs	900	10 seconds per inch
2000 lbs	600	4 seconds per inch

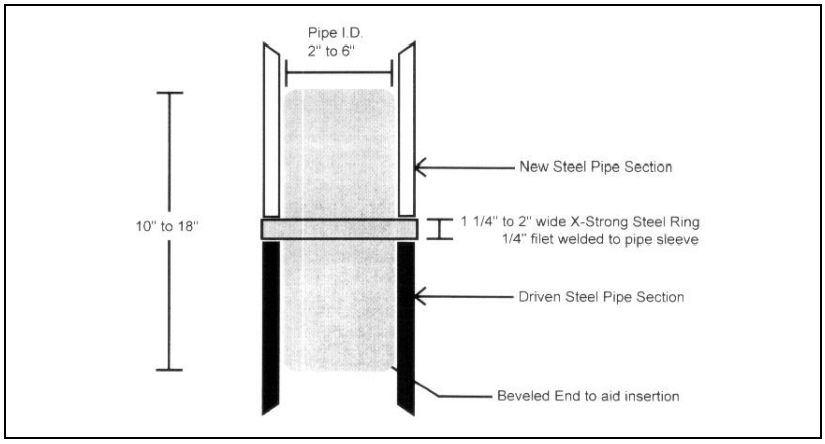
The driving criteria recommended in the table above will be verified by a static load test program (see discussion in Item 8).

6. 6-inch piles shall be driven to refusal with a minimum 2000-lb hydraulic hammer. We recommend the following refusal criteria based on the size of hammer utilized:

Hammer Size	Blow per Minute	Refusal Criteria (6-inch pile)
2000 lbs	600	10 seconds per inch
3000 lbs	500	6 seconds per inch
4700 lbs	500	4 seconds per inch

The driving criteria recommended in the table above will be verified by a static load test program (see discussion in Item 8).

7. Piles shall be driven in nominal sections and connected with compression fitted sleeve couplers (see detail below – Courtesy of McDowell Pile King, Kent, WA). We discourage welding of pipe joints, particularly when galvanized pipe is used, as we have frequently observed welds broken during driving.



8. At least 3% (but no more than 5) of the 3-inch, 4-inch, and 6-inch pin piles should be load tested. All load tests shall be performed in accordance with the procedure outlined in ASTM D1143. The maximum test load shall be 2 times the design load. The objective of the testing program is to verify the adequacy of the driving criteria, and the efficiency of the hammer used for the project.

9. As required by the City of Mercer Island, the geotechnical engineer of record or his/her representative shall provide full time observation of pile installation and testing.

The quality of a pin pile foundation is dependent, in part, on the experience and professionalism of the installation company. We recommend that a company with experienced personnel be selected to install the piles.

Lateral Resistance

Lateral capacity of vertical pin piles should be ignored in design calculations. Some resistance to lateral loads may be accomplished by battering the piles to a slope of 1(H):4(V), or steeper.

In addition, lateral forces may be resisted by tying the grade beams and pile caps to the soldier pile shoring wall, if it is designed as a permanent wall. Passive soil resistance values for embedded pile caps and grade beams may be determined using an equivalent fluid weight of 300 pounds per cubic foot (pcf). This value includes a factor of safety of at least 1.5 assuming that a properly compacted structural fill will be placed adjacent to the sides of the pile caps and grade beams.

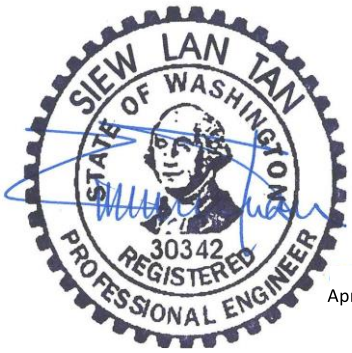
Friction at the base of pile-supported grade beams should be ignored.

Obstructions

Obstructions, if encountered, should be removed to facilitate the pile driving. If obstructions cannot be removed, the structural engineer of record should be notified to revise the pile layout to accommodate moving the piles.

We appreciate the opportunity to work on this project. Please call if there are any questions.

Sincerely,



April 21, 2022

Siew L. Tan, P.E.
Principal Geotechnical Engineer