

The Murillo Company

10325 LANDBURY STE. 400 • HOUSTON, TX 77099-4299
PHONE (281) 933-9702 • FAX (281) 933-1051

GEOTECHNICAL INVESTIGATION

6147 REAMER STREET

HOUSTON, TEXAS

PREPARED BY

THE MURILLO COMPANY
GEOTECHNICAL CONSULTANTS
HOUSTON, TEXAS

REPORT NUMBER

GEO3942022

REPORTED TO

DAVID BLATT
HOUSTON, TEXAS

AUGUST 2022

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INTRODUCTION

The study reported herein is an investigation of the subsurface conditions at the site of a proposed Single Family Residence, to be constructed at 6147 Reamer Street in Houston, Harris County, Texas (Key Map 530 V).

AUTHORIZATION

This investigation was authorized on July 27, 2022 by David Blatt, Property Owner, in an agreement with this office for Geotechnical Engineering Services.

SUBSURFACE EXPLORATION

The Subsurface Exploration at the site was accomplished by means of two (2) undisturbed sample core borings drilled to a depth of thirty (30) feet below existing ground surface. Approximate locations of the borings are shown on the attached Boring Plan.

SUBSURFACE CONDITIONS

Specific types and depths of subsurface strata encountered at the site are shown on the attached Boring Logs. Review of the Boring Logs indicates that the generalized stratigraphy at the site is approximately as follows:

<u>Depth, Feet</u>	<u>Description of Strata</u>
0 - 10	Very stiff dark gray to tan and gray clay (CH) w/ferrous and calcareous nodules
10 - 27	Firm to dense gray and tan silty fine sand (SM), waterbearing or Very stiff to soft gray and tan sandy clay (CL) w/ferrous nodules, moist
27 - 30	Very stiff tan, red and gray clay (CH) w/calcareous nodules and sand seams

Surface Material: 3.0" Crushed Concrete

Surface Soils

The near Surface Soils are "CH" type when classified by the Unified Soils Classification System. This type soil normally exhibits high swell potential during seasonal moisture variations.

Ground Water

Ground water was encountered at the site during drilling operations at a depth of eighteen (18) feet below existing ground surface. Static water level upon completion of the drilling and sampling procedures was at a depth of fifteen (15) feet.

SUBSURFACE VARIATIONS

The information contained in this report summarizes conditions encountered on the date and at the locations where the borings were drilled. The depth to a static ground water table and subsurface soil moisture content will vary with seasonal and environmental variations, such as frequency and magnitude of rainfall and future construction activities, which may alter the surface and drainage characteristics of the site. In cohesive soils, fluctuations in ground water depth occur over a longer period than in granular soils.

An accurate evaluation of the steady ground water level requires long-term measurements of monitoring wells and/or piezometers, which was beyond the scope of this study. The ground water level that might occur cannot be accurately predicted based on short-term exploration.

DESIGN ANALYSIS AND RECOMMENDATIONS

Construction at the site envisions a single family residence elevated ten (10) feet above ground and a garage structure at grade.

With this type construction, the residential structure may be supported by Square Timber Piles, Drilled and Underreamed Footings or Helical Piles. The garage structure may be supported by a Grade Beam Foundation or a Post Tension Foundation. Each will be discussed in subsequent paragraphs.

RESIDENTIAL STRUCTURE

Square Timber Piles

Based on the Boring Logs, we developed a typical profile representative of soil conditions, and computed allowable axial pile capacities for the site profile.

The results of computations in the cohesive soils are presented on the attached Pile Capacity Curve for Square Timber Piles (see Figure 1). A minimum factor of safety of 2.0 was used to obtain the allowable pile capacity.

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<u>Pile Diameter</u>	<u>Depth, Ft.</u>	<u>Load, KIPS*</u>
12" x 12"	15	20
	20	27
	25	35

* Includes point bearing and skin friction

Drilled and Underreamed Footings

A foundation consisting of Drilled and Underreamed Footings which extend to a depth of eight (8) feet below existing ground surface may be used to support the structural loads.

Utilizing a minimum factor of safety of 3 for dead load or a minimum factor of safety of 2 for total load, the allowable bearing capacity of the foundation soils at the recommended depth, is given as 3,500 pounds per square foot for dead load or 5,000 pounds per square foot for total load.

An allowable side friction value of 500 pounds per square foot may be used if uplift pressures are considered. Lateral loads acting against drilled pier shafts should be based on a maximum 20 kips.

Footing Installation

Each footing excavation should be inspected by the On-Site Geotechnical Engineer's Representative prior to placing concrete to insure that (a) the footing has been constructed to the specified dimensions, at the correct depth and in the correct formation established by the previously mentioned criteria, (b) the footing is concentric with the pier shaft or column, and (c) the excessive cuttings, build-up and any soft compressible materials have been removed from the bottom of the excavation.

A bell angle of forty five (45) degrees and a shaft to bell diameter of 3:1 may be used for all footings which do not exceed seventy two (72) inches. Footings which exceed seventy two (72) inches may require that they be sized with a bell angle of sixty (60) degrees and a shaft to bell diameter of 2:1, if sloughing occurs.

Placement of concrete should be accomplished as soon as possible to prevent changes in the state of stress and caving of the foundation soils. No footings should be poured without the prior approval of the On-Site Geotechnical Engineer's Representative.

Foundation Settlement

A detailed settlement analysis was not within the scope of this study. It is anticipated that drilled footings designed using the recommended allowable bearing capacities will experience differential settlements that will be within the one (1) inch maximum this type structure can tolerate.

Helical Piles

A Helical Pile Foundation system may be considered as an alternative to Square Timber Piles or Drilled and Underreamed Piers. Helical Piles are installed to a design torque and not to a required depth. The Helical Pile Designers use torque to estimate the axial capacity of the pile and should select the size and number of helical bearing plates for each Helical Pile based on planned loads of the proposed structure.

An experienced Helical Pile Contractor should be used to install the Helical Piles. Torque measurements during installation of the Helical Piles should be used to verify the axial capacity of the Helical Piles. The Helical Piles should be installed per the manufacturer's recommendations.

Load Test

A Load Test on a production type Helical Pile should be performed as part of the construction to confirm the estimated design capacity. The tested Helical Pile should be installed and torqued to the design torque to support the proposed structure. The Load Test should be witnessed by the Geotechnical Engineer's Representative.

GARAGE STRUCTURE

Grade Beam Foundation

It is recommended that if a Grade Beam Foundation is used, an allowable bearing capacity not exceeding 1,200 pounds per square foot for dead load or 1,800 pounds per square foot for total load be used in design.

The weighted value of the Plasticity Index (effective P.I.) as determined in accordance with B.R.A.B. Report No.33, was determined to be 37%. A Swell Index (S.I.) in determining the Support Index (c) to be used is 3.7%. The potential vertical rise utilizing no surcharge except for weight of slab and live load is 2.50 inches.

No zones of excess hydrostatic pressure were encountered within the full depth explored which would adversely affect the slab foundation. The exterior grade beams should extend a minimum eighteen (18) inches into the regraded surface or compacted building pad soils.

Post Tension Foundation

The structural design procedure as recommended by the Post-Tensioning Institute (PTI) in their design manual entitled "Design of Post-Tensioned Slabs-on-Ground," Third Edition dated 2004, should be used in design.

The design should consist of four (4) inch minimum slab thickness and exterior grade beams of ten (10) inch minimum width, using the following parameters:

- | | |
|--------------------------------------|-------------------|
| 1. Type Clay Soil | = Montmorillonite |
| 2. Effective Plasticity Index (P.I.) | = 37% |
| 3. Percent of Clay Mineral | = 50% |
| 4. Depth to Constant Moisture | = 9 feet |
| 5. Constant Suction, pF | = 3.45 |
| 6. Velocity of Moisture Flow | = 0.70 in/mo |
| 7. Thornthwaite Moisture Index | = +18 |

Utilizing the soils properties given above, the edge moisture variation, e_m equals 7.2 feet (for center lift) and 4.8 feet (for edge lift). The differential soil movement, Y_m is then calculated as:

$$Y_m = 0.700 \text{ inches (edge lift)} < 4.0 \text{ Inch}$$

$$Y_m = 1.100 \text{ inches (center lift)} < 4.0 \text{ Inch}$$

It is recommended that an allowable bearing capacity not exceeding 1,200 pounds per square foot for dead load or 1,800 pounds per square foot for total load be used in design. Exterior grade beams should be placed a minimum eighteen (18) inches into the regraded surface or compacted building pad soils.

Foundation Settlement

A detailed settlement analysis was not within the scope of this study. It is anticipated that the footings designed using the recommended allowable bearing capacity will experience small settlements that will be well within the tolerable limit for the proposed structure.

Potential Vertical Rise

Potential Vertical Rise (PVR) was estimated using a computer program, based on an empirical modified procedure developed by Mc Dowell, as outlined in Texas Department of Transportation (TxDOT) Test Method TEX-124.

Based on existing grades, the total PVR at this site was computed at 2.50 inches. It is possible that the magnitudes of PVR may be greater than the predicted values if soils with greater potential for shrink-swell movement are present in areas of the site where boreholes were not located.

Movement (PVR) is normally influenced by seasonal changes in soil moisture, placement of a building pad, location of landscaping, or permanent watering systems placed adjacent to a structure.

Compacted Building Pad

Conventional "slab on fill" may be used for the interior portion of the structures planned at the site. The floor slab should be placed on a Compacted Building Pad a minimum twenty four (24) inch in thickness, or to an elevation which conforms to the City of Houston Building Authority minimum code requirements. Whichever is higher in elevation should be used.

Prior to placement of the Building Pad material, all concrete, vegetation, topsoil containing organic material or other deleterious material should be cleared and grubbed. The exposed surface should be proof-rolled in accordance with TxDOT Item 216 (2014). Any pockets of soft or weak soils encountered should be removed.

Fill material should be placed under laboratory control, in no greater than ten (10) inch loose layers, and compacted to a minimum 95% of Standard Proctor Density as determined by the ASTM D-698 Procedure, at Optimum Moisture Content (0 to +3%).

The material used as Select Fill for the Building Pad should consist of an imported, select non-active sandy clay type soil having a Plasticity Index (P.I.) between 8% and 25%.

FLOOD ZONE CONSIDERATION

Determining a site specific Flood Zone and related building criteria is beyond the scope of our services and this report. Site development engineering firms can provide these services when the subject property is located within a Flood Zone, and should be contacted for this information.

SURFACE DRAINAGE

The following drainage precautions should be observed during construction and maintained at all times after the structures have been completed:

- (a) Backfill around the perimeter foundation walls should be moistened and compacted to a minimum 90% of Standard Proctor Density according to ASTM D-698 Procedure, at Optimum Moisture Content (0 to +3%)
- (b) The ground surface around the perimeter foundation walls should have a minimum slope that provides positive drainage away from the structures a minimum ten (10) feet, or can be sloped to drain away from the structures in all directions on a maximum 1:12 slope
- (c) Roof downspouts and other water collection systems should discharge well beyond the limits of the backfill, or perimeter grade beams. We suggest a minimum three (3) feet
- (d) Perimeter grade beams should not be exposed more than eight (8) inches above final grade, in order to minimize moisture changes and erosion of the soil strata at bottom of grade beams

LANDSCAPING

The owner and design team should be made aware that placing large bushes and trees adjacent to the structure may contribute to future distress to the foundation system. Above grade planter boxes should be considered in lieu of landscape beds. If this landscape approach is not acceptable, vegetation placed in landscape beds adjacent to the structure should be limited to plants and shrubs that will not exceed a mature height of about four (4) feet.

Large bushes and trees that will generally exceed this height should be planted at a reasonable distance away from the structure so that their canopy or "drip line" does not extend over the structure when the tree reaches maturity. Cut-off walls or barriers may be considered to prevent roots from existing trees and vegetation from affecting the foundation of the proposed structure. Watering of vegetation should be performed in a timely and controlled manner and prolonged watering should be avoided.

SITE PREPARATION

In order to remedy construction problems which may develop if attempts are made to work the surface materials following prolonged periods of rainfall, it is recommended that prior to starting any work at the site that proper construction drainage be provided to maintain a relatively dry construction site.

CONSTRUCTION MATERIALS TESTING

The Murillo Company (TMC) should be retained to provide Construction Materials Testing (CMT) and observation services during construction, particularly during all foundation installation and earthwork related activities.

As the Geotechnical Engineer of Record, it is important that our technical personnel provide these services to help ensure that our design recommendations are interpreted properly and that actual field conditions are those described in our geotechnical report.

With TMC's involvement in the project during the construction phase, we can help avoid potential problems before they become a significant issue. This can only be an effective process if our technical personnel routinely visit the project site and perform appropriate tests and observations during construction.

By continuing our involvement on the project after the geotechnical design phase, and by providing the CMT services during construction, a single point of contact is established for the owner regarding TMC's services for the project.

LIMITATIONS

This report was intended for the exclusive use of Client or Their Representative, and is applicable only for the project and property identified herein. As to any other property or project, this report is informational only and is not a recommendation for any design of any other structure. It is not to be used for any other purpose or property and is specifically not to be used as a basis to design any other structure. An environmental assessment of the site or identification or prevention of pollutants, hazardous materials or conditions was not in our scope of services for this project and any reference in this report is provided for information purposes only. Your receipt of this report signifies your agreement to hold harmless The Murillo Company from any liability whatsoever if this report is used for, or the basis of, a design of any other structure.

Respectfully submitted,



Daniel Gutierrez, P.E.
President

August 24, 2022

Copies submitted:

David Blatt (1)
File (1)



THE MURILLO COMPANY
F-2911

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PHONE (281) 933-9702 • FAX (281) 933-1051

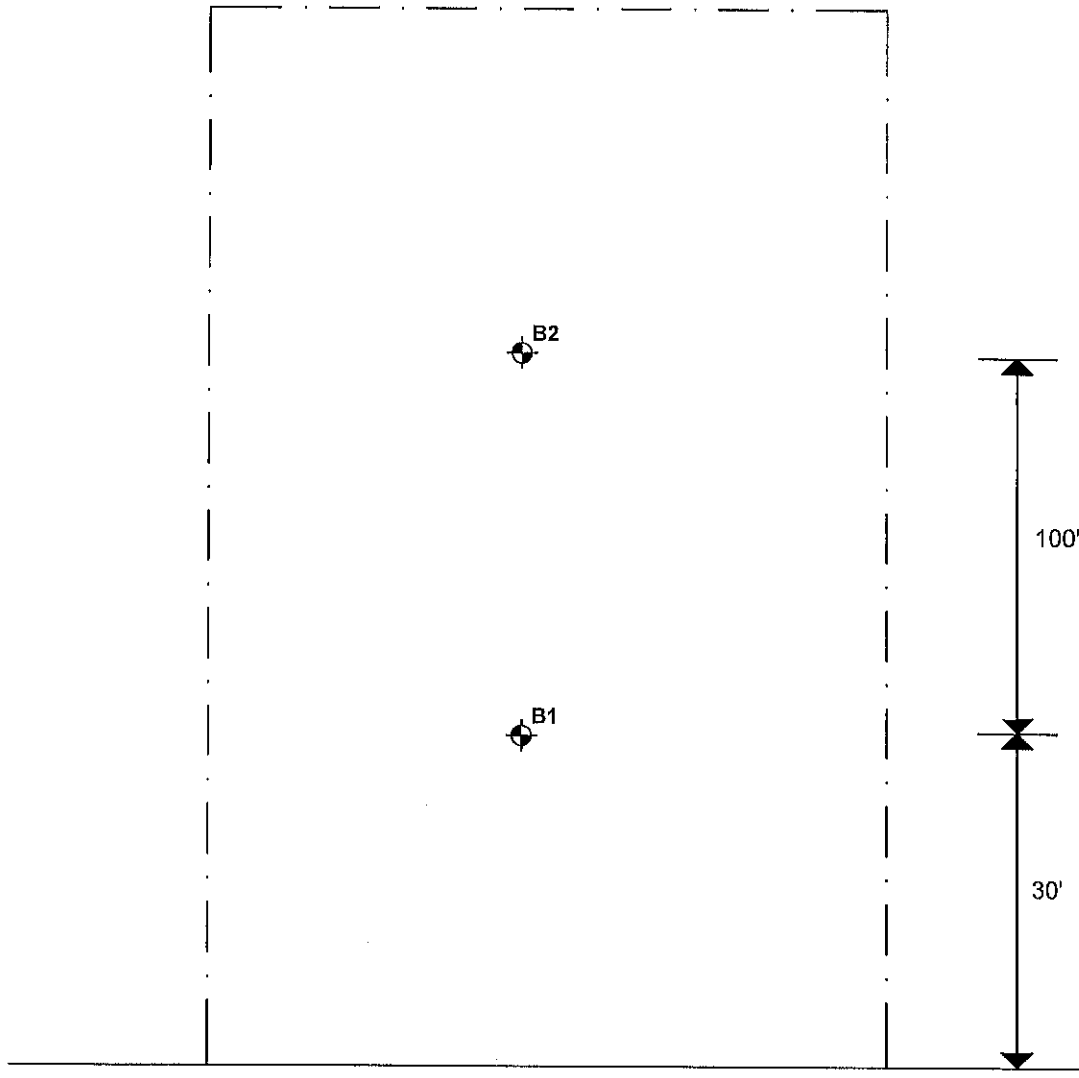
APPENDIX

Boring Plan
Boring Logs B1 and B2
Figure 1
Test Methods Used

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6147 REAMER STREET

NOT TO SCALE

BORING PLAN
GEO3942022
AUGUST 2022

BORING LOG B1



The Murillo Company
 10325 Landsbury Drive, Suite 400
 Houston, TX, 77099
 OFFICE: 281-933-9702

PROJECT: 6147 REAMER STREET
 PROJECT NO.: GEO3942022
 LOCATION: SEE BORING PLAN
 DATE: 8-5-22

DEPTH, ft	SYMBOL	CORES	DESCRIPTION	UNIT DRY WEIGHT, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PERCENT PASSING NO. 200 SIEVE	PERCENT CLAY CONTENT	BLOWS PER FOOT	SHEAR STRENGTH, tsf
0			Very stiff dark gray clay	103	14	53	20	33				<div style="text-align: center;">○ POCKET PENETROMETER</div> <div style="text-align: center;">● LABORATORY UNCONFINED</div>
5			Very stiff tan and gray clay w/ferrous nodules and sand seams	111	19	61	23	38				
10				114	17							
15			Very soft gray silty fine sand, waterbearing	111	20	21	21	0				
20			Firm to dense gray and tan silty fine sand, waterbearing									
25												
30			Very stiff tan, red and gray clay w/calcareous nodules and slickensides, moist	109	20							
30			Termination depth = 30 feet depth									
35			Surface Material 3.0" Crushed Concrete									

LOG A GNGND5 GEO3942022.GPJ LOG A GNGND5.GDT 8/23/22

WATER OBSERVATIONS:

▽ : WATER ENCOUNTERED AT 18.0 FT. DURING DRILLING.

▼ : WATER DEPTH AT 15.0 FT. AFTER DRILLING.

BORING LOG B2

Sheet 1 of 1



The Murillo Company
 10325 Landsbury Drive, Suite 400
 Houston, TX, 77099
 OFFICE: 281-933-9702

PROJECT: 6147 REAMER STREET
 PROJECT NO.: GEO3942022
 LOCATION: SEE BORING PLAN
 DATE: 8-5-22

DEPTH, ft	SYMBOL	CORES	DESCRIPTION	UNIT DRY WEIGHT, PCF	MOISTURE CONTENT, %	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	PERCENT PASSING NO. 200 SIEVE	PERCENT CLAY CONTENT	BLOWS PER FOOT	SHEAR STRENGTH, tsf
0			Very stiff dark gray clay									○ POCKET PENETROMETER ● LABORATORY UNCONFINED
0 - 5			Very stiff tan and gray clay w/ferrous and calcareous nodules	116	15	59	21	38				○ POCKET PENETROMETER ● LABORATORY UNCONFINED
5 - 8				108	23	60	23	37				○ POCKET PENETROMETER ● LABORATORY UNCONFINED
8 - 10			Very stiff gray and tan sandy clay w/ferrous nodules	118	17							○ POCKET PENETROMETER ● LABORATORY UNCONFINED
10 - 15			Soft gray and tan sandy clay, moist	109	21							○ POCKET PENETROMETER ● LABORATORY UNCONFINED
15			▽									
15 - 20			Firm to dense gray and tan silty fine sand, waterbearing								15	
20 - 25												
25 - 30											34	
30 - 32			Very stiff tan, red and gray clay w/calcareous nodules and sand seams	108	19							○ POCKET PENETROMETER ● LABORATORY UNCONFINED
30 - 35			Termination depth = 30 feet depth									
35			Surface Material 3.0" Crushed Concrete									

LOG A.GNCG05 GEO3942022.GPJ LOG A.GNCG05.GDT 8/23/22

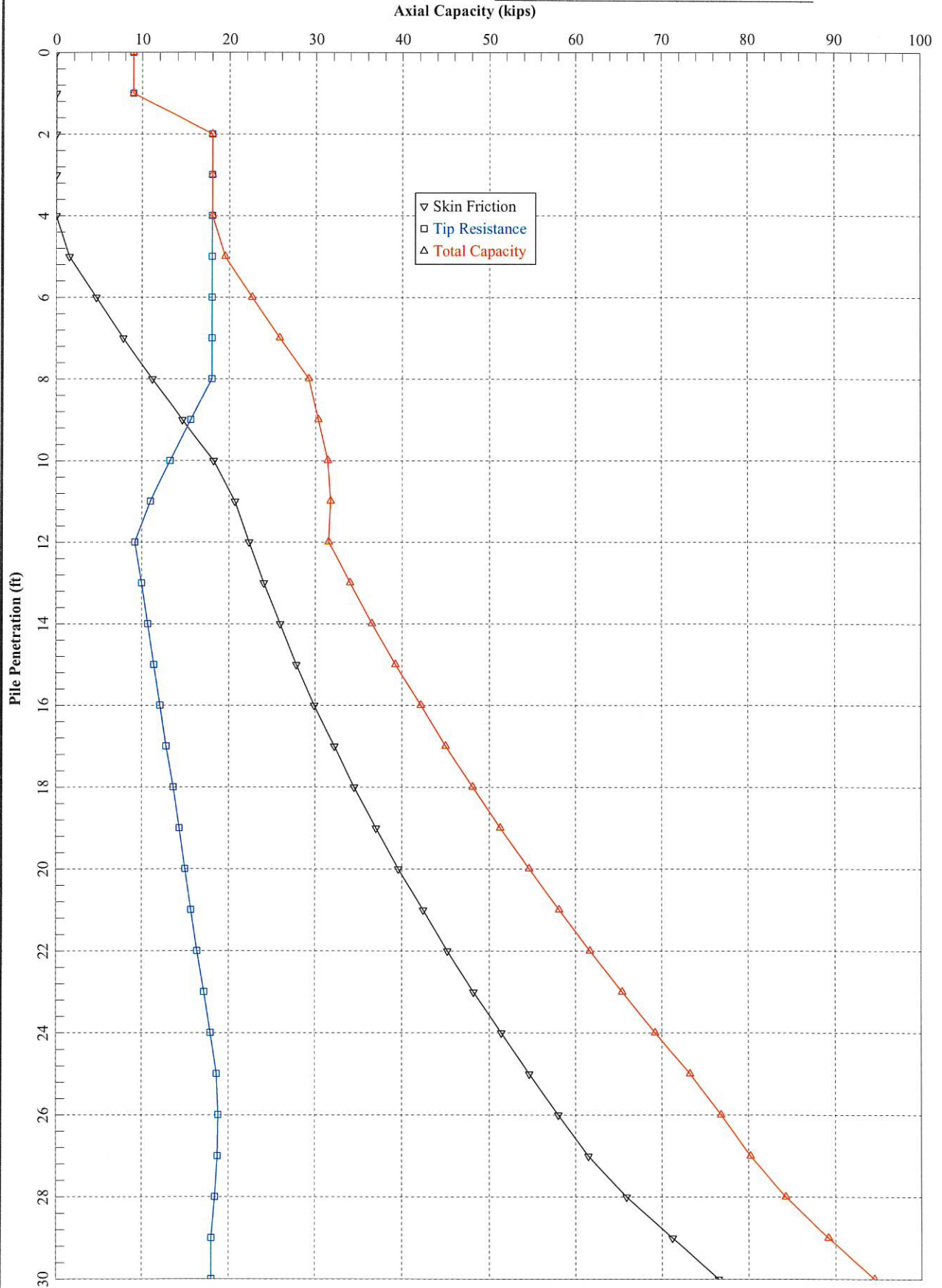
WATER OBSERVATIONS:

- ▽ : WATER ENCOUNTERED AT 18.0 FT. DURING DRILLING.
- ▼ : WATER DEPTH AT 15.0 FT. AFTER DRILLING.

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*Values given are Ultimate Capacity

12 Inch Square Timber Pile

GEO3942022
FIGURE 1

TEST METHODS USED (If Applicable)

- ASTM D421 – Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constant
- ASTM D422 – Particle Size Analysis of Soils
- ASTM D698 – Moisture Density Relations (Standard Proctor)
- ASTM D854 – Specific Gravity of Soils
- ASTM D1140 – Amount of Material in Soils Finer than No. 200 Sieve
- ASTM D1557 – Moisture Density Relations (Modified Proctor)
- ASTM D1883 – CBR (California Bearing Ratio) of Laboratory-Compacted Soils
- ASTM D2166 – Unconfined Compressive Strength of Cohesive Soil
- ASTM D2216 – Water Content of Soil, Rock, and Soil-Aggregate Mixtures
- ASTM D2217 – Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Content
- ASTM D2435 – One-Dimensional Consolidation Properties of Soils
- ASTM D2487 – Classification of Soils for Engineering Purposes
- ASTM D2850 – Unconsolidated, Undrained Strength of Cohesive Soils in Triaxial Compression
- ASTM D4318 – Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D4546 – One-Dimensional Swell or Settlement Properties of Cohesive Soils