Geotechnical Engineering Report

The Lens

St. Petersburg, Florida

March 5, 2013

Terracon Project No. H4135006

Prepared for:

Michael Maltzan Architecture, Inc.

Los Angeles, California

Prepared by:

Terracon Consultants, Inc.

Tampa, Florida

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Geotechnical ■ Environmental ■ Construction Materials ■ Facilities

March 5, 2013

Michael Maltzan Architecture, Inc.
2801 Hyperion Avenue, Studio 107
Los Angeles, California 90027

Attn: Mr. Tim Williams
P: 323 913 3098
F: 323 913 5932

Re: Geotechnical Engineering Report
The Lens
St. Petersburg, Florida
Terracon Project Number: H4135006

Dear Mr. Williams:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. This study was performed in general accordance with our proposal number PH 4120528 Rev1 dated January 11, 2013.

This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.
Certificate of Authorization Number 8830

Craig M. Anstett, P.E.
Regional Manager, Principal
Florida PE-60850

Stephen C. Knauss, P.E., D.GE
Senior Project Engineer
Florida PE-28202

Enclosures
cc: 1 – Client (PDF)
1 – File

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GEOTECHNICAL ENGINEERING REPORT
THE LENS
ST. PETERSBURG, FLORIDA

Terracon Project No. H4135006
March 5, 2013

1.0 INTRODUCTION

A geotechnical exploration has been performed for The Lens which is proposed to replace the St. Petersburg Pier located at the east terminus of 2nd Avenue NE in downtown St. Petersburg, Florida. Nineteen (19) borings, designated B-1 through B-19, have been performed to depths of between 80 and 115 feet below the existing ground surface or existing pier deck. This report specifically addresses the recommendations for the proposed structure. Logs of the borings along with a site location plan, soil survey map and boring location plans are included in Appendix A of this report.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- earthwork
- groundwater conditions
- foundation design and construction

2.0 PROJECT INFORMATION

The proposed development area consists of the existing St. Petersburg Pier which was originally constructed in the 1920's. The end of the Pier was renovated in the early 1970's. The majority of the structure extends approximately 1450 feet into the bay. It is estimated the structure is 10 feet above the normal water level and that the water depth is also 10 feet.

2.1 Project Description

Item	Description
Site layout	See Appendix A, Exhibit A-4: Boring Location Plan
Proposed Lens Components	Pier with several components including: Welcome Mat, Hub, Overwater Drive, Overwater Bridge, Lens Canopy, Promontory, and Marina.
Structural System	Precast and cast-in-place concrete supported by drilled shafts and driven piles.
Maximum loads (provided)	Drilled Shafts: 250 Tons Compression 12.5 Tons Lateral at 37 feet above mud line (Maximum 2 inches of deflection) Driven Piles: 90 Tons Compression Lateral load applied at 28 feet above mud line
Scour Depth (provided)	Drilled Shafts: 6 feet below mud line Driven Piles: 3 feet below mud line

2.2 Site Location and Description

Item	Description
Location	East terminus of 2nd Avenue NE in downtown St. Petersburg. The Pier overlooks Tampa Bay to the east. More accurately described as 800 2nd Avenue Northeast, St. Petersburg, FL 33701
Existing improvements	The proposed development area consists of the existing St. Petersburg Pier which was originally constructed in the 1920's. The end of the Pier was renovated in the early 1970's. The majority of the structure extends approximately 1450 feet into the bay. It is estimated the structure is 10 feet above the normal water level and that the water depth is also 10 feet.
Current ground cover	The landside of the Pier primarily consists of asphaltic concrete on the south side and sand on the northern side.
Existing topography	The limited landside portions of the project site appear nearly level. The southern landside portion consists of a parking lot and the northern landside portion consists of a beach area. The beach area appears to have a slight downward slope towards Tampa Bay. The USGS topographic quadrangle maps Saint Petersburg, Florida (1998) and Port Tampa, Florida (1981) depict the ground surface elevation of about +5 feet referencing the National Geodetic Vertical Datum of 1929 (NGVD29). However, note that the elevations in this report will refer to the St. Petersburg datum where elevation 0 feet NGVD equals approximately +98 feet.

3.0 SUBSURFACE CONDITIONS

The geology of the site is presented in the following report section. A discussion of subsurface conditions encountered in our borings follows the geology section.

3.1 Regional Geology

The subject property is located in southeastern Pinellas County within the Gulf Coastal Lowlands Physiographic Province of Florida (Puri and Vernon, 1964 and White, 1970). The Gulf Coastal Lowlands Province is characterized as marine karstic plain of low relief with poor drainage, extending north-south adjacent to the Gulf of Mexico, ranging in width from 2 to 45 miles and composed of sand and clayey sands of varying thickness overlying limestone and or dolomite. Elevations range from sea level to approximately 100 feet.

The three major geologic units that have influenced the development of karst in the vicinity of the project site are, in order of age from youngest to oldest; the undifferentiated sediments of Pleistocene/Pliocene age overlying the Oligocene-Pliocene age Hawthorn Group sediments overlying the Upper Oligocene to lower Miocene Arcadia Formation and the Oligocene age Suwannee Limestone.

The undifferentiated Pleistocene sediments are light gray, tan, brown to black siliciclastics; unconsolidated to poorly consolidated, clean to clayey, silty, unfossiliferous, variably organic-bearing sands to blue green to olive green, poorly to moderately consolidated, sandy, silty clays. Organics occur as peat, plant debris and roots (Scott, 2001). Thicknesses range from approximately 10 to 60 feet in the project area (FGS Bulletin No. 68, 2008).

The Upper Oligocene to Lower Miocene Arcadia Formation includes the Tampa Member of the Arcadia Formation. According to Scott (2001), the Tampa Member is variable in thickness throughout its extent. North of the project site, the Tampa Member is absent due to erosion or non-deposition. The Tampa Member consists primarily of limestone with subordinate dolostone, sands and clays. The limestones are variably quartz sand and clay with minor to no phosphate. Colors range from white to yellowish gray. Sand and clay beds occur sporadically within the Tampa Member (Scott, 2001). In the vicinity of the project site, thicknesses range from approximately 200 to 250 feet. (FGS Bulletin No. 68, 2008).

3.2 Soil Survey

The Soil Survey of Pinellas County, Florida as prepared by the United States Department of Agriculture (USDA), Soil Conservation Service (now renamed the Natural Resource Conservation Service - NRCS), identifies the soil type at the subject site as Urban Land and Coastal Beaches. It

should be noted that the Soil Survey is not intended as a substitute for site-specific geotechnical exploration; rather it is a useful tool in planning a project scope in that it provides information on soil types likely to be encountered. Boundaries between adjacent soil types on the Soil Survey maps are approximate (included in Appendix as Exhibit A-2). Descriptions of the mapped soil units are included in Appendix A as Exhibit A-3.

According to the soil survey, the risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens concrete or uncoated steel. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The risk for corrosion of concrete and uncoated steel at this site is high.

3.3 Typical Profile

The various soils encountered have been consolidated into 3 groups; cohesionless (Group A), cohesive (Group B) and Limestone (Group C). Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

Soil Group	Strata	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
		6 to 10	Air[1,3]	N/A
		17 to 20	Water[2,3]	N/A
Group A	1, 2, 3	47 to 62	Fine sand with trace to many shell fragments (SP), Fine sand to fine sand with silt (SP, SP-SM), Clayey fine sand (SC)	Very loose to Dense
Group B	3, 4, 5	63 to Termination of the Borings	Clayey fine sand (SC) Sandy clay (CL), Clay (CH)	Loose to very dense or soft to very hard
Group C	6	Termination of the Borings	Weathered Limestone Formation	
	1. Approximate depth to water from top of Pier deck. 2. Approximate depth to mud line from top of water surface. 3. Not present in borings B-1 to B-4 which were drilled on land.			

Conditions encountered at each boring location and results of laboratory testing are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be

gradual. Details for each of the borings can be found on the boring logs in Appendix A of this report. Descriptions of our field exploration are included as Exhibit A-5 in Appendix A. Descriptions of our laboratory testing procedures are included as Exhibit B-1 in Appendix B.

3.4 Groundwater

The landside boreholes (Borings B-1, B-2, B-3, and B-4) were observed during drilling for the presence and level of groundwater. Groundwater was observed in these borings, between depths of 6 inches and 4 feet below existing grade, corresponding to elevations ranging from +97 to +99 feet. Longer term monitoring in cased holes or piezometers, possibly installed to greater depths than explored under this project scope, would be required to better define groundwater conditions at the site.

It should be recognized that fluctuations of the groundwater table will occur primarily due to tidal fluctuations of Tampa Bay and to a lesser degree seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the boring was performed.

We estimate that during the normal wet season with rainfall and recharge at a maximum, groundwater levels will be about elevation +100 feet. Our estimate of the seasonal groundwater conditions are based on the USDA Soil Survey, available survey data, the encountered soil types, recent weather conditions, and the encountered water levels.

This seasonal water table estimate does not represent the temporary rise in water table that occurs immediately following a storm event, including adjacent to other stormwater management facilities. This is different from static groundwater levels in wet ponds and/or drainage canals which can affect the design water levels of new, nearby ponds. The seasonal high water table may vary from normal when affected by extreme weather changes, localized or regional flooding, karst activity, future grading, drainage improvements, or other construction that may occur on our around the site following the date of this report.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

The following evaluations and recommendations are based on the project characteristics previously described, the data obtained during our field exploration and our experience with similar subsurface conditions and construction methods. If the project information contained in this report is incorrect or if additional information becomes available, a review must be made by our office to determine if any modifications in the recommendations are necessary.

The proposed construction will include a new Pier with multiple components. Two types of foundations will be utilized to support the structure; drilled shafts and driven piles. Design and

construction recommendations for foundation systems and other earth connected phases of the project are outlined below.

4.2 Driven Piles

4.2.1 Axial Capacity

We understand that 18-inch square pre-stressed concrete pile sections have been chosen for this project. The computer software FBDeep Version 2.01c was used to evaluate estimated Davisson capacities (ultimate axial capacities) for the 18-inch square pre-stressed concrete piles. The input soil parameters for FBDeep were obtained from the SPT borings (B-1 through B-19) performed for this evaluation. We also assumed 3 feet of scour in our analysis. The Davisson capacities versus pile tip elevations (axial capacity curves) for the 18-inch square pile section for each boring are presented in the Appendix as Exhibits C-3, C-4 and C-5. The axial capacity curves were used to estimate approximate pile tip elevations for the required axial design capacity of 90 tons (ultimate axial capacity of 180 tons using factor of safety of 2.0).

Based on the FB Deep results and review of the SPT borings performed, the piles are anticipated to achieve the required axial design capacity of 90 tons between elevations +20 feet and +30 feet. Piles in vicinity of borings B-8 and B-15 will require deeper penetration to achieve the required capacity. Piles in the vicinity of Boring B-8 will need to be driven to an approximate elevation of +10 feet and those in the vicinity of B-15 to an approximate elevation of +5 feet.

A minimum center to center pile spacing of three pile diameters is recommended to help minimize group capacity reduction effects. An allowable uplift capacity of 30 tons per pile may be considered where tension (uplift) capacity is required.

Set-checks and Re-drives instrumented with PDA (Pile Driving Analyzer) may be required to determine if axial capacities have been achieved in some areas during the test and/or production pile installation. Set-checks and Re-drives are utilized because the capacity of piles may increase after driving has stopped and the soils stabilize. By re-driving the pile for a short distance it is possible to observe the increase in pile capacity after the soils have stabilized. Set-Checks and Re-drives shall be in conducted in accordance with FDOT Specification Section 455-1.1.

4.2.2 Pile Load Testing

We recommend a dynamic load testing program using PDA, including the driving of several test piles (i.e. approximately 5% of total number of production piles) in production pile locations spaced across the site to provide an indication of the potential variability in driving conditions and to confirm that the required axial capacity can be achieved in these variable conditions with the contractor's pile driving equipment. The purpose of the test pile program is to provide the contractor recommended production pile driving criteria required across the site developed based on the results and subsequent analyses of test pile program.

Our experience with the PDA indicates that a significant cost savings (over static load testing of piles) may be realized if the PDA is properly utilized to monitor the installation as to pile driving stresses, capacities and integrity.

Pile driving inspection is recommended for all production piles based on driving criteria developed based on the results of test pile program. Continuous driving and installation records should be maintained for each test and production pile for the Geotechnical Engineer's review.

In addition, prior to installing the test piles, the geotechnical engineer should be informed of the specific equipment proposed for use by the pile contractor. The contractor should submit a description of the following for review and preliminary evaluation of the proposed hammer system by the geotechnical engineer:

- List and size of proposed equipment including proposed hammer system and predrilling/preforming equipment and their manufactures' data sheet
- Size, thickness and material type of proposed capblock (hammer) and pile cushions.
- Sequence of driving of piles for each different configuration of pile layout
- Proposed schedule for test pile program and production pile driving.

The geotechnical engineer should be retained to perform preliminary Wave Equation analyses that validate the selection of the proposed equipment. The geotechnical engineer should also observe the initial test pile driving operations to determine if the pile driving installation is being performed according to the recommendations in the report.

4.2.3 Preliminary WEAP Analyses on Selected Hammer Systems

The three hammer systems were selected based on our experience in this area and consideration of chosen pile type (i.e. 18 inch square pre-stressed pile) and dimension and summarized as follows:

1. An APE Model D25-42 open-ended (i.e. single acting) diesel impact hammer has a rated energy of 62.0 kip-feet and a ram weight of 5.5 kips.
2. An APE Model D30-42 open-ended (i.e. single acting) diesel impact hammer has a rated energy of 74.4 kip-feet and a ram weight of 6.6 kips.
3. An APE Model D36-42 open-ended (i.e. single acting) diesel impact hammer has a rated energy of 89.3 kip-feet and a ram weight of 7.9 kips.

To evaluate suitability of above selected three hammer systems for driving 18-inch square precast, pre-stressed piles for the referenced project, Wave Equation Analysis of Piles (WEAP) using the program 2010 GRLWEAP™ was performed. The wave equation analysis models the hammer-pile-soil system using the one-dimensional wave equation. For the preliminary analyses, we have used hammer input values for the driving systems in the manufacture' specifications for each hammer system, quake and damping values based on the soil information of the generalized subsurface profile in the following table and default open diesel hammer efficiency of 80%.

Generalized Subsurface Profile Used for WEAP Analyses

Depth (ft)	Material Encountered
0 to 20 feet	Air/Water
20 to 45 feet	Very Loose SAND
45 to 50 feet	Loose SAND
50 to 60 feet	Very Soft CLAY
60 to 70 feet	Stiff CLAY
70 to 90 feet	WEATHERED LIMESTONE

The preliminary wave equation analyses indicate that all three selected pile driving hammer systems, APE D25-42, D30-42 and D36-42, appear to be suitable and generally capable of driving the 18-inch square pre-stressed concrete piles to the required ultimate capacity of 360 kips (= Factor of Safety of 2.0 X Design Load of 180 kips) at a blow count ranging from 36 blows to 120 blows per foot per Section 455-5.2 without reaching practical refusal (20 blows per inch) or over-stressing the piles in compression or tension per Section 455-5.11.2 of the FDOT Specifications. The preliminary WEAP results also indicate that hammer may need to operate hammer stroke height of 5 feet or less to maintain minimum required blow count of 36 blows per foot.

The preliminary wave equation analyses results (Bearing Graph for various ultimate axial loads including required ultimate axial bearing capacity of 360 kips and Inspector's Chart for required ultimate axial bearing capacity of 360 kips) for each hammer system are attached in the Appendix as Exhibit C-7.

Please note that the results above are preliminary. Acceptance of all equipment and procedures are subject to satisfactory field performance as detailed in the specifications.

4.2.4 Lateral Analysis

Based on an evaluation using the computer program *LPILE Plus 4.0*, we determined the lateral capacity for an 18-inch square prestressed concrete pile for various pile head deflections. Our evaluation assumed a free head condition. The following assumptions and criteria were utilized in our analysis:

A series of analysis (cases) were conducted utilizing a constant axial load. The analysis varied the deflection from 0.25 inches to 2.5 inches in 0.25 inch increments and the resulting shear stress vs. depth for those defections was calculated.

- 18-inch square prestressed concrete pile extending 28 feet from the mud line.
- Modeled as a Free Head Condition.
- Assumed 3 feet of scour.
- Lateral load applied at top of pile which is 28 feet above the mud line (elevation +114 feet).
- Axial compression load of 90 tons applied.
- Assume B-15 soil profile

Our Findings/Conclusions are as follows:

The lateral capacity of an 18-inch square prestressed concrete pile under the assumptions noted above ranges from 0.1 kips with 0.25 inches of deflection to 1 kip with 2.5 inches of deflection. The Shear Force vs. depth curves for various pile head deflections ranging from 0.25 inches to 2.5 inches (in increments of 0.25 inches) are presented in the Appendix as Exhibit C-6.

4.3 Drilled Shafts

4.3.1 Axial Capacity

The Over Water Pedestrian Bridge will be supported by drilled shafts with a maximum compression column load of 250 tons and maximum lateral load of 12.5 tons applied approximately 37 feet above the unscoured mud line. We have assumed 6 feet of scour in our analysis.

In general, most of the drilled shaft capacity will be derived beginning between the elevations of +50 feet to +35 feet in the harder and denser soils. Although some nominal capacity will be derived above that elevation it is generally ignored. Drilled shafts in Florida are generally considered to obtain their capacity through side friction because they will be drilled using the “wet” method and while the bottom of a shaft must be cleaned, the capacity obtained from the bottom of a shaft is generally not included in the capacity due to strain incompatibility between the side friction and end bearing. Pending the results of a load test and pilot borings, we have utilized an average allowable frictional capacity on the order of 1.5 tsf. The numbers presented

in the table are a guideline and the depth for the desired capacity may need to be adjusted based on the actual conditions at that drilled shaft location. This is particularly true at sites like this one where there is some variability in the soil conditions across the site. In Florida, when drilled shafts are the utilized, pilot hole borings are drilled at each proposed shaft location to identify the actual soil conditions. The pilot boring consists of an SPT boring drilled to at least 3 diameters beyond the preliminary or proposed tip elevation. The tip elevation of the shaft is then determined at that location. Below are the preliminary tip elevations corresponding to borings that are in the vicinity of proposed shaft locations:

Shaft Diameter (in)	Drilled Shaft Minimum Tip Elevation (Depth) (Allowable Capacity 250Tons)							
	B-3	B-6	B-7	B-8	B-10	B-11	B-13	B-15
60	+29(73)	+36.5(69)	+38(67)	+29(76)	+26(79)	+43.5(62)	+30.5(75)	+25(81)

In general, the drilled shafts are cased to the top of the bearing surface with temporary steel casing. However for this project it is expected that the usual temporary casing will be permanent. This casing is typically installed either with the drill rig or with a vibratory hammer.

4.3.2 Lateral Analysis

We evaluated the lateral capacity of the dilled shaft foundations using the computer program LPILE Plus 4.0. The following assumptions and criteria were utilized in our analysis:

- 48-inch diameter superstructure column extending from approximate water surface up to elevation of +123.1 (27 feet long)
- Modeled as a Free Head Condition.
- 1.3 percent steel in superstructure column (23 #9 bars).
- Drilled shaft extending from approximate water surface downward. Water surface elevation is approximately +96.1.
- Assumed 6 feet of scour (scoured mud line elevation of +80.1 feet).
- Lateral load of 25 kips applied at top of superstructure column at el. +123.1 feet in addition to axial load of 500 kips.
- Assume B-15 soil profile

General Findings/Conclusions:

- Modeling of a drilled shaft with 54-inch diameter, 2% steel (minimum % for this analysis to run), 5 ksi concrete, resulted in top of superstructure column deflection of 3.8 inches.
- Modeling of drilled shaft with 60-inch diameter, 1.3% steel, 5 ksi concrete, resulted in top of superstructure column deflection of 1.7 inches. The point of fixity occurs at approximately elevation +54 feet.

The output file for the 60 inch shaft is presented in the Appendix as Exhibits C-8.

4.3.3 Construction Considerations

Based on subsurface conditions, the drilled shafts will be installed using the "wet" method. This essentially means that the shaft will be filled with slurry (manufactured liquid) that will stabilize the hole (hold the hole open). Generally the "wet" method includes a natural slurry, however since the bearing layers contain zones of clayey sand we recommend that either a polymer of mineral slurry be utilized. The following recommendations are applicable for the wet method of drilled shaft construction.

- Casing of the top portion of shaft excavations on land is recommended to help maintain stability and reduce the potential for caving at the top of the excavation.

- A slurry displacement method drilled shaft is constructed by excavating with a drill rig equipped with appropriately sized tooling (earth augers, clean-out buckets, etc.) beneath drilling mud slurry which stabilizes the excavated shaft walls above the tooling.

- Typically, the slurry is introduced into the excavation after the groundwater table has been penetrated and/or the soils on the sides of the excavation are observed to cave.

- When the design shaft depth is reached, fluid concrete is placed through a tremie pipe at the bottom of the excavation and the slurry is displaced out of the top of the shaft excavation as the shaft fills with concrete.

- The slurry level in the shaft excavation should be maintained at a minimum of 5 feet or one shaft diameter (whichever is greater) above the subsurface water level.

- Observation during drilled shaft excavation should include verification of plumbness, maintenance of sufficient slurry head, monitoring the density, viscosity, pH and sand content of the drilling slurry, and monitoring any changes in the depth of the excavation between initial approval and prior to concreting using a weighted tape measure. The following drilling fluid properties are recommended:

Recommended Drilling Slurry Specifications (AASHTO, 2008)

Property of Slurry (Units)	Requirement	Test Method (API Standard Method)
Density (lb/ft^3)	Mineral: 64.3 to 72 Polymer: ≤ 64	Mud Weight Density Balance (API 13B-1)
Viscosity (sec/quart)	Mineral: 28 to 50 Polymer: 32 to 135	Marsh Funnel and Cup
pH	Mineral: 8 to 11 Polymer: 8 to 11.5	Glass Electrode pH Meter or pH Paper Strips
Sand Content Immediately Prior to Concrete Placement (% by Volume)	Mineral: < 4.0 Polymer ≤ 1.0	Sand Content (API 13B-1)

- The specific gravity or relative density of the drilling mud slurry should be periodically monitored from the initial mixing to the completion of the excavation of each shaft. An increase in the specific gravity or density of the drilling slurry at the bottom of the shaft by as much as 10 percent could be indicative of soil particles settling out of the slurry onto the bottom of the excavation. Excessive accumulation of loose particles in the bottom of the shaft prior to concrete placement could result in a reduction of the allowable bearing capacity of the bottom of the drilled shaft or discontinuities in the shaft cross section if loose soil becomes suspended in the fluid concrete mass during concrete placement.

- The required fabricated reinforcing steel cage should be placed in the drilled shaft excavation after the shaft has reached the required depth and the drilling slurry has been cleaned/modified as necessary to meet specification requirements, and as close to the initiation of shaft concrete placement as feasible. The reinforcing cage should be designed to allow fluid concrete to flow freely between and around the individual bars and provide concrete cover of at least 6 inches between the reinforcing steel elements and the surrounding soil.

- Following approval of the shaft excavation depth and drilling slurry properties, the drilled shaft should be concreted as soon as practically possible using tremie methods. The concrete should have a 7- to 10-inch slump prior to discharge into the tremie. The bottom of the tremie pipe should be set at about one tremie pipe diameter above the bottom of the shaft excavation. A closure flap at the bottom of the tremie should be used, or a sliding plug introduced into the tremie before the fluid concrete, to reduce the potential for the concrete being contaminated by the slurry. The bottom of the tremie pipe must be completely embedded (typically at least 5 feet) in fluid concrete during placement, which should be a continuous operation.

Due to the inherent variability in the subsurface materials, a representative of the Geotechnical Engineer should verify the design parameters are valid during construction. Some modification to the design values presented in this report could be required in the field.

4.3.4 Pilot Borings

Because the drilled shafts will be installed using the "wet" method it is not possible to visually inspect the materials that the shaft is penetrating. As a result, it is necessary to determine the nature of the material prior to drilling the shaft and establish the shaft tip elevation based upon the results of the "pilot" hole or boring. This can be a problem where the soil conditions vary across a site such as we have on this site. To alleviate this problem, pilot holes are drilled at each shaft location. This is generally performed prior to mobilization by the drilled shaft contractor and accomplished using a geotechnical drilling rig. The Geotechnical Engineer of Record then reviews the boring logs (along with the load test data) and adjusts the tip depths or elevations of the shafts as needed to achieve the required capacity. Procedures for the installation of drilled shafts in Florida sometimes use the Florida Department of Transportation publication "Standard Specifications for Road and Bridge Construction", Section 455, as a reference for drilled shaft installation.

4.3.5 Load Test

We also recommend that a load test be conducted prior to the start of the installation of production shafts to refine the shaft lengths. Two common methods include the Osterberg Cell® and a Statnamic® load test. This Osterberg Cell® method utilizes a jack embedded into the shaft. The Statnamic® load test, involves the use of a controlled explosive charge and with it a brief loud noise. The shaft is instrumented with strain gages so that it can be determined where the capacity is obtained and thus allows for adjustments to be made to the length of the shaft to account for the actual load carrying capacity of the soils at this site. A static load test could also be conducted, but requires a reaction force consisting of a frame anchored to the ground or a mass equivalent to the desired maximum test load. This method can be labor intensive and impractical for high capacity load tests.

A single load test will provide sufficient information to prove the design criteria is met. We recommend that the test shaft be a non-production shaft to allow it to be tested well above the design capacity. This will provide data for us to evaluate whether the frictional capacity can be increased somewhat over that which we have recommended.

4.3.6 Inspection and Additional Testing

Testing and inspection during construction should include a qualified drilled shaft inspector to monitor the drilling operations and the concrete placement. In addition, other inspection techniques can be used to inspect a completed shaft for the integrity of the concrete. What are commonly referred to as Crosshole Sonic Logging (CSL) tubes may be installed to check the integrity of the concrete in the shaft within the reinforcing cage. These tubes consist of steel pipes, usually 1½ inches in diameter, installed by tying them to the reinforcing cage. The number of tubes varies with the diameter of the shaft and usually there is one tube for each foot

of diameter of shaft used. CSL testing or Thermal Integrity testing can use these tubes. CSL uses sound waves to check for concrete integrity between the tubes and thus checks the concrete inside of the reinforcing cage. Thermal Integrity testing checks the concrete utilizing the variability of the heat of hydration that the concrete emits while curing. This method checks around a radius from the CSL tubes and is thus able to determine differences in the concrete outside of the reinforcing cage. While CSL testing can be conducted anytime following 2 to 3 days after concrete placement, Thermal Integrity testing has to be conducted within several days after concrete placement. We recommend CSL or Thermal Integrity tubes be installed on all shafts so that they can be tested in the event there is a question of shaft integrity.

4.4 Earthwork (Dry Land Construction)

4.4.1 Site Preparation

Prior to placing any fill, all vegetation, topsoil, pavements, concrete, possible fill material and any otherwise unsuitable material should be removed from the construction areas. Wet or dry material should either be removed or moisture conditioned and re-compacted. After stripping and grubbing and achieving cut grades, the exposed surface should be proofrolled where possible to aid in locating loose or soft areas. Proof-rolling can be performed with appropriate heavy equipment to obtain a minimum compaction as defined in Section 4.4.3. Unstable soil (pumping) should be removed or moisture conditioned and compacted in place prior to placing fill.

Where fill is placed on existing slopes, we recommend that fill slopes be over filled and then cut back to develop an adequately compacted slope face. Slopes should be provided with appropriate erosion protection.

4.4.2 Material Requirements

Compacted structural fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Location for Placement	Maximum Lift Thickness (in.)
General [1]	SP (fines content < 5%)	All locations and elevations	12[3]
	SP-SM (fines content between 5 and 12%)[2]	All locations and elevations, except strict moisture control will be required during placement, particularly during the rainy season.	8 to 12[3]

1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris.
2. If fines contents are greater than 12%, special design and construction procedures may be necessary.
3. Loose thickness when heavy compaction equipment is used in vibratory mode. Lift thickness should be decreased if static compaction is being used, typically to no more than 8 inches, and the required compaction must still be achieved. Use 4 to 6 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is required.

4.4.3 Compaction Requirements-Mass Fill Areas

Item	Description
Minimum Compaction Requirements [1]	95 percent of the material's maximum modified Proctor dry density (ASTM D 1557).
Moisture Content[2]	Within ±2 percent of optimum moisture content as determined by the Modified Proctor test, at the time of placement and compaction.
Minimum Testing Frequency	One field density test per 10,000 square feet or fraction thereof per 1-foot lift.

1. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the cohesionless fill material pumping when proofrolled.

4.4.4 Utility Trench Backfill

All trench excavations should be made with sufficient working space to permit construction including backfill placement and compaction. Utility trenches are a common source of water infiltration and migration.

4.4.5 Grading and Drainage

Final surrounding grades should be sloped away from the structure on all sides to prevent ponding of water. Gutters, downspouts, or other appropriate methods that direct water a minimum of 10 feet beyond the footprint of the proposed structures are recommended. Site grades should be set considering the estimated seasonal high groundwater presented in Section 3.4.

4.4.6 Earthwork Construction Considerations

After initial proofrolling and compaction, unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of floor slabs and pavements. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and re-compacted prior to floor slab and pavement construction.

Trees or other vegetation whose root systems have the ability to remove excessive moisture from the subgrade and foundation soils should not be planted next to the structure. Trees and shrubbery should be kept away from the exterior edges of the foundation element a distance at least equal to 1.5 times their expected mature height.

As a minimum, all temporary excavations should be sloped or braced as required by Occupational Health and Safety Administration (OSHA) regulations to provide stability and safe working conditions. Temporary excavations will probably be required during grading operations. The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required, to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

Terracon should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; proof-rolling; placement and compaction of controlled compacted fills; backfilling of excavations into the completed subgrade, and just prior to construction of building floor slabs.

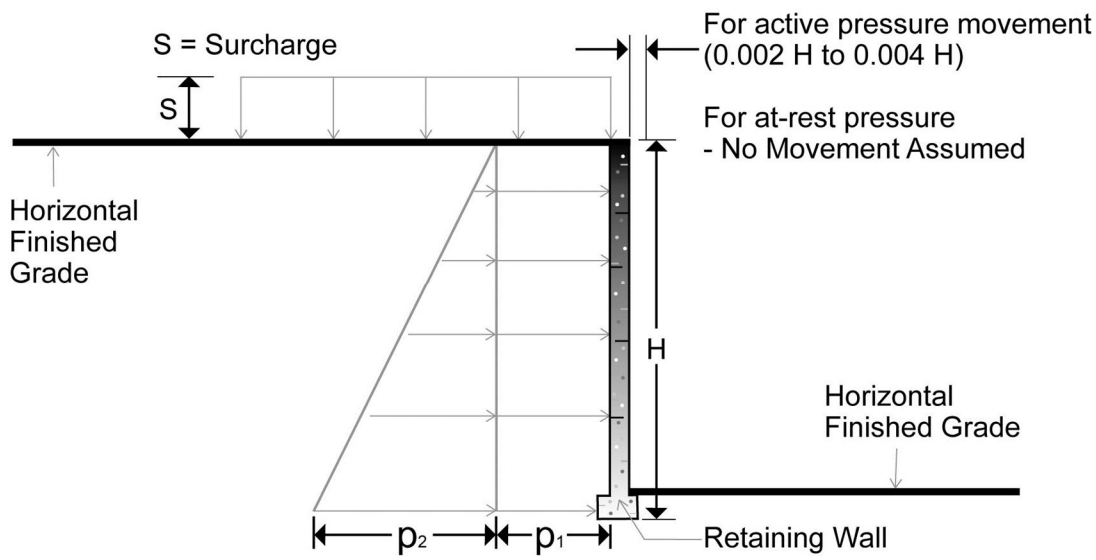
4.5 Seismic Considerations

Florida is under the jurisdiction of its own building code as opposed to the International Building Code. The Florida Building Code does not have a requirement or provision for evaluating

seismic potential. Florida is generally regarded to be in a zone of low seismic risk. Therefore we do not consider seismic effects to be a concern at this site.

4.6 Lateral Earth Pressures

Reinforced concrete walls with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to those indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement, such as a wall that is structurally confined at both the top and bottom of the wall. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls.



Earth Pressure Coefficients

Earth Pressure Conditions	Coefficient for Backfill Type	Equivalent Fluid Density (pcf)	Surcharge Pressure, p_1 (psf)	Earth Pressure, p_2 (psf)
Active (Ka)	Granular - 0.33	40	(0.33)S	(40)H
At-Rest (Ko)	Granular - 0.46	55	(0.46)S	(55)H
Passive (Kp)	Granular - 3.0	360	---	---

Applicable conditions to the above include:

- Uniform surcharge, where S is surcharge pressure
- In-situ soil backfill weight a maximum of 120 pcf
- Horizontal backfill, compacted between 95 and 98 percent of modified Proctor maximum dry density
- Loading from heavy compaction equipment not included
- No hydrostatic pressures acting on wall
- No dynamic loading
- No safety factor included in soil parameters

Backfill placed against structures should consist of granular soils. For the granular values to be valid, the granular backfill must extend out from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the active and passive cases, respectively. To calculate the resistance to sliding, a value of 0.32 should be used as the ultimate coefficient of friction between the footing and the underlying soil.

To control hydrostatic pressure behind the wall we recommend that a drain be installed at the foundation wall with a collection pipe leading to a reliable discharge. If this is not possible, then combined hydrostatic and lateral earth pressures should be calculated for lean clay backfill using an equivalent fluid weighing 90 and 100 pcf for active and at-rest conditions, respectively. For granular backfill, an equivalent fluid weighing 85 and 90 pcf should be used for active and at-rest, respectively. These pressures do not include the influence of surcharge, equipment or floor loading, which should be added. Heavy equipment should not operate within a distance closer than the exposed height of retaining walls to prevent lateral pressures more than those provided

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

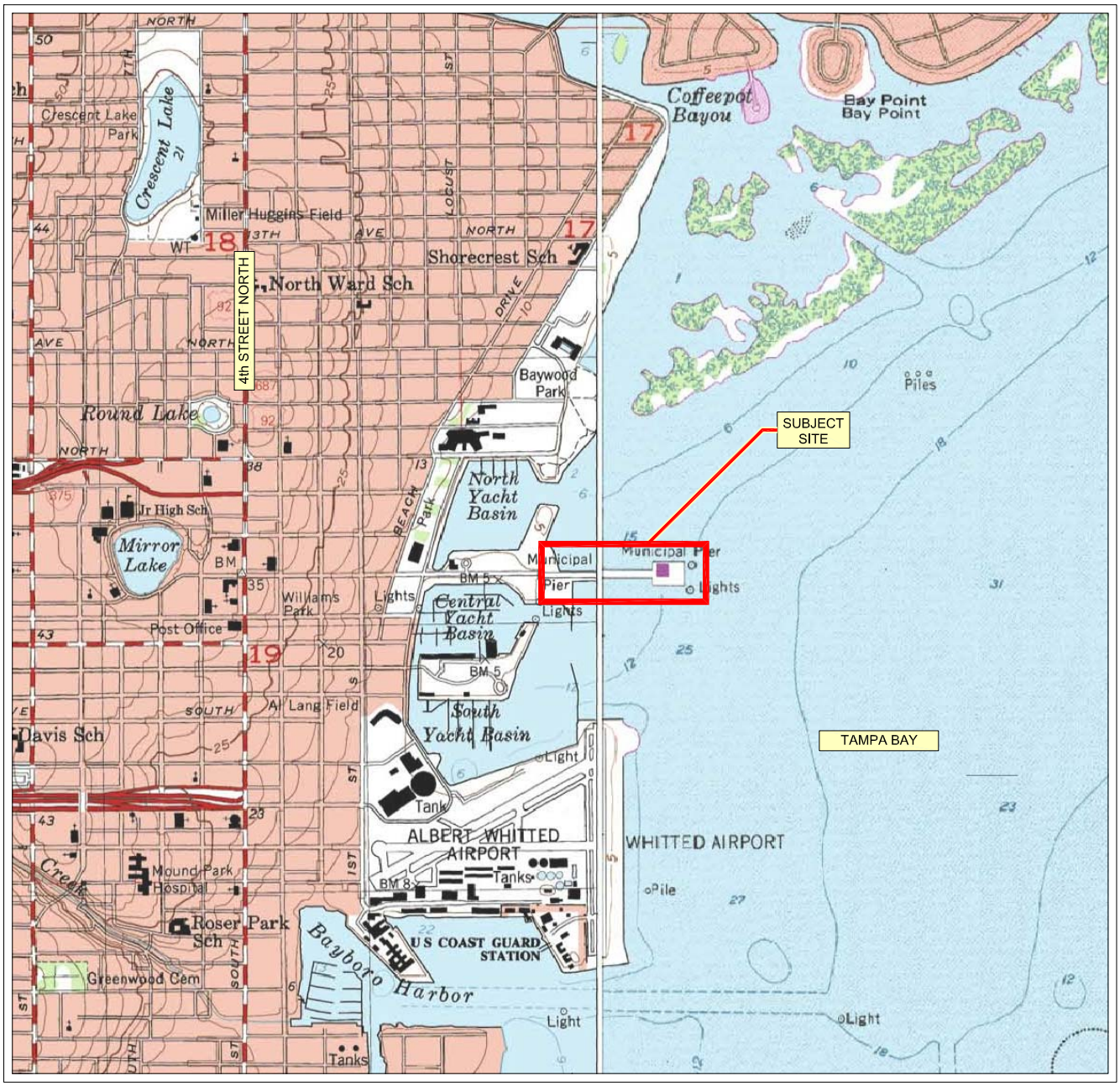
The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either expressed or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A
FIELD EXPLORATION

UNITED STATES – DEPARTMENT OF THE INTERIOR – GEOLOGICAL SURVEY



SCALE 1:24 000

KILOMETERS 1 .5 0 1 2

MILES 1000 0 1000 2000

FEET 1 .5 0 1

1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

CONTOUR INTERVAL 5 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

N

SECTION: 19
TOWNSHIP: 31 SOUTH
RANGE: 17 EAST

SAINT PETERSBURG, FLORIDA | PORT TAMPA, FLORIDA
1998 | 1956; PHOTOREVISED 1981
7.5 MINUTE SERIES (QUADRANGLE)

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Project Mngr: CA	Project No. 37117134	Terracon Consulting Engineers and Scientists	TOPOGRAPHIC VICINITY MAP
Drawn By: MG	Scale: AS SHOWN	504 E. TYLER STREET TAMPA, FLORIDA 33602	GEOTECHNICAL ENGINEERING REPORT
Checked By: CA	File No. 37117134	PH. (813) 221-0050 FAX. (813) 221-0051	THE LENS
Approved By: CA	Date: 2-28-13		ST. PETERSBURG, PINELLAS COUNTY, FLORIDA

EXHIBIT A-1

SCALE 1" = 2000'

1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000

U.S.D.A. SOIL SURVEY FOR PINELLAS COUNTY, FLORIDA
ISSUED: 1970

N

SECTION: 19
TOWNSHIP: 31 SOUTH
RANGE: 17 EAST

SOIL LEGEND	
Co	COASTAL BEACHES
Ub	URBAN LAND

Project Mngr:	CA
Drawn By:	MG
Checked By:	CA
Approved By:	CA

Project No.	37117134
Scale:	AS SHOWN
File No.	37117134
Date:	2-28-13

Terracon
Consulting Engineers and Scientists
504 E. TYLER STREET TAMPA, FLORIDA 33602
PH. (813) 221-0050 FAX. (813) 221-0051

SOILS MAP
GEOTECHNICAL ENGINEERING REPORT
THE LENS
ST. PETERSBURG, PINELLAS COUNTY, FLORIDA

EXHIBIT
A-2

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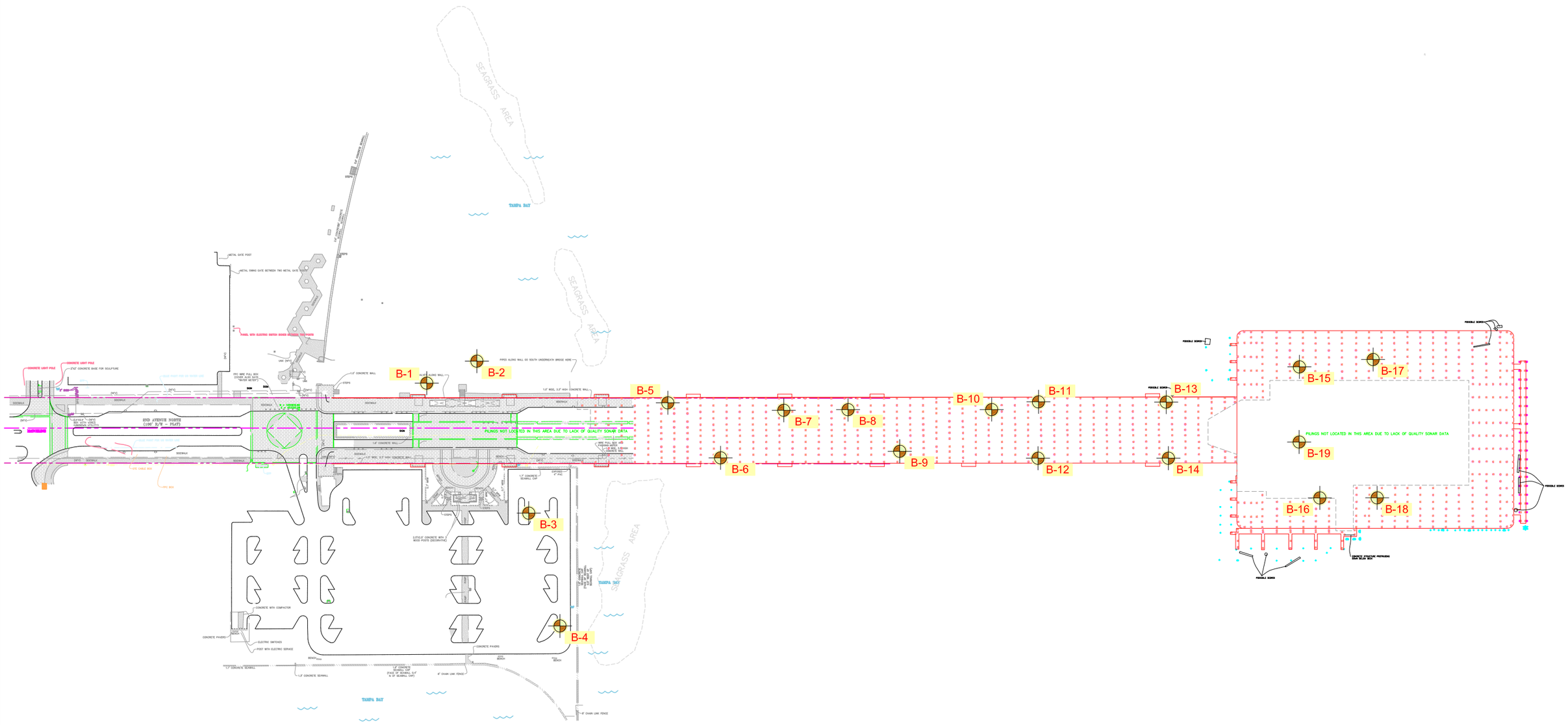
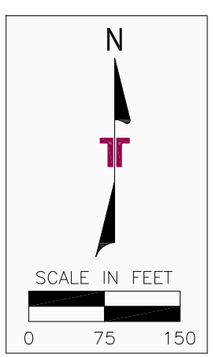
Soil Survey Descriptions

Co – Coastal Beaches This map unit supports little or no vegetation. Areas are either bare or covered with saltwater during daily high tides and stormy periods. This mapping unit is used for beach and water activities. The seasonal high water table is apparent from 2 feet above the surface to the surface from January through December. The parent material consists of sandy marine sediments with varying amounts of shell fragments.

Ub – Urban Land Urban land consists of high-density residential developments, commercial buildings, streets, highways, parking lots, and other types of impervious ground cover. The areas of Pinellas soil that are not covered by impervious material are too small to be delineated separately at the scale of mapping and are mostly grassy areas.





LEGEND

APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING

Project Mngr: CA	Project No. H4135006	Terracon Consulting Engineers and Scientists	BORING LOCATION PLAN	EXHIBIT
Drawn By: MG	Scale: AS SHOWN	504 E. TYLER STREET TAMPA, FLORIDA 33602	GEOTECHNICAL ENGINEERING REPORT	A-4
Checked By: CA	File No. H4135006	PH. (813) 221-0050 FAX. (813) 221-0051	THE LENS	
Approved By: CA	Date: 2-18-13		ST. PETERSBURG, PINELLAS COUNTY, FLORIDA	

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Field Exploration Description

The boring locations were laid out at the project site by Terracon personnel based on a drawing provided to us. The actual boring locations were then surveyed by George F. Young, Inc. and they are shown on the boring location plan. George F. Young also provided the boring elevations.

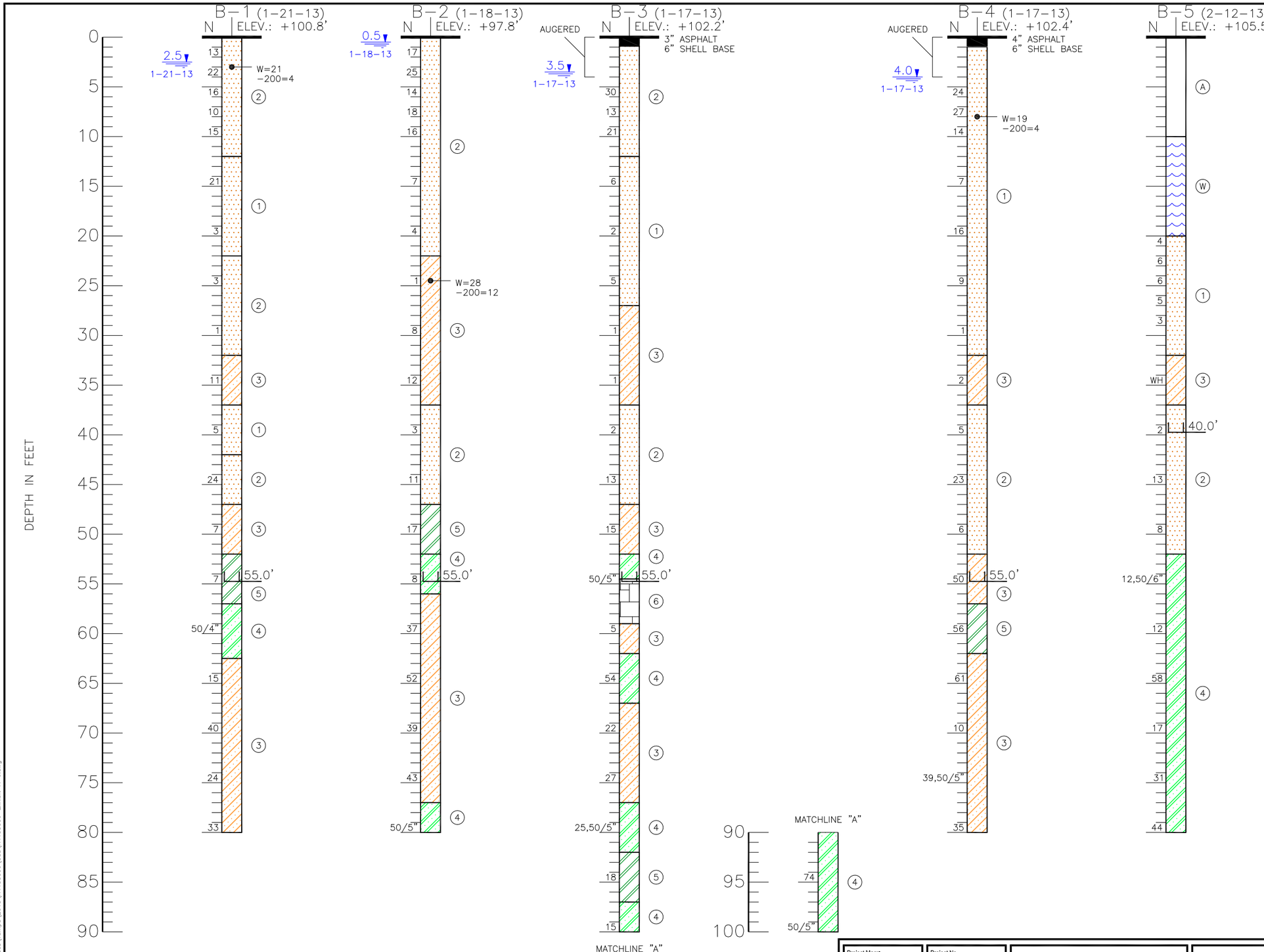
Boring B-1 through B-4 were drilled with an ATV-mounted, rotary drilling rig equipped with a rope and cathead-operated safety hammer. Borings B-5 through B-19 were drilled with a truck-mounted, rotary drilling rigs with an automatic hammer.

The boreholes were advanced with a cutting head and stabilized with the use of bentonite (drillers' mud). Soil samples were obtained by the split spoon sampling procedure in general accordance with the Standard Penetration Test (SPT) procedure. In the split spoon sampling procedure, the number of blows required to advance the sampling spoon the last 12 inches of an 18-inch penetration or the middle 12 inches of a 24-inch penetration by means of a 140-pound hammer with a free fall of 30 inches (or automatic hammer with an equivalent energy), is the standard penetration resistance value (N). This value is used to estimate the in-situ relative density of cohesionless soils and the consistency of cohesive soils. The sampling depths and penetration distance, plus the standard penetration resistance values, are shown on the boring logs.

Portions of the samples from the borings were sealed in glass jars to reduce moisture loss, and then the jars were taken to our laboratory for further observation and classification. Upon completion, the boreholes were backfilled with the site soil.

Field logs of each boring were prepared by the drill crew. These logs included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. The boring logs included with this report represent an interpretation of the field logs and include modifications based on laboratory observation of the samples.

An automatic SPT hammer was used to advance the split-barrel sampler in some of the borings performed on this site. A significantly greater efficiency is achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. This higher efficiency has an appreciable effect on the SPT-N value. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.



Project Mngr:	CA
Drawn By:	MG
Checked By:	CA
Approved By:	CA
Project No.	H4135006
Scale:	AS SHOWN
File No.	H4135006
Date:	2-18-13

Terracon
Consulting Engineers and Scientists
504 E. TYLER STREET TAMPA, FLORIDA 33602
PH. (813) 221-0050 FAX. (813) 221-0051

SOIL BORING PROFILES

GEOTECHNICAL ENGINEERING REPORT

THE LENS

ST. PETERSBURG, PINELLAS COUNTY, FLORIDA

EXHIBIT

A-6

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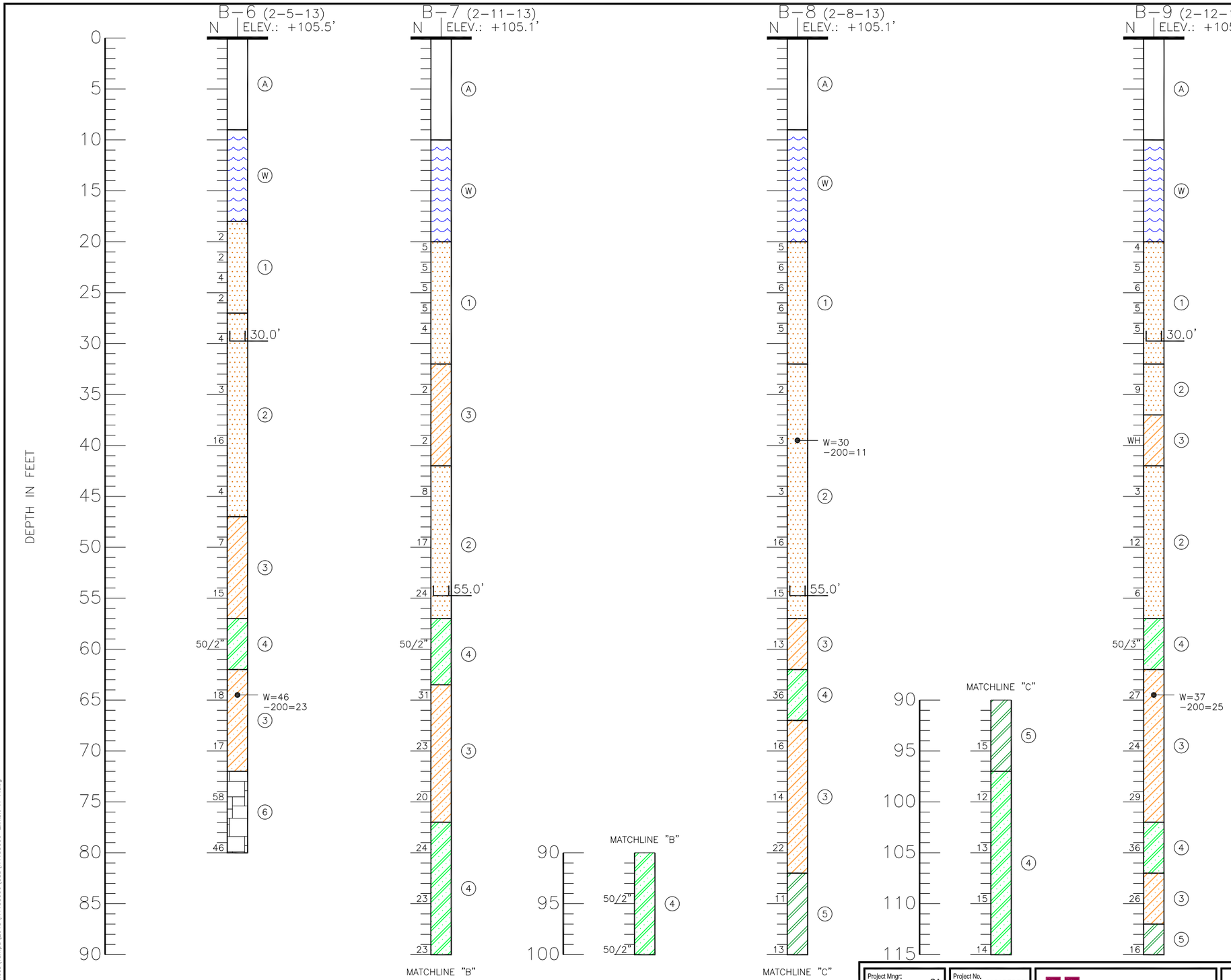

LEGEND

(A)	AIR
(W)	WATER
(1)	GRAY/BROWN FINE SAND WITH MANY TO TRACE SHELL FRAGMENTS (SP)
(2)	BROWN/GRAY FINE SAND TO SAND WITH SILT (SP)(SP-SM)
(3)	BROWN/GRAY CLAYEY SAND (SC)
(4)	GREEN/GRAY SANDY CLAY (CL)
(5)	GREEN/GRAY CLAY (CH)
(6)	WEATHERED LIMESTONE FORMATION
(SP)	UNIFIED SOIL CLASSIFICATION GROUP SYMBOL AS DETERMINED BY VISUAL EXAMINATION
0.5 ▼ 1-18-13	OBSERVED GROUNDWATER LEVEL IN FEET WITH DATE OF READING
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
(SP)	(50) BLOWS REQUIRED TO DRIVE SAMPLING SPOON (5) INCHES
⌊55.0'	DEPTH TO WHICH CASING WAS DRIVEN IN FEET
WH	SAMPLING SPOON ADVANCED UNDER WEIGHT OF ROD AND HAMMER
WR	SAMPLING SPOON ADVANCED UNDER WEIGHT OF ROD
◀ 100%	DRILLING FLUID CIRCULATION LOSS (%)
W	NATURAL MOISTURE CONTENT (%)
-200	FINES PASSING No. 200 SIEVE (%)
LL	LIQUID LIMIT (%)
PI	PLASTICITY INDEX (%)

Project Mngr:	CA
Drawn By:	MG
Checked By:	CA
Approved By:	CA
Project No.	H4135006
Scale:	AS SHOWN
File No.	H4135006
Date:	2-18-13

Terracon
Consulting Engineers and Scientists
504 E. TYLER STREET TAMPA, FLORIDA 33602
PH. (813) 221-0050 FAX. (813) 221-0051

SOIL BORING PROFILES

GEOTECHNICAL ENGINEERING REPORT

THE LENS

ST. PETERSBURG, PINELLAS COUNTY, FLORIDA

EXHIBIT

A-7

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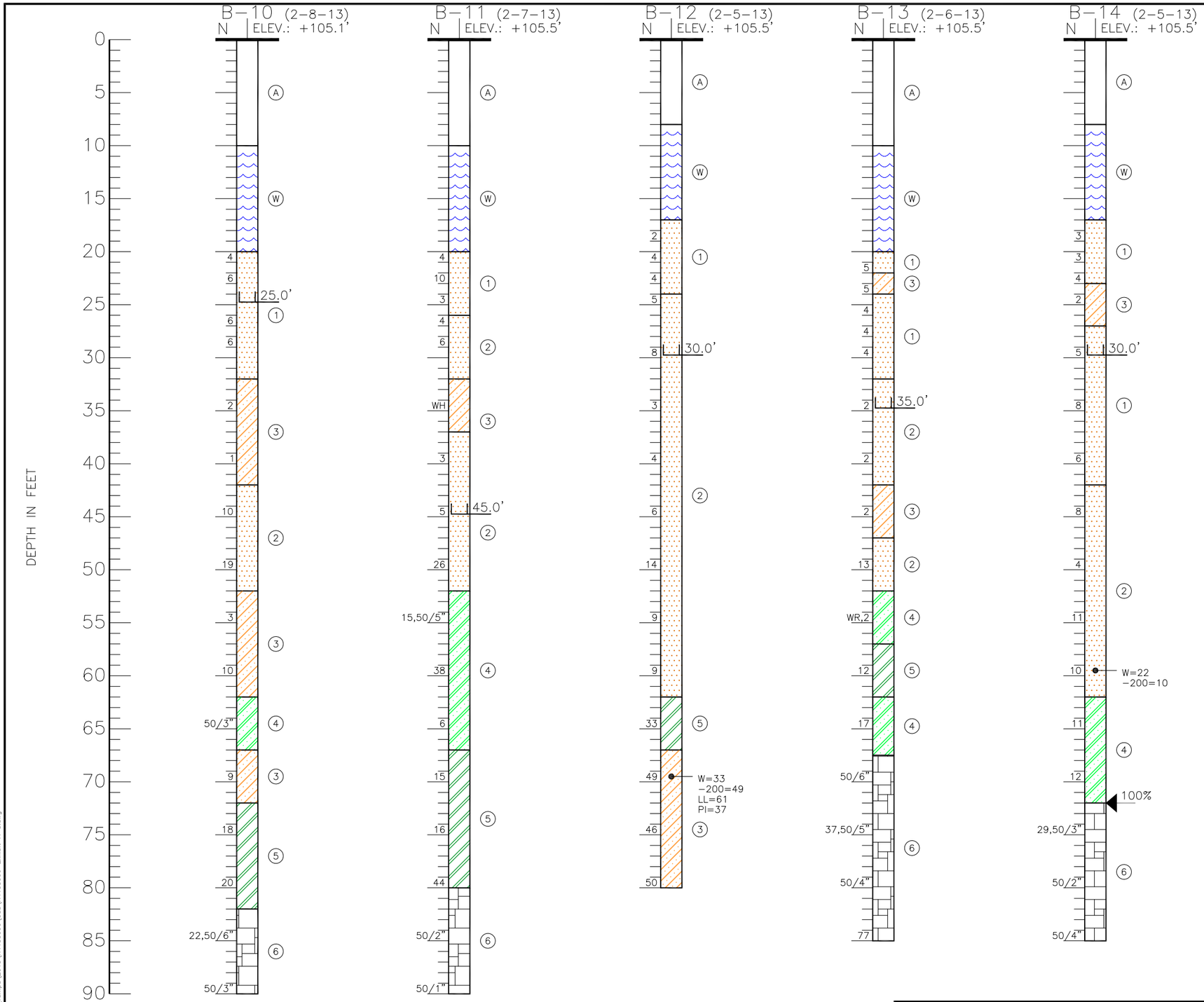

LEGEND

(A)	AIR
(W)	WATER
(1)	GRAY/BROWN FINE SAND WITH MANY TO TRACE SHELL FRAGMENTS (SP)
(2)	BROWN/GRAY FINE SAND TO SAND WITH SILT (SP)(SP-SM)
(3)	BROWN/GRAY CLAYEY SAND (SC)
(4)	GREEN/GRAY SANDY CLAY (CL)
(5)	GREEN/GRAY CLAY (CH)
(6)	WEATHERED LIMESTONE FORMATION
(SP)	UNIFIED SOIL CLASSIFICATION GROUP SYMBOL AS DETERMINED BY VISUAL EXAMINATION
0.5 ▼ 1-18-13	OBSERVED GROUNDWATER LEVEL IN FEET WITH DATE OF READING
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
(SP)	(50) BLOWS REQUIRED TO DRIVE SAMPLING SPOON (5) INCHES
55.0'	DEPTH TO WHICH CASING WAS DRIVEN IN FEET
WH	SAMPLING SPOON ADVANCED UNDER WEIGHT OF ROD AND HAMMER
WR	SAMPLING SPOON ADVANCED UNDER WEIGHT OF ROD
◀ 100%	DRILLING FLUID CIRCULATION LOSS (%)
W	NATURAL MOISTURE CONTENT (%)
-200	FINES PASSING No. 200 SIEVE (%)
LL	LIQUID LIMIT (%)
PI	PLASTICITY INDEX (%)

Project Mngr: CA	Project No. H4135006	Terracon Consulting Engineers and Scientists	SOIL BORING PROFILES
Drawn By: MG	Scale: AS SHOWN	504 E. TYLER STREET TAMPA, FLORIDA 33602	GEOTECHNICAL ENGINEERING REPORT
Checked By: CA	File No. H4135006	PH. (813) 221-0050 FAX. (813) 221-0051	THE LENS
Approved By: CA	Date: 2-18-13		ST. PETERSBURG, PINELLAS COUNTY, FLORIDA

EXHIBIT A-8

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APPENDIX B – LABORATORY TESTING

Laboratory Testing

During the field exploration, a portion of each recovered sample was sealed in a glass jar and transported to our laboratory for further visual observation and laboratory testing. Selected samples retrieved from the borings were tested for moisture (water) content, fines content (soil passing a US standard #200 sieve), and Atterberg limit testing. Those results are included in this report and on the respective boring logs. The visual-manual classifications were modified as appropriate based upon the laboratory testing results.

The soil samples were classified in general accordance with the appended General Notes and the Unified Soil Classification System based on the material's texture and plasticity. The estimated group symbol for the Unified Soil Classification System is shown on the boring logs and a brief description of the Unified Soil Classification System is included in Appendix B. The results of our laboratory testing are presented in the Laboratory Test Results section of this report and on the corresponding borings logs.

SUMMARY OF LABORATORY TESTS
THE LENS
ST. PETERSBURG, FLORIDA

Boring Number	Sample Depth (ft) From To	USCS ID	Stratum Number	Percent Passing No. 200 Sieve	Natural Moisture (%)	Atterberg Limits	
						LL	PI
B-1	2-4	SP	2	4	21	--	--
B-2	23.5-25	SC	3	12	28	--	--
B-4	6-8	SP	1	4	19	--	--
B-6	63.5-65	SC	3	23	46	--	--
B-8	38.5-40	SP-SM	2	11	30	--	--
B-9	63.5-65	SC	3	25	37	--	--
B-12	68.5-70	SC	3	49	33	61	37
B-14	58.5-60	SP-SM	2	10	22	--	--
B-15	38.5-40	SP	2	4	22	--	--
B-15	58.5-60	SC	3	34	43	--	--
B-17	53.5-55	CH	5	91	75	--	--

APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1-$^{3}/_{8}$" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube – 2" O.D., 3" O.D., unless otherwise noted	PA:	Power Auger (Solid Stem)
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB	Wash Boring or Mud Rotary

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling	ESH:	Estimated Seasonal High Groundwater
DCI:	Dry Cave in	BCR:	Before Casing Removal	ESL:	Estimated Seasonal Low Groundwater
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0 – 1	Very Soft
500 – 1,000	2 – 3	Soft
1,000 – 2,000	4 – 6	Medium Stiff
2,000 – 4,000	7 – 12	Stiff
4,000 – 8,000	13 – 26	Very Stiff
8,000+	> 26	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Relative Density
0 – 3	Very Loose
4 – 9	Loose
10 – 29	Medium Dense
30 – 50	Dense
> 50	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	≥ 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Sand	#4 to #200 sieve (4.75 to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 – 10
Medium	11 – 30
High	> 30

Rev. 4/10

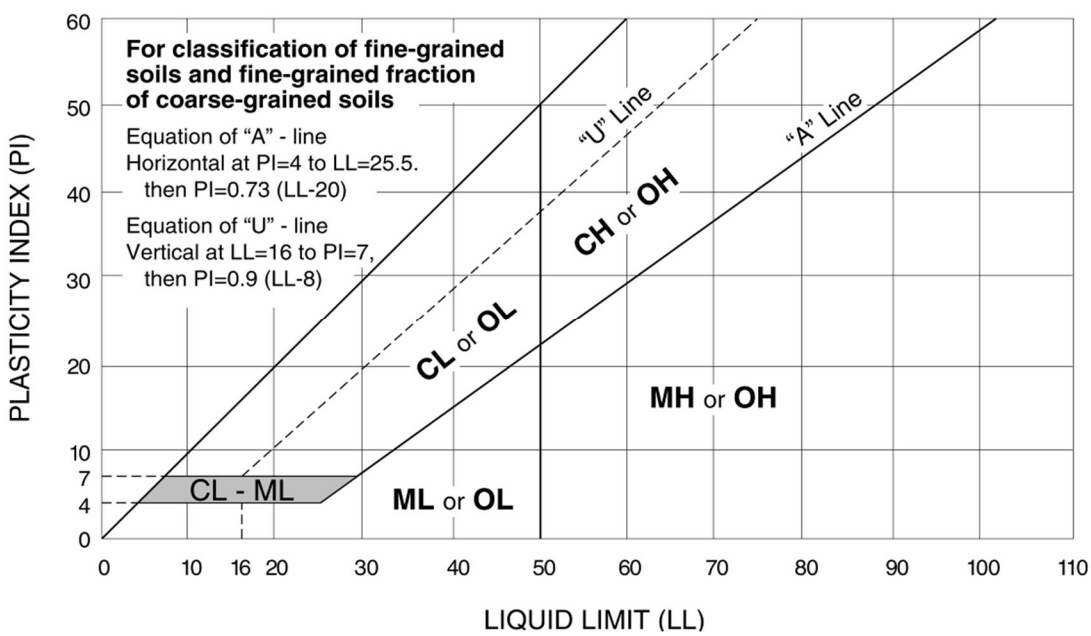
UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay [K,L,M,N]
						Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay [K,L,M,P]
						Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.



Terracon

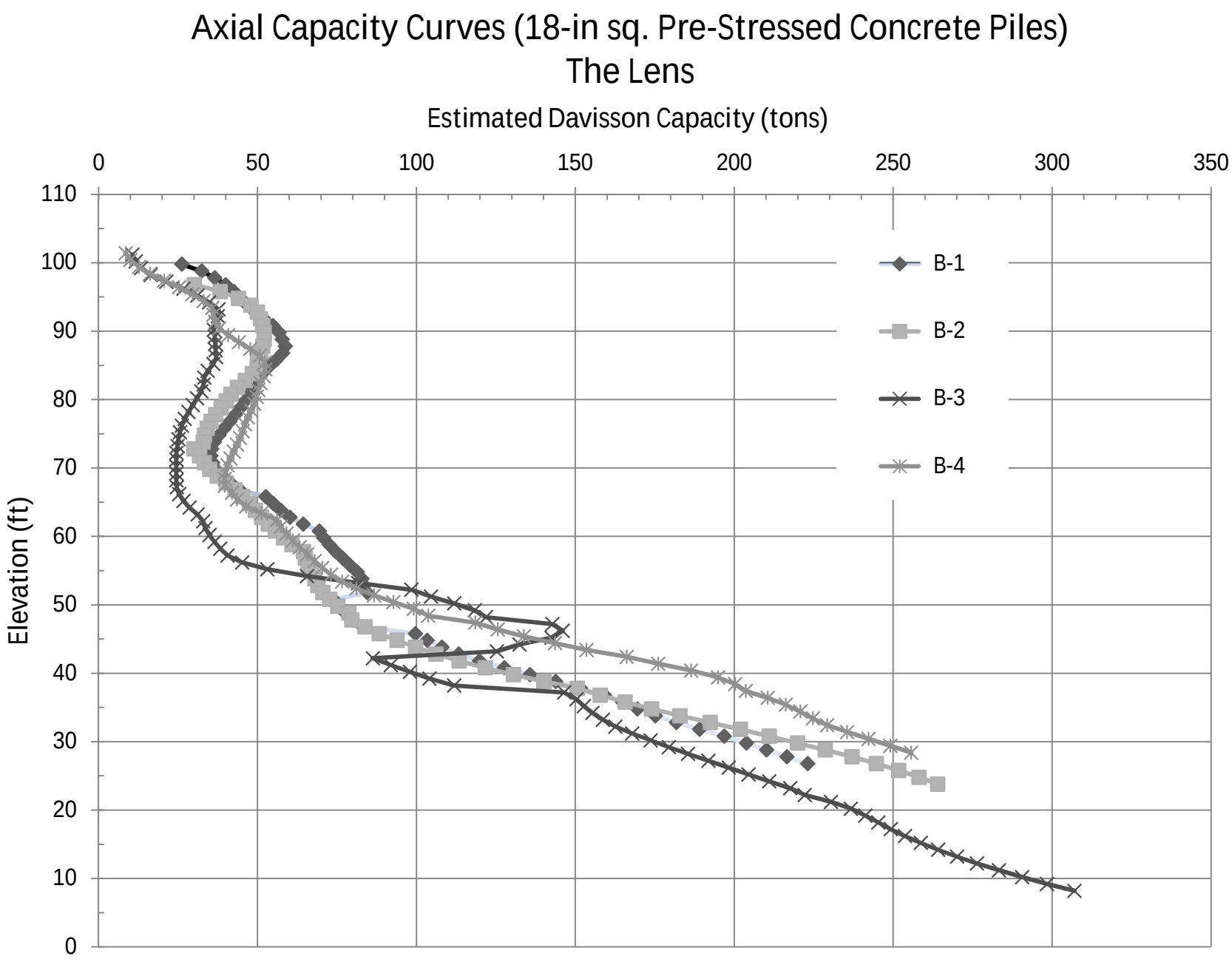

Axial Capacity Curves (18-in sq. Pre-Stressed Concrete Piles)
The Lens
Estimated Davisson Capacity (tons)
0
50
100
150
200
250
300
350
Elevation (ft)
110
100
90
80
70
60
50
40
30
20
10
0
B-1
B-2
B-3
B-4

Exhibit C-3

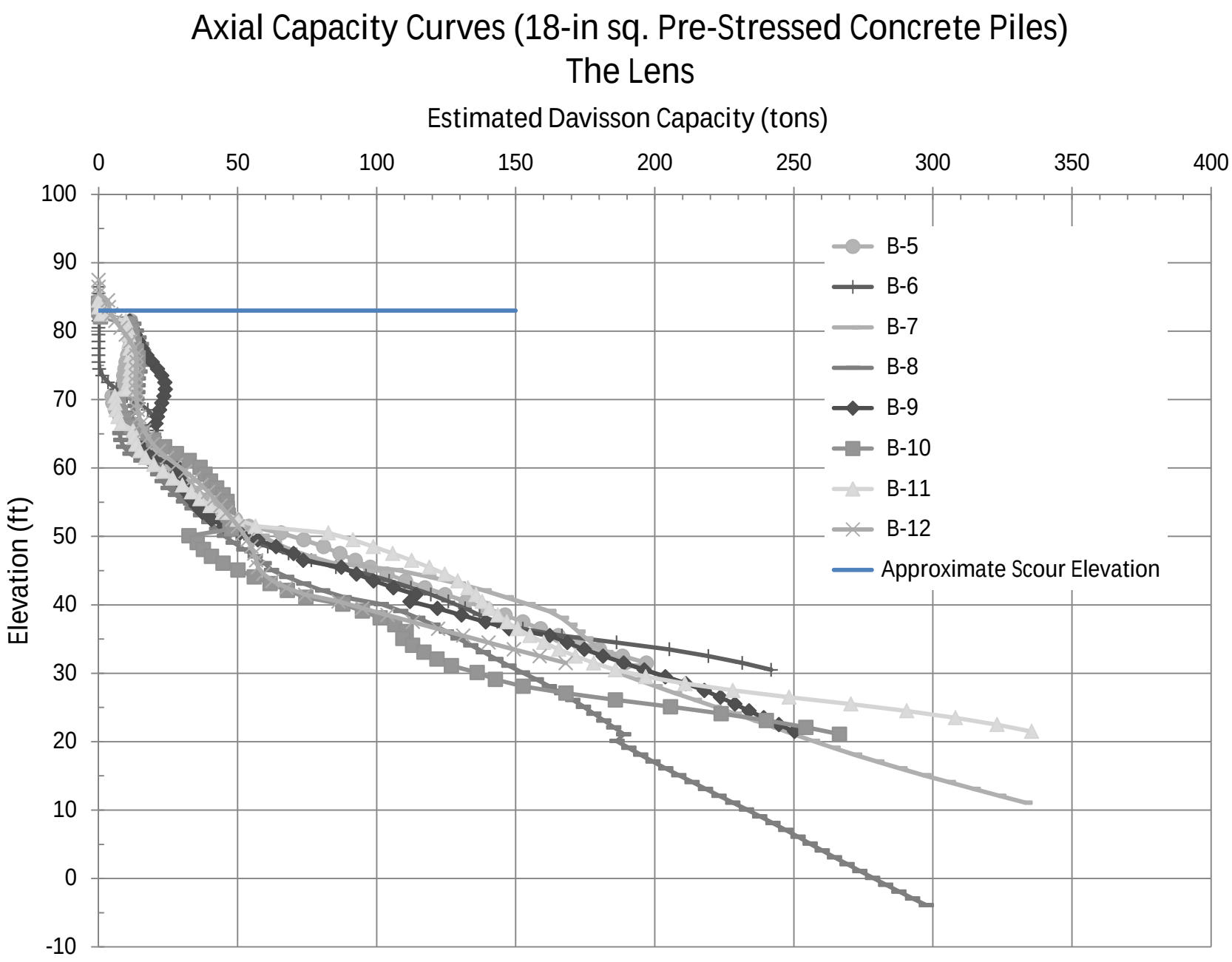

Axial Capacity Curves (18-in sq. Pre-Stressed Concrete Piles)
The Lens
Estimated Davisson Capacity (tons)
0
50
100
150
200
250
300
350
400
Elevation (ft)
100
90
80
70
60
50
40
30
20
10
0
-10
B-5
B-6
B-7
B-8
B-9
B-10
B-11
B-12
Approximate Scour Elevation

Exhibit C-4

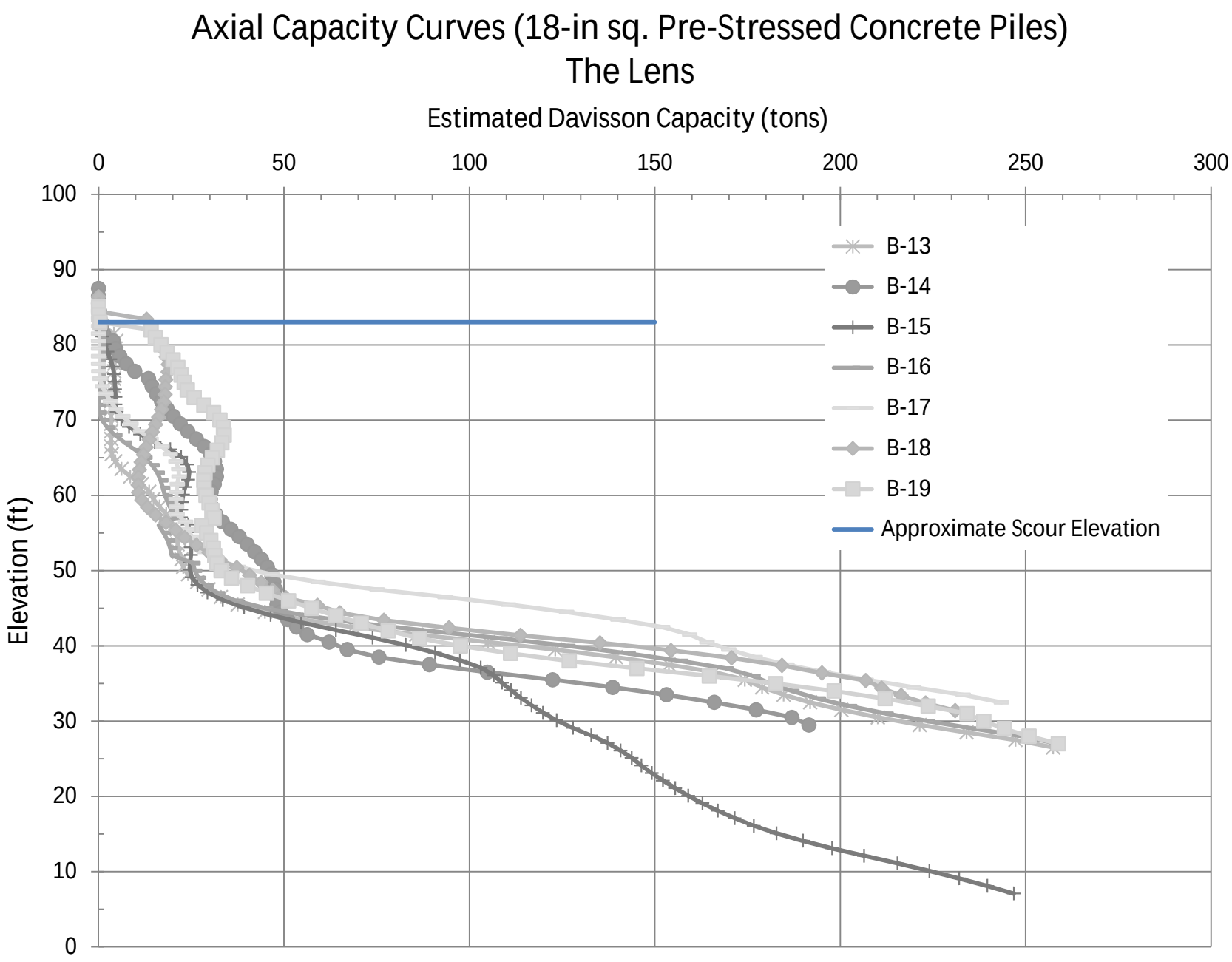

Axial Capacity Curves (18-in sq. Pre-Stressed Concrete Piles)
The Lens
Estimated Davisson Capacity (tons)
0
50
100
150
200
250
300
Elevation (ft)
100
90
80
70
60
50
40
30
20
10
0
B-13
B-14
B-15
B-16
B-17
B-18
B-19
Approximate Scour Elevation

Exhibit C-5

Exhibit C-6

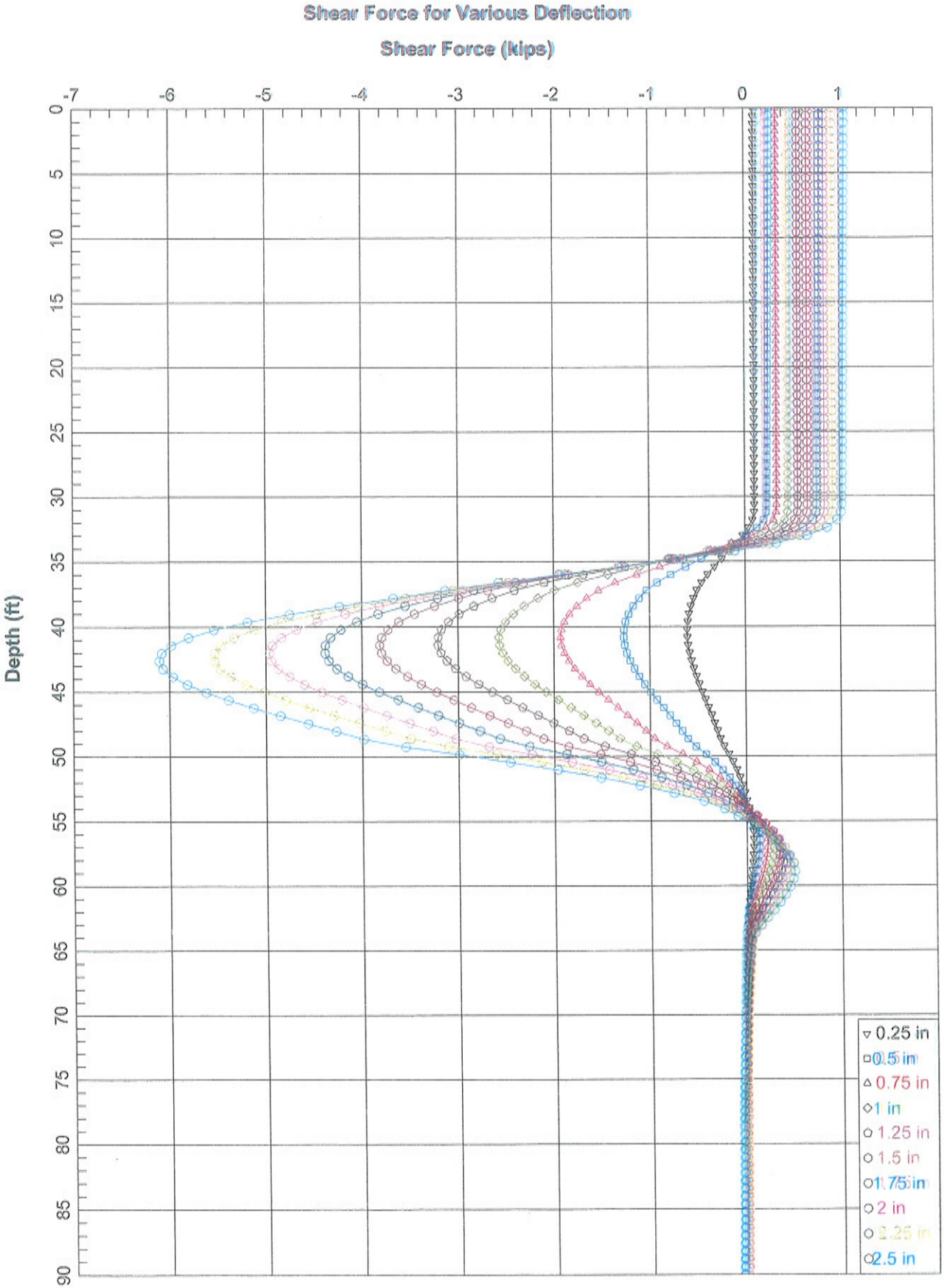

Shear Force for Various Deflection
Shear Force (kips)
-7
-6
-5
-4
-3
-2
-1
0
1
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
0.25 in
0.5 in
0.75 in
1 in
1.25 in
1.5 in
1.75 in
2 in
2.25 in
2.5 in

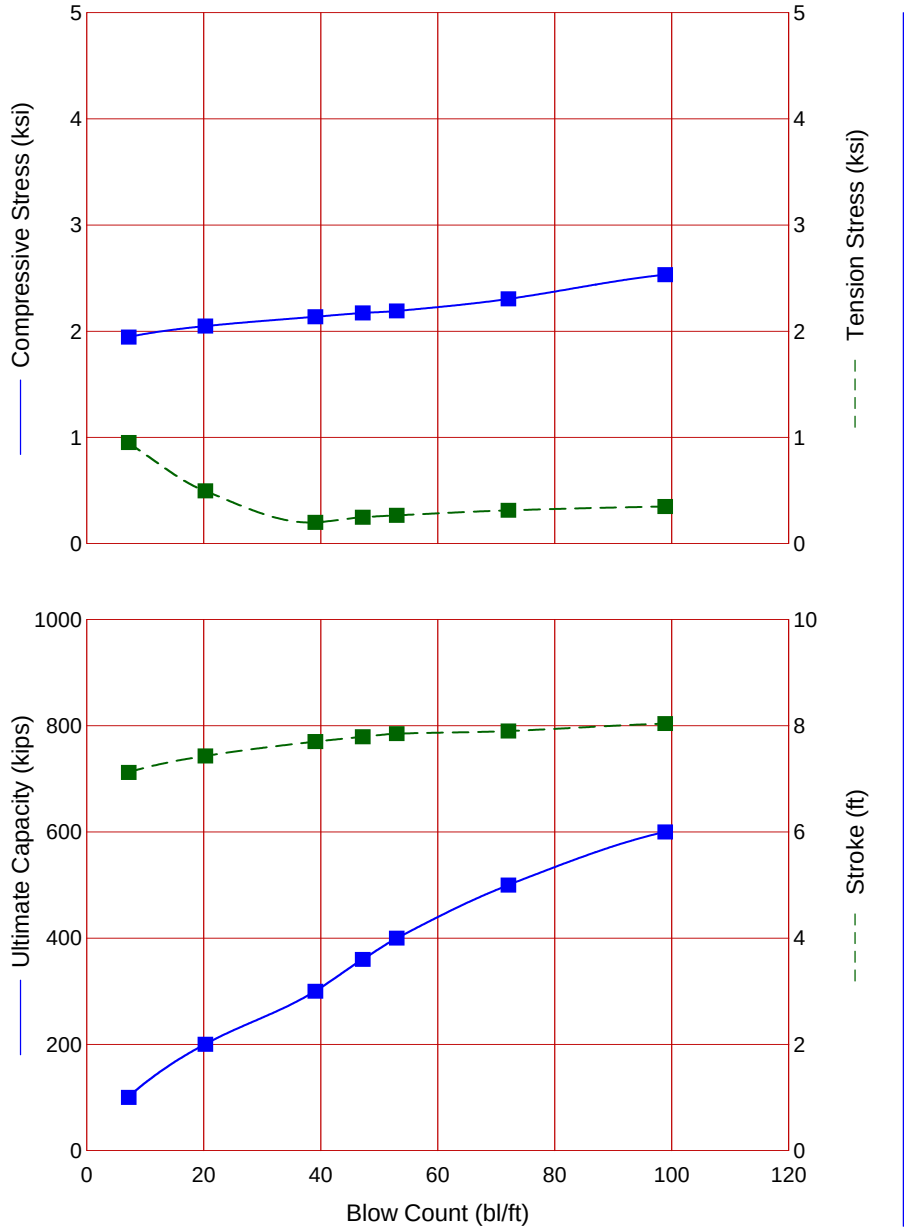
Exhibit C-7

Preliminary WEAP Analyses

- APE D25-42: Bearing Graph and Inspector's Chart
- APE D30-42: Bearing Graph and Inspector's Chart
- APE D36-42: Bearing Graph and Inspector's Chart

Terracon
St.Pete Pier_APE D25_62 kip-ft Energy BG

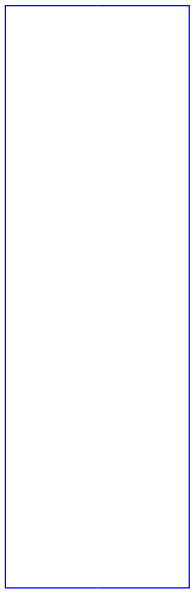
05-Mar-2013
GRLWEAP Version 2010



APE D 25-42

Ram Weight	5.51	kips
Efficiency	0.800	
Pressure	1400 (100%)	psi
Helmet Weight	3.50	kips
Hammer Cushion	34825	kips/in
Pile Cushion	2025	kips/in
COR of P.C.	0.500	
Skin Quake	0.100	in
Toe Quake	0.150	in
Skin Damping	0.100	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	90.00	ft
Pile Penetration	60.00	ft
Pile Top Area	324.00	in2

Pile Model



Skin Friction Distribution

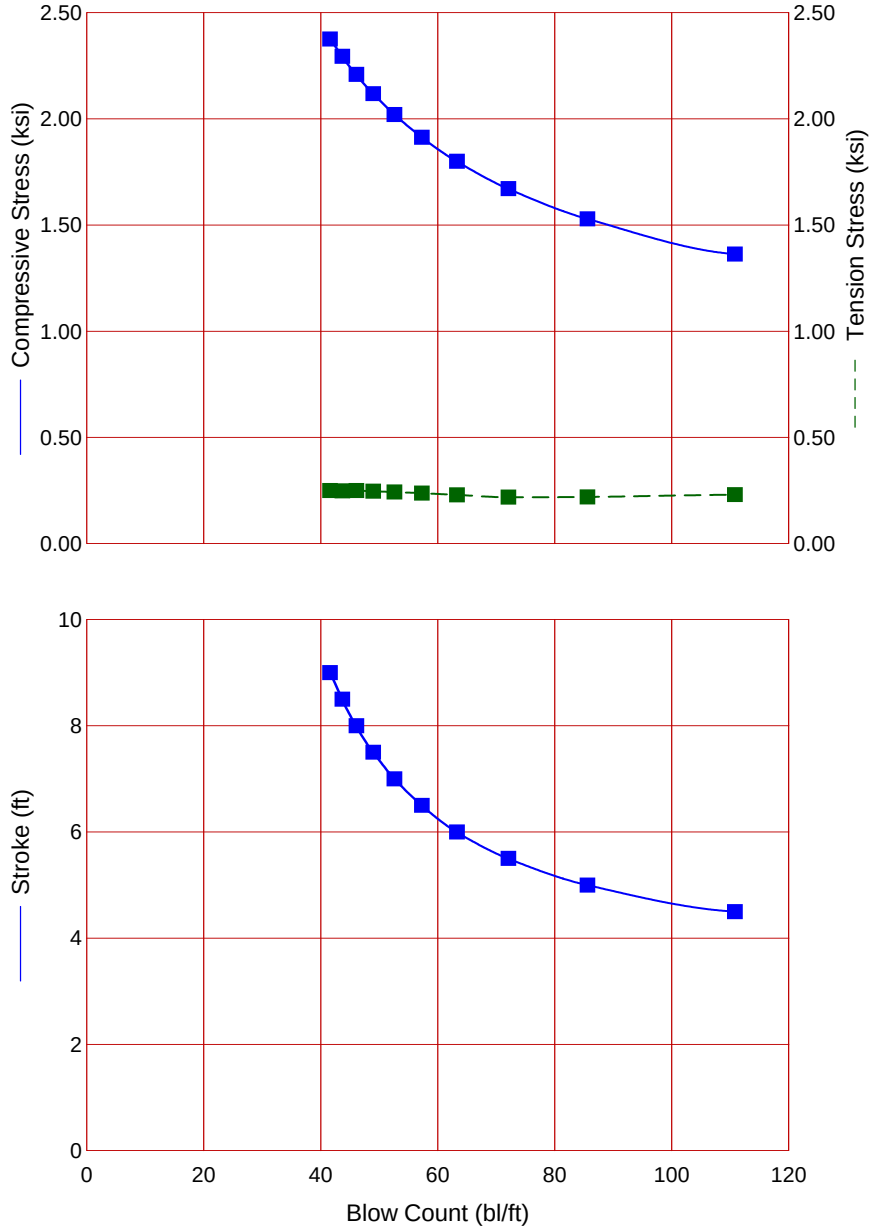
Res. Shaft = 17 %
(Proportional)

Terracon 05-Mar-2013
St.Pete Pier_APE D25_62 kip-ft Energy BG GRLWEAP Version 2010

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
100.0	1.95	0.95	7.2	7.12	17.66
200.0	2.05	0.50	20.3	7.43	15.65
300.0	2.14	0.20	39.1	7.70	15.65
360.0	2.17	0.25	47.2	7.79	15.67
400.0	2.19	0.27	53.0	7.85	15.58
500.0	2.30	0.31	72.1	7.90	15.22
600.0	2.53	0.35	98.9	8.04	15.34

Terracon
St.Pete Pier_APE D25_62 kip-ft Energy IC

05-Mar-2013
GRLWEAP Version 2010

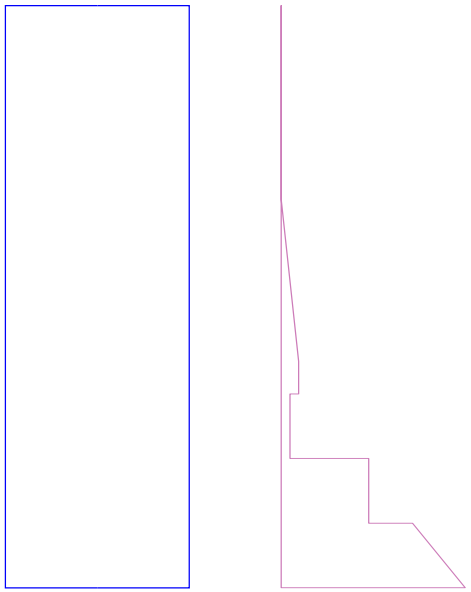


APE D 25-42

Capacity	360.0	kips
Ram Weight	5.51	kips
Efficiency	0.800	
Pressure	1400 (100%)	psi
Helmet Weight	3.50	kips
Hammer Cushion	34825	kips/in
Pile Cushion	2025	kips/in
COR of P.C.	0.500	
Skin Quake	0.100	in
Toe Quake	0.150	in
Skin Damping	0.100	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	90.00	ft
Pile Penetration	60.00	ft
Pile Top Area	324.00	in2

Pile Model

Skin Friction Distribution



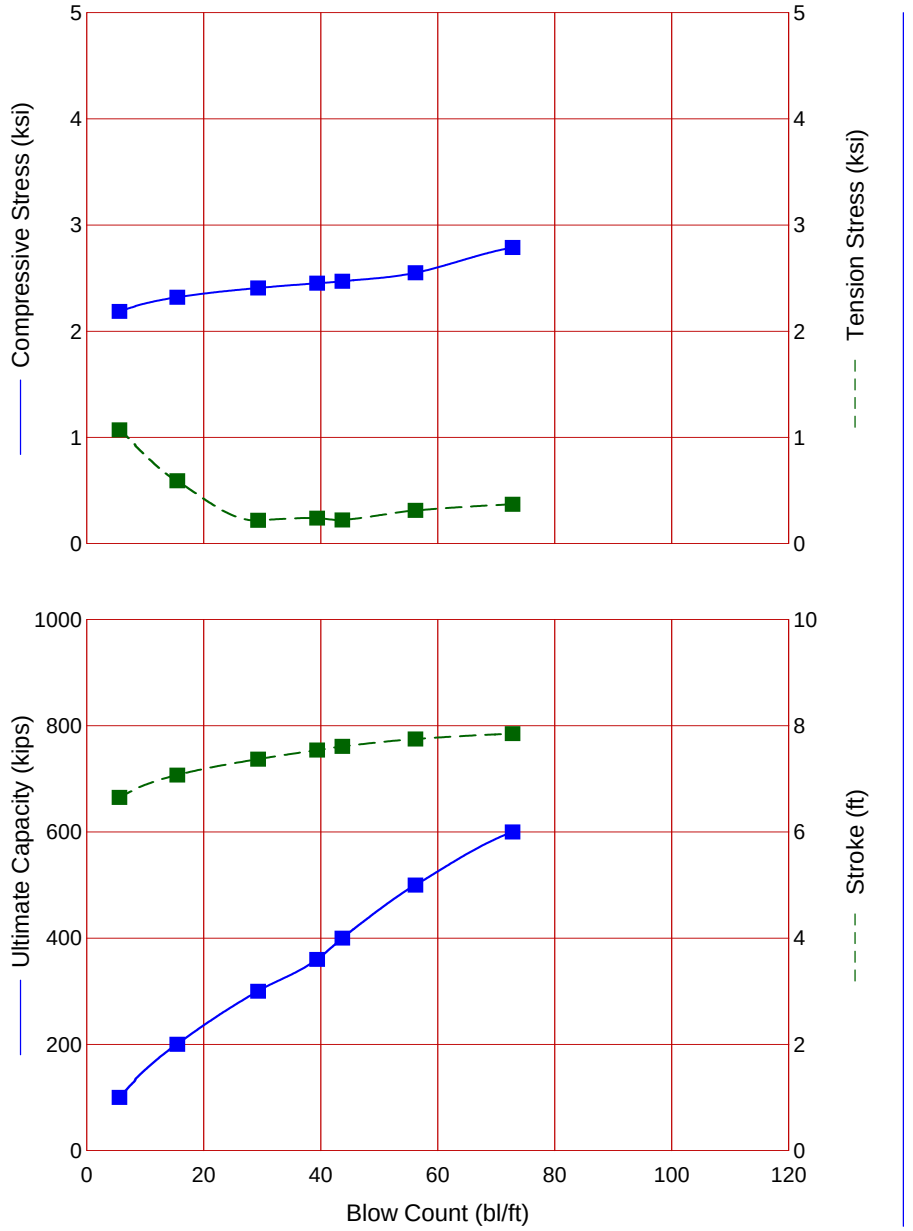
Res. Shaft = 17 %
(Proportional)

Terracon 05-Mar-2013
St.Pete Pier_APE D25_62 kip-ft Energy IC GRLWEAP Version 2010

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
360.0	1.36	0.23	110.8	4.50	6.64
360.0	1.53	0.22	85.6	5.00	8.24
360.0	1.67	0.22	72.1	5.50	9.74
360.0	1.80	0.23	63.3	6.00	11.17
360.0	1.91	0.24	57.3	6.50	12.48
360.0	2.02	0.24	52.6	7.00	13.77
360.0	2.12	0.25	49.0	7.50	14.99
360.0	2.21	0.25	46.1	8.00	16.14
360.0	2.29	0.25	43.7	8.50	17.26
360.0	2.38	0.25	41.6	9.00	18.35

Terracon
St.Pete Pier_APE D30_74 kip-ft energy BG

05-Mar-2013
GRLWEAP Version 2010

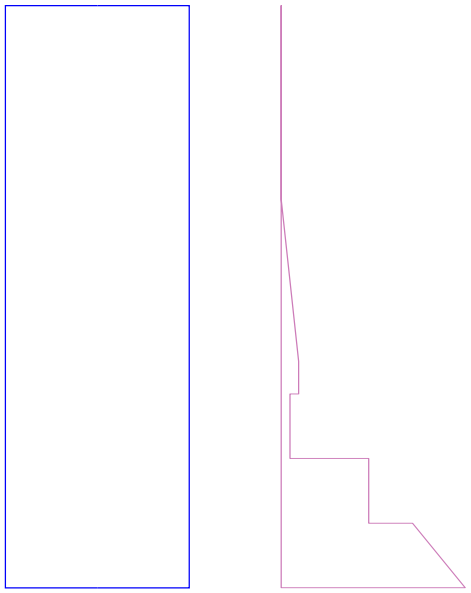


APE D 30-42

Ram Weight	6.62	kips
Efficiency	0.800	
Pressure	1425 (100%)	psi
Helmet Weight	3.50	kips
Hammer Cushion	102485	kips/in
Pile Cushion	2025	kips/in
COR of P.C.	0.500	
Skin Quake	0.100	in
Toe Quake	0.150	in
Skin Damping	0.100	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	90.00	ft
Pile Penetration	60.00	ft
Pile Top Area	324.00	in2

Pile Model

Skin Friction Distribution



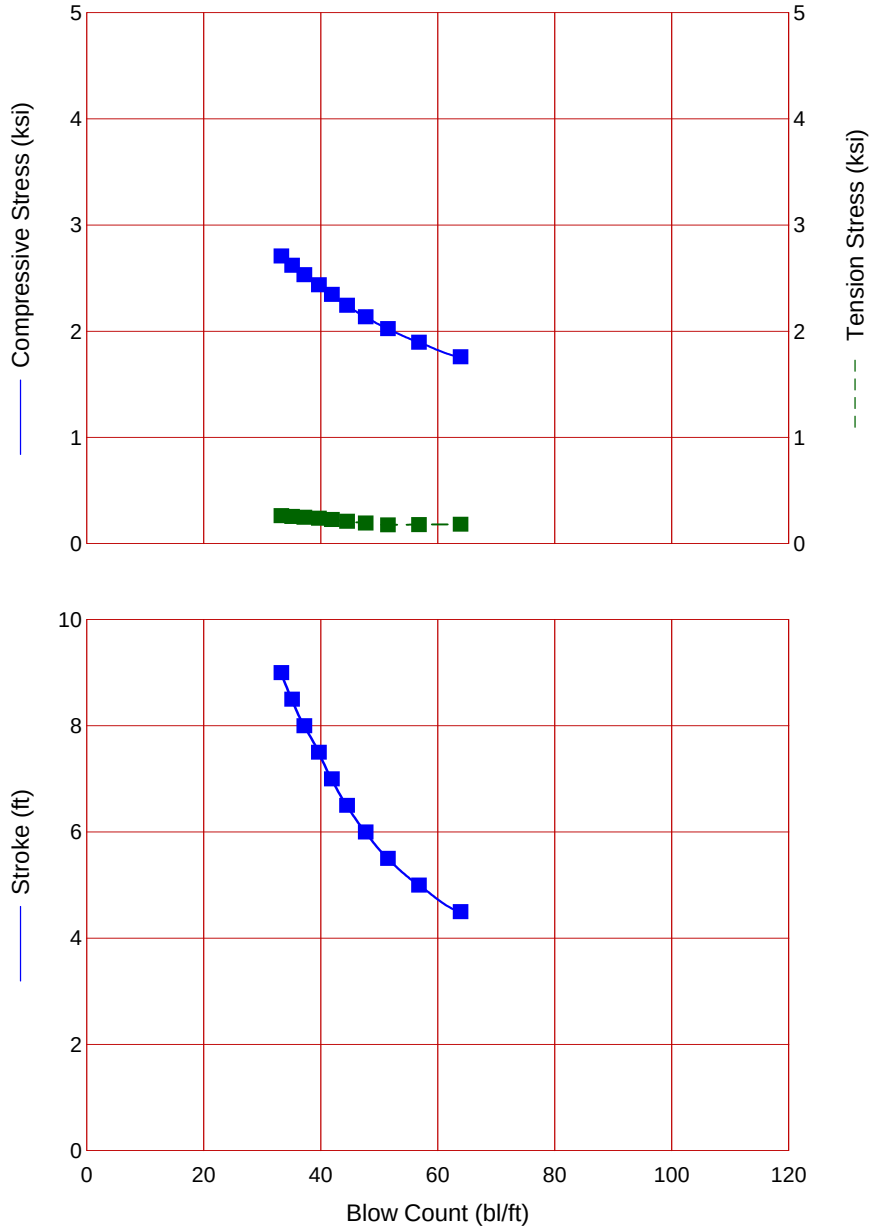
Res. Shaft = 17 %
(Proportional)

Terracon 05-Mar-2013
St.Pete Pier_APE D30_74 kip-ft energy BG GRLWEAP Version 2010

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
100.0	2.19	1.07	5.6	6.65	23.59
200.0	2.32	0.59	15.5	7.07	20.84
300.0	2.41	0.22	29.3	7.37	20.15
360.0	2.45	0.24	39.4	7.54	20.46
400.0	2.47	0.22	43.7	7.61	20.41
500.0	2.55	0.31	56.2	7.75	20.03
600.0	2.79	0.37	72.8	7.85	20.01

Terracon
St.Pete Pier_APE D30_74 kip-ft energy IC

05-Mar-2013
GRLWEAP Version 2010

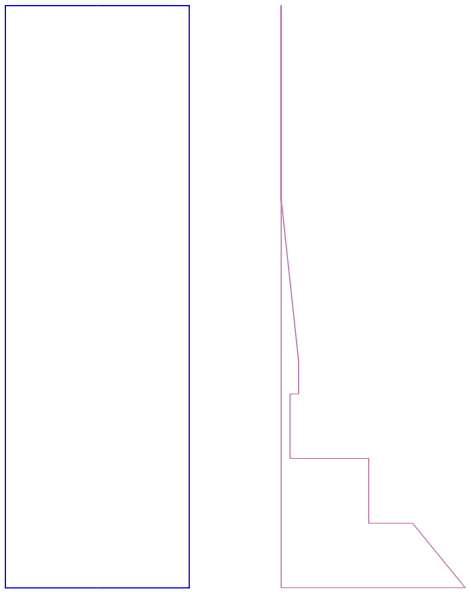


APE D 30-42

Capacity	360.0	kips
Ram Weight	6.62	kips
Efficiency	0.800	
Pressure	1425 (100%)	psi
Helmet Weight	3.50	kips
Hammer Cushion	102485	kips/in
Pile Cushion	2025	kips/in
COR of P.C.	0.500	
Skin Quake	0.100	in
Toe Quake	0.150	in
Skin Damping	0.100	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	90.00	ft
Pile Penetration	60.00	ft
Pile Top Area	324.00	in2

Pile Model

Skin Friction Distribution



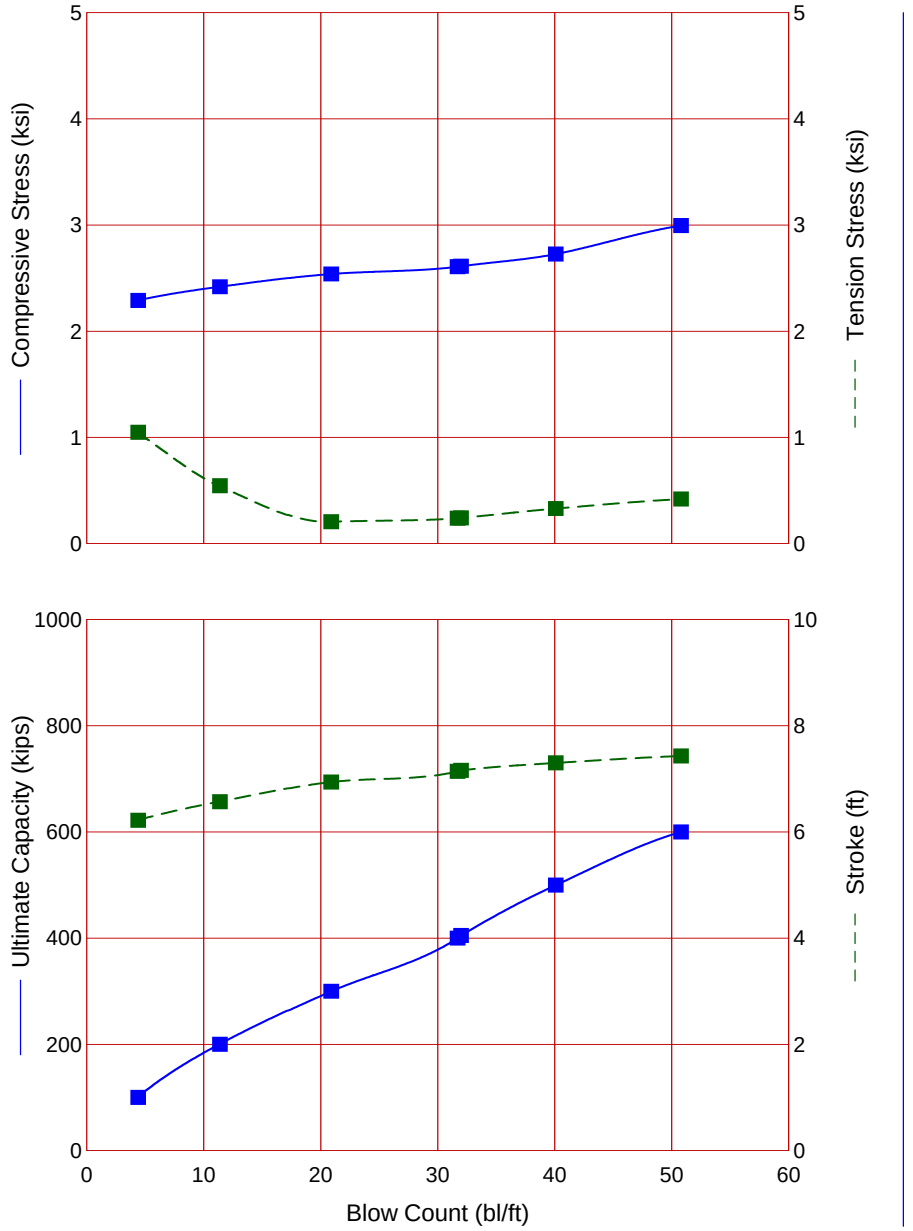
Res. Shaft = 17 %
(Proportional)

Terracon 05-Mar-2013
St.Pete Pier_APE D30_74 kip-ft energy IC GRLWEAP Version 2010

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
360.0	1.76	0.18	63.9	4.50	11.61
360.0	1.90	0.18	56.8	5.00	13.22
360.0	2.02	0.18	51.5	5.50	14.77
360.0	2.13	0.20	47.7	6.00	16.19
360.0	2.24	0.21	44.5	6.50	17.61
360.0	2.35	0.23	41.9	7.00	19.00
360.0	2.44	0.24	39.7	7.50	20.29
360.0	2.53	0.25	37.2	8.00	21.62
360.0	2.62	0.26	35.1	8.50	22.94
360.0	2.71	0.26	33.3	9.00	24.25

Terracon
St.Pete Pier_APE D36_89 kip-ft energy BG

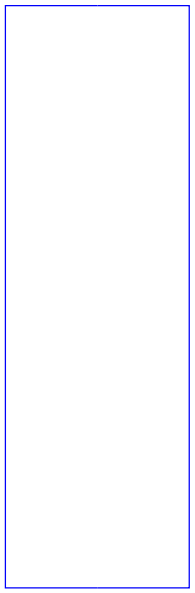
05-Mar-2013
GRLWEAP Version 2010



APE D 36-42

Ram Weight	7.94	kips
Efficiency	0.800	
Pressure	1475 (100%)	psi
Helmet Weight	3.50	kips
Hammer Cushion	102485	kips/in
Pile Cushion	2025	kips/in
COR of P.C.	0.500	
Skin Quake	0.100	in
Toe Quake	0.150	in
Skin Damping	0.100	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	90.00	ft
Pile Penetration	60.00	ft
Pile Top Area	324.00	in2

Pile Model



Skin Friction Distribution

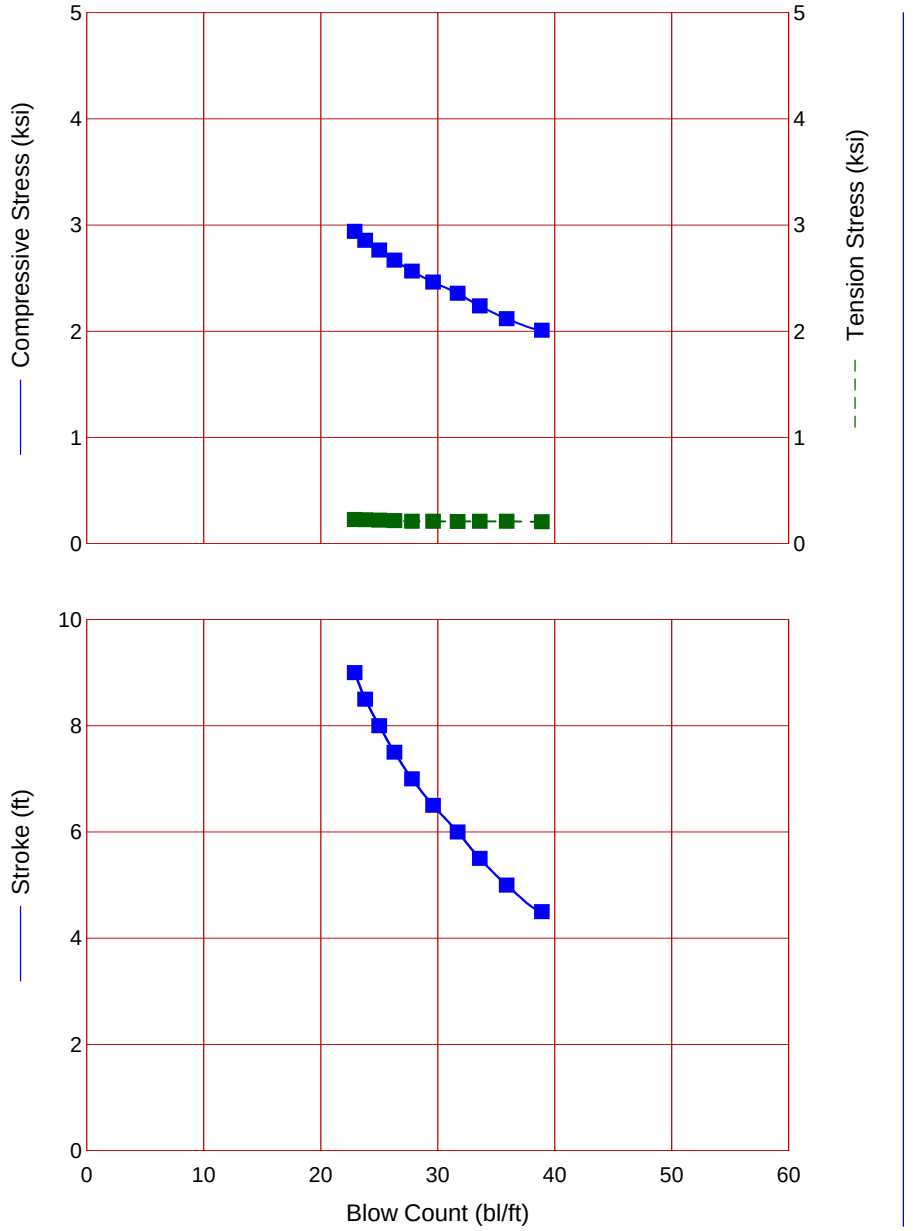
Res. Shaft = 17 %
(Proportional)

Terracon 05-Mar-2013
St.Pete Pier_APE D36_89 kip-ft energy BG GRLWEAP Version 2010

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
100.0	2.29	1.05	4.4	6.22	31.50
200.0	2.42	0.55	11.4	6.57	27.89
300.0	2.54	0.21	20.9	6.94	26.71
400.0	2.61	0.24	31.7	7.14	26.73
405.0	2.61	0.24	32.0	7.16	26.74
500.0	2.73	0.33	40.1	7.30	26.27
600.0	2.99	0.42	50.8	7.43	26.28

Terracon
St.Pete Pier_APE D36_89 kip-ft energy IC

05-Mar-2013
GRLWEAP Version 2010

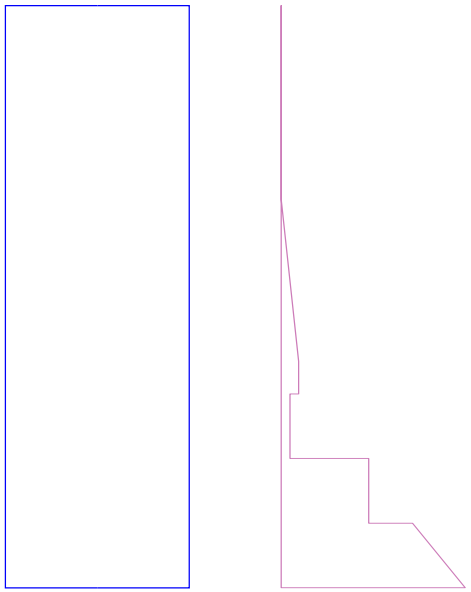


APE D 36-42

Capacity	360.0	kips
Ram Weight	7.94	kips
Efficiency	0.800	
Pressure	1475 (100%)	psi
Helmet Weight	3.50	kips
Hammer Cushion	102485	kips/in
Pile Cushion	2025	kips/in
COR of P.C.	0.500	
Skin Quake	0.100	in
Toe Quake	0.150	in
Skin Damping	0.100	sec/ft
Toe Damping	0.150	sec/ft
Pile Length	90.00	ft
Pile Penetration	60.00	ft
Pile Top Area	324.00	in2

Pile Model

Skin Friction Distribution



Res. Shaft = 17 %
(Proportional)

Terracon 05-Mar-2013
St.Pete Pier_APE D36_89 kip-ft energy IC GRLWEAP Version 2010

Ultimate Capacity kips	Maximum Compression Stress ksi	Maximum Tension Stress ksi	Blow Count bl/ft	Stroke ft	Energy kips-ft
360.0	2.01	0.21	38.9	4.50	17.12
360.0	2.12	0.21	35.9	5.00	19.18
360.0	2.24	0.21	33.6	5.50	21.09
360.0	2.36	0.21	31.7	6.00	22.98
360.0	2.46	0.21	29.6	6.50	24.72
360.0	2.57	0.21	27.8	7.00	26.45
360.0	2.67	0.22	26.3	7.50	28.19
360.0	2.76	0.22	25.0	8.00	29.85
360.0	2.86	0.23	23.8	8.50	31.48
360.0	2.94	0.23	22.9	9.00	33.03

Exhibit C-8

Shaft 14 - 60 in shaft 1 3 percent steel in column.lp6o

==========

Pile Plus for Windows, Version 2012-06.029

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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This copy of LPile is licensed to:

Terracon
Terracon

Serial Number of Security Device: 162969940
Company Name Stored in Security Device: WPC, Inc. (Terracon)

Files Used for Analysis

Path to file locations: N:\H4135006 St. Petersburg Pier - Lens\The Lens Lateral Analysis\
Name of input data file: Shaft 14 - 60 in shaft 1.3 percent steel in column.lp6d
Name of output report file: Shaft 14 - 60 in shaft 1.3 percent steel in column.lp6o
Name of plot output file: Shaft 14 - 60 in shaft 1.3 percent steel in column.lp6p
Name of runtime messeage file: Shaft 14 - 60 in shaft 1.3 percent steel in column.lp6r

---

Date and Time of Analysis

Date: February 26, 2013 Time: 10:34:06

Problem Title

Project Name: The Lens - St. Petersburg Pier Replacement

Job Number: H4135006

Client: Michael Maltzan Architecture, Inc.

Engineer: TES

Description: Lateral Analysis of Drilled Shafts - B-15 (Shaft 14)

Program Options

Engineering units are US Customary Units: pounds, inches, feet

Basic Program Options:

This analysis computes pile response to lateral loading and will compute nonlinear moment-curvature and nominal moment capacity for section types with nonlinear properties.

Computation Options:
- Analysis does not use p-y multipliers (individual pile or shaft only)
- Analysis assumes no shear resistance at pile tip
- Analysis for fixed-length pile or shaft only
- No computation of foundation stiffness matrix elements
- Output pile response for full length of pile
- Analysis assumes no soil movements acting on pile
- No p-y curves to be computed and output for user-specified depths

Solution Control Parameters:

- Number of pile increments	=	150	
- Maximum number of iterations allowed	=	1000	
- Deflection tolerance for convergence	=	1.0000E-05	in
- Maximum allowable deflection	=	100.0000	in

Pile Response Output Options:
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1

Pile Structural Properties and Geometry

Total Number of Sections	=	2
Total Pile Length	=	100.00 ft
Depth of ground surface below top of pile	=	43.00 ft

Pile dimensions used for p-y curve computations defined using 4 points.
p-y curves are computed using values of pile diameter interpolated over the length of the pile.

Point	Depth X ft	Pile Diameter in
1	0.00000	48.0000000
2	27.000000	48.0000000
3	27.000000	60.0000000
4	100.000000	60.0000000

Input Structural Properties:

Pile Section No. 1:

Section Type	=	Drilled Shaft (Bored Pile)
Section Length	=	27.000 ft
Section Diameter	=	48.000 in

Pile Section No. 2:

Section Type	=	Drilled Shaft (Bored Pile)
Section Length	=	73.000 ft
Section Diameter	=	60.000 in

Ground Slope and Pile Batter Angles

Ground Slope Angle	=	0.000	degrees
	=	0.000	radians
Pile Batter Angle	=	0.000	degrees
	=	0.000	radians

Soil and Rock Layering Information

The soil profile is modelled using 6 layers

Layer 1 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	43.00000	ft
Distance from top of pile to bottom of layer	=	47.00000	ft
Effective unit weight at top of layer	=	37.60000	pcf
Effective unit weight at bottom of layer	=	37.60000	pcf
Friction angle at top of layer	=	30.00000	deg.
Friction angle at bottom of layer	=	30.00000	deg.
Subgrade k at top of layer	=	30.00000	pci
Subgrade k at bottom of layer	=	30.00000	pci

Layer 2 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	47.00000	ft
Distance from top of pile to bottom of layer	=	59.00000	ft
Effective unit weight at top of layer	=	27.60000	pcf
Effective unit weight at bottom of layer	=	27.60000	pcf
Friction angle at top of layer	=	28.00000	deg.
Friction angle at bottom of layer	=	28.00000	deg.
Subgrade k at top of layer	=	20.00000	pci
Subgrade k at bottom of layer	=	20.00000	pci

Layer 3 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	59.00000	ft

Distance from top of pile to bottom of layer	=	64.00000	ft
Effective unit weight at top of layer	=	52.60000	pcf
Effective unit weight at bottom of layer	=	52.60000	pcf
Friction angle at top of layer	=	35.00000	deg.
Friction angle at bottom of layer	=	35.00000	deg.
Subgrade k at top of layer	=	50.00000	pci
Subgrade k at bottom of layer	=	50.00000	pci

Layer 4 is soft clay, p-y criteria by Matlock, 1970

Distance from top of pile to top of layer	=	64.00000	ft
Distance from top of pile to bottom of layer	=	74.00000	ft
Effective unit weight at top of layer	=	27.60000	pcf
Effective unit weight at bottom of layer	=	27.60000	pcf
Undrained cohesion at top of layer	=	250.00000	psf
Undrained cohesion at bottom of layer	=	250.00000	psf
Epsilon-50 at top of layer	=	0.02000	
Epsilon-50 at bottom of layer	=	0.02000	

Layer 5 is stiff clay with water-induced erosion

Distance from top of pile to top of layer	=	74.00000	ft
Distance from top of pile to bottom of layer	=	84.00000	ft
Effective unit weight at top of layer	=	57.60000	pcf
Effective unit weight at bottom of layer	=	57.60000	pcf
Undrained cohesion at top of layer	=	750.00000	psf
Undrained cohesion at bottom of layer	=	750.00000	psf
Epsilon-50 at top of layer	=	0.01000	
Epsilon-50 at bottom of layer	=	0.01000	
Subgrade k at top of layer	=	40.00000	pci
Subgrade k at bottom of layer	=	40.00000	pci

Layer 6 is stiff clay with water-induced erosion

Distance from top of pile to top of layer	=	84.00000	ft
Distance from top of pile to bottom of layer	=	107.00000	ft
Effective unit weight at top of layer	=	57.60000	pcf
Effective unit weight at bottom of layer	=	57.60000	pcf
Undrained cohesion at top of layer	=	1500.00000	psf
Undrained cohesion at bottom of layer	=	1500.00000	psf
Epsilon-50 at top of layer	=	0.00500	
Epsilon-50 at bottom of layer	=	0.00500	
Subgrade k at top of layer	=	60.00000	pci
Subgrade k at bottom of layer	=	60.00000	pci

(Depth of lowest soil layer extends 7.00 ft below pile tip)

Summary of Soil Properties

Layer	Layer Depth	Effective Unit Wt.	Undrained Cohesion	Angle of Friction	Uniaxial qu	RQD % or	Strain Factor J	Rock Mass kpy	In-situ Test	In-situ Test	Elastic Subgrade Rock Emass krm
Soil Type											

Num.	(p-y Curve Criteria)	ft	pcf	psf	psi	deg.	psi	GSI	Epsilon 50	Factor	pci	psi
	Type	Property	Mod. pci									
1	Sand (Reese, et al.)	43.000	37.600	--	30.000	--	--	--	--	--	--	--
		47.000	37.600	--	30.000	--	--	--	--	--	--	--
2	Sand (Reese, et al.)	47.000	27.600	--	20.000	--	--	--	--	--	--	--
		59.000	27.600	--	20.000	--	--	--	--	--	--	--
3	Sand (Reese, et al.)	59.000	52.600	--	50.000	--	--	--	--	--	--	--
		64.000	52.600	--	50.000	--	--	--	--	--	--	--
4	Soft Clay	64.000	27.600	250.000	--	--	--	0.02000	--	--	--	--
		74.000	27.600	250.000	--	--	--	0.02000	--	--	--	--
5	Stiff Clay with Free Water	74.000	57.600	750.000	--	--	--	0.01000	--	40.000	--	--
		84.000	57.600	750.000	--	--	--	0.01000	--	40.000	--	--
6	Stiff Clay with Free Water	84.000	57.600	1500.000	--	--	--	0.00500	--	60.000	--	--
		107.000	57.600	1500.000	--	--	--	0.00500	--	60.000	--	--

Loading Type

Cyclic loading criteria were used for computation of p-y curves for all analyses.

Number of cycles of loading = 100

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, lbs

Shaft 14 - 60 in shaft 1 3 percent steel in column.lp6o

1	1	V = 25000. lbs	M = 0.0000 in-lbs	500000.

V = perpendicular shear force applied to pile head
M = bending moment applied to pile head
y = lateral deflection relative to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applie to pile head
Axial thrust is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 2

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft:

Length of Section	=	27.00000000	ft
Shaft Diameter	=	48.00000000	in
Concrete Cover Thickness	=	3.00000000	in
Number of Reinforcing Bars	=	23	bars
Yield Stress of Reinforcing Bars	=	60.00000000	ksi
Modulus of Elasticity of Reinforcing Bars	=	29000.	ksi
Gross Area of Shaft	=	1809.55736847	sq. in.
Total Area of Reinforcing Steel	=	23.00000000	sq. in.
Area Ratio of Steel Reinforcement	=	1.27	percent
Edge-to-Edge Bar Spacing	=	4.43740328	in
Rebar Offset	=	0.0000000	in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	8972.869	kips
Tensile Load for Cracking of Concrete	=	-904.603	kips
Nominal Axial Tensile Capacity	=	-1380.000	kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.12800	1.00000	20.43600	0.00000
2	1.12800	1.00000	19.67818	5.51357
3	1.12800	1.00000	17.46091	10.61822
4	1.12800	1.00000	13.94866	14.93536
5	1.12800	1.00000	9.40189	18.14482
6	1.12800	1.00000	4.15783	20.00856
7	1.12800	1.00000	-1.39460	20.38836
8	1.12800	1.00000	-6.84360	19.25604
9	1.12800	1.00000	-11.78504	16.69560
10	1.12800	1.00000	-15.85244	12.89691
11	1.12800	1.00000	-18.74413	8.14172
12	1.12800	1.00000	-20.24566	2.78270
13	1.12800	1.00000	-20.24566	-2.78270

14	1.12800	1.00000	-18.74413	-8.14172
15	1.12800	1.00000	-15.85244	-12.89691
16	1.12800	1.00000	-11.78504	-16.69560
17	1.12800	1.00000	-6.84360	-19.25604
18	1.12800	1.00000	-1.39460	-20.38836
19	1.12800	1.00000	4.15783	-20.00856
20	1.12800	1.00000	9.40189	-18.14482
21	1.12800	1.00000	13.94866	-14.93536
22	1.12800	1.00000	17.46091	-10.61822
23	1.12800	1.00000	19.67818	-5.51357

Concrete Properties:

Compressive Strength of Concrete	=	5.0000000 ksi
Modulus of Elasticity of Concrete	=	4030.5086528 ksi
Modulus of Rupture of Concrete	=	-0.5303301 ksi
Compression Strain at Peak Stress	=	0.0021089
Tensile Strain at Fracture of Concrete	=	-0.0001150
Maximum Coarse Aggregate Size	=	0.7500000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	500.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318-08 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than than 0.003. See ACI 318-08, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 500.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Concrete Stress ksi	Max Steel Stress ksi	Run Msg
0.000000625	825.2625785	1320420126.	112.6411651	0.0000704	0.0000404	0.3275649	2.0372711	
0.000001250	1650.5039086	1320403127.	68.3508275	0.0000854	0.0000254	0.3955588	2.4690175	

0.000001875	2475.6908762	1320368467.	53.6008219	0.0001005	0.0000105	0.4631681	2.9014947	
0.000002500	3300.7912222	1320316489.	46.2358904	0.0001156	-0.000004410	0.5303902	3.3347021	
0.000003125	4125.2203061	1320070498.	41.8240692	0.0001307	-0.0000193	0.5972099	3.7685563	
0.000003750	4947.6421299	1319371235.	38.8868101	0.0001458	-0.0000342	0.6635918	4.2028406	
0.000004375	5767.2679904	1318232684.	36.7909550	0.0001610	-0.0000490	0.7295114	4.6374024	
0.000005000	6583.7167609	1316743352.	35.2203737	0.0001761	-0.0000639	0.7949546	5.0721542	
0.000005625	7396.7933417	1314985483.	33.9996566	0.0001912	-0.0000788	0.8599130	5.5070440	
0.000006250	8206.3918360	1313022694.	33.0236680	0.0002064	-0.0000936	0.9243814	5.9420399	
0.000006875	9012.4501487	1310901840.	32.2255590	0.0002216	-0.0001084	0.9883565	6.3771208	
0.000007500	9012.4501487	1201660020.	28.7210142	0.0002154	-0.0001446	0.9615829	6.1946206	C
0.000008125	9012.4501487	1109224634.	27.8379343	0.0002262	-0.0001638	1.0067369	6.5027632	C
0.000008750	9012.4501487	1029994303.	27.0569011	0.0002367	-0.0001833	1.0507482	6.8047886	C
0.000009375	9012.4501487	961328016.	26.3586945	0.0002471	-0.0002029	1.0936782	7.1010201	C
0.0000100	9012.4501487	901245015.	25.7322804	0.0002573	-0.0002227	1.1357283	7.3927613	C
0.0000106	9012.4501487	848230602.	25.1648317	0.0002674	-0.0002426	1.1769018	7.6799637	C
0.0000113	9012.4501487	801106680.	24.6479008	0.0002773	-0.0002627	1.2172734	7.9630777	C
0.0000119	9012.4501487	758943170.	24.1754704	0.0002871	-0.0002829	1.2569477	8.2427777	C
0.0000125	9012.4501487	720996012.	23.7420226	0.0002968	-0.0003032	1.2959915	-8.7065168	C
0.0000131	9046.0104746	689219846.	23.3415552	0.0003064	-0.0003236	1.3343883	-9.2942705	C
0.0000138	9258.3540736	673334842.	22.9705692	0.0003158	-0.0003442	1.3722004	-9.8847856	C
0.0000144	9467.7064219	658623055.	22.6266626	0.0003253	-0.0003647	1.4095174	-10.4774600	C
0.0000150	9674.7141050	644980940.	22.3075964	0.0003346	-0.0003854	1.4464124	-11.0717955	C
0.0000156	9877.9196491	632186858.	22.0071723	0.0003439	-0.0004061	1.4826891	-11.6692500	C
0.0000163	10080.	620279750.	21.7273471	0.0003531	-0.0004269	1.5186184	-12.2678876	C
0.0000169	10279.	609123028.	21.4645286	0.0003622	-0.0004478	1.5541160	-12.8683463	C
0.0000175	10476.	598651032.	21.2171271	0.0003713	-0.0004687	1.5892017	-13.4705080	C
0.0000181	10672.	588820382.	20.9845288	0.0003803	-0.0004897	1.6239483	-14.0738570	C
0.0000188	10867.	579557279.	20.7646722	0.0003893	-0.0005107	1.6583161	-14.6787094	C
0.0000194	11060.	570814676.	20.5566175	0.0003983	-0.0005317	1.6923300	-15.2849005	C
0.0000200	11252.	562584331.	20.3607628	0.0004072	-0.0005528	1.7261083	-15.8915575	C
0.0000206	11442.	554745610.	20.1728365	0.0004161	-0.0005739	1.7594029	-16.5005721	C
0.0000213	11631.	547360330.	19.9962318	0.0004249	-0.0005951			

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1.7925489   -17.1094221  C
 0.0000219        11820.    540332317.    19.8273216     0.0004337    -0.0006163
1.8253264   -17.7197928  C
 0.0000225        12007.    533641919.    19.6659196     0.0004425    -0.0006375
1.8577769   -18.3313874  C
 0.0000231        12194.    527306338.    19.5134820     0.0004512    -0.0006588
1.8900814   -18.9428211  C
 0.0000238        12380.    521255323.    19.3671552     0.0004600    -0.0006800
1.9220501   -19.5555718  C
 0.0000244        12565.    515466702.    19.2264417     0.0004686    -0.0007014
1.9536830   -20.1696590  C
 0.0000256        12933.    504718646.    18.9662443     0.0004860    -0.0007440
2.0165185   -21.3973596  C
 0.0000269        13298.    494821572.    18.7239731     0.0005032    -0.0007868
2.0780877   -22.6299536  C
 0.0000281        13663.    485779961.    18.5038239     0.0005204    -0.0008296
2.1390741   -23.8620686  C
 0.0000294        14024.    477398619.    18.2975754     0.0005375    -0.0008725
2.1989132   -25.0983030  C
 0.0000306        14384.    469671558.    18.1081693     0.0005546    -0.0009154
2.2581205   -26.3345321  C
 0.0000319        14742.    462501561.    17.9321272     0.0005716    -0.0009584
2.3165303   -27.5721398  C
 0.0000331        15099.    455808861.    17.7667299     0.0005885    -0.0010015
2.3740105   -28.8122850  C
 0.0000344        15455.    449586408.    17.6139772     0.0006055    -0.0010445
2.4309403   -30.0518164  C
 0.0000356        15809.    443764313.    17.4709118     0.0006224    -0.0010876
2.4871227   -31.2924142  C
 0.0000369        16162.    438284396.    17.3351197     0.0006392    -0.0011308
2.5423865   -32.5356062  C
 0.0000381        16514.    433149252.    17.2087888     0.0006561    -0.0011739
2.5971057   -33.7781827  C
 0.0000394        16865.    428325962.    17.0910209     0.0006730    -0.0012170
2.6512781   -35.0201404  C
 0.0000406        17215.    423763197.    16.9789292     0.0006898    -0.0012602
2.7046279   -36.2639490  C
 0.0000419        17564.    419441493.    16.8723382     0.0007065    -0.0013035
2.7572064   -37.5092042  C
 0.0000431        17912.    415357615.    16.7724257     0.0007233    -0.0013467
2.8092433   -38.7538349  C
 0.0000444        18260.    411491391.    16.6786302     0.0007401    -0.0013899
2.8607365   -39.9978376  C
 0.0000456        18607.    407824861.    16.5904516     0.0007569    -0.0014331
2.9116842   -41.2412087  C
 0.0000469        18953.    404324603.    16.5055015     0.0007737    -0.0014763
2.9618086   -42.4865839  C
 0.0000481        19297.    400985326.    16.4243582     0.0007904    -0.0015196
3.0112369   -43.7328049  C
 0.0000494        19642.    397804079.    16.3477719     0.0008072    -0.0015628
3.0601238   -44.9783839  C
 0.0000506        19985.    394769091.    16.2754077     0.0008239    -0.0016061
3.1084674   -46.2233169  C
 0.0000519        20328.    391869725.    16.2069631     0.0008407    -0.0016493
3.1562655   -47.4675998  C
 0.0000531        20671.    389096344.    16.1421639     0.0008576    -0.0016924
3.2035161   -48.7112286  C
 0.0000544        21013.    386440196.    16.0807615     0.0008744    -0.0017356
3.2502170   -49.9541991  C
 0.0000556        21353.    383877770.    16.0203530     0.0008911    -0.0017789
3.2960309   -51.2000180  C
 0.0000569        21693.    381418134.    15.9629789     0.0009079    -0.0018221
3.3412961   -52.4452115  C
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 0.0000581        22033.    379054787.    15.9084730     0.0009247    -0.0018653
3.3860145   -53.6897301  C
 0.0000594        22371.    376781590.    15.8566567     0.0009415    -0.0019085
3.4301842   -54.9335691  C
 0.0000606        22710.    374592910.    15.8073663     0.0009583    -0.0019517
3.4738029   -56.1767240  C
 0.0000619        23047.    372483565.    15.7604513     0.0009752    -0.0019948
3.5168683   -57.4191900  C
 0.0000631        23385.    370448788.    15.7157732     0.0009921    -0.0020379
3.5593783   -58.6609624  C
 0.0000644        23721.    368484176.    15.6732043     0.0010090    -0.0020810
3.6013306   -59.9020366  C
 0.0000656        24057.    366585664.    15.6326265     0.0010259    -0.0021241
3.6427229   -60.0000000  CY
 0.0000669        24393.    364748209.    15.5936887     0.0010428    -0.0021672
3.6835135   -60.0000000  CY
 0.0000681        24727.    362963170.    15.5552962     0.0010597    -0.0022103
3.7235376   -60.0000000  CY
 0.0000694        25061.    361234237.    15.5186494     0.0010766    -0.0022534
3.7630030   -60.0000000  CY
 0.0000706        25392.    359537537.    15.4833916     0.0010935    -0.0022965
3.8018638   -60.0000000  CY
 0.0000719        25708.    357671702.    15.4468607     0.0011102    -0.0023398
3.8396941   -60.0000000  CY
 0.0000731        25990.    355414502.    15.4060272     0.0011266    -0.0023834
3.8760051   -60.0000000  CY
 0.0000744        26243.    352850916.    15.3618419     0.0011425    -0.0024275
3.9109614   -60.0000000  CY
 0.0000794        27097.    341375387.    15.1742522     0.0012045    -0.0026055
4.0411871   -60.0000000  CY
 0.0000844        27784.    329287702.    14.9791556     0.0012639    -0.0027861
4.1582482   -60.0000000  CY
 0.0000894        28358.    317292406.    14.7873939     0.0013216    -0.0029684
4.2646883   -60.0000000  CY
 0.0000944        28862.    305823575.    14.6052565     0.0013784    -0.0031516
4.3622280   -60.0000000  CY
 0.0000994        29291.    294747218.    14.4245672     0.0014334    -0.0033366
4.4501955   -60.0000000  CY
 0.0001044        29675.    284309923.    14.2555055     0.0014879    -0.0035221
4.5307767   -60.0000000  CY
 0.0001094        30011.    274386295.    14.0924237     0.0015414    -0.0037086
4.6035930   -60.0000000  CY
 0.0001144        30327.    265151576.    13.9380987     0.0015942    -0.0038958
4.6695066   -60.0000000  CY
 0.0001194        30591.    256258055.    13.7883640     0.0016460    -0.0040840
4.7283319   -60.0000000  CY
 0.0001244        30845.    248003971.    13.6498417     0.0016977    -0.0042723
4.7812949   -60.0000000  CY
 0.0001294        31084.    240265663.    13.5161441     0.0017487    -0.0044613
4.8278519   -60.0000000  CY
 0.0001344        31283.    232805275.    13.3854896     0.0017987    -0.0046513
4.8681296   -60.0000000  CY
 0.0001394        31472.    225805021.    13.2640259     0.0018487    -0.0048413
4.9030307   -60.0000000  CY
 0.0001444        31655.    219258412.    13.1496613     0.0018985    -0.0050315
4.9324730   -60.0000000  CY
 0.0001494        31828.    213071284.    13.0391155     0.0019477    -0.0052223
4.9563492   -60.0000000  CY
 0.0001544        31976.    207129523.    12.9317264     0.0019963    -0.0054137
4.9748297   -60.0000000  CY
 0.0001594        32110.    201472403.    12.8295111     0.0020447    -0.0056053
4.9881975   -60.0000000  CY
 0.0001644        32240.    196139089.    12.7346129     0.0020933    -0.0057967
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4.9965852   -60.0000000  CY
 0.0001694        32365.    191086273.    12.6415067     0.0021412    -0.0059888
4.9999205    60.0000000  CY
 0.0001744        32486.    186300946.    12.5541221     0.0021891    -0.0061809
4.9976889    60.0000000  CY
 0.0001794        32597.    181723301.    12.4704747     0.0022369    -0.0063731
4.9999985    60.0000000  CY
 0.0001844        32693.    177317621.    12.3897411     0.0022844    -0.0065656
4.9976411    60.0000000  CY
 0.0001894        32779.    173091172.    12.3119547     0.0023316    -0.0067584
4.9999763    60.0000000  CY
 0.0001944        32862.    169065627.    12.2394194     0.0023790    -0.0069510
4.9964204    60.0000000  CY
 0.0001994        32940.    165216228.    12.1660837     0.0024256    -0.0071444
4.9996255    60.0000000  CY
 0.0002044        33016.    161546674.    12.0975972     0.0024724    -0.0073376
4.9931745    60.0000000  CY
 0.0002094        33091.    158044930.    12.0335218     0.0025195    -0.0075305
4.9980501    60.0000000  CY
 0.0002144        33162.    154693636.    11.9727084     0.0025666    -0.0077234
4.9999682    60.0000000  CY
 0.0002194        33231.    151481340.    11.9156277     0.0026140    -0.0079160
4.9938314    60.0000000  CY
 0.0002244        33289.    148363508.    11.8585948     0.0026608    -0.0081092
4.9981567    60.0000000  CY
 0.0002294        33344.    145370889.    11.8041685     0.0027076    -0.0083024
4.9999467    60.0000000  CY
 0.0002344        33392.    142472141.    11.7503908     0.0027540    -0.0084960
4.9916529    60.0000000  CY
 0.0002394        33436.    139680864.    11.6955838     0.0027996    -0.0086904
4.9964575    60.0000000  CY
 0.0002444        33479.    136999349.    11.6439456     0.0028455    -0.0088845
4.9992473    60.0000000  CY
 0.0002494        33521.    134419989.    11.5954565     0.0028916    -0.0090784
4.9979368    60.0000000  CY
 0.0002544        33561.    131937030.    11.5498875     0.0029380    -0.0092720
4.9915567    60.0000000  CY
 0.0002594        33602.    129548079.    11.5065361     0.0029845    -0.0094655
4.9961976    60.0000000  CY
 0.0002644        33640.    127242008.    11.4663366     0.0030314    -0.0096586
4.9990380    60.0000000  CYT
 0.0002694        33675.    125009752.    11.4299319     0.0030789    -0.0098511
4.9998790    60.0000000  CYT
 0.0002744        33708.    122852398.    11.3957107     0.0031267    -0.0100433
4.9883799    60.0000000  CYT
 0.0003044        33844.    111191195.    11.2107815     0.0034123    -0.0111977
4.9919569    60.0000000  CYT
 0.0003344        33910.    101412526.    11.0629568     0.0036992    -0.0123508
4.9898562    60.0000000  CYT
 0.0003644        33910.     93062953.    11.0152335     0.0040137    -0.0134763
4.9872274    60.0000000  CYT
```

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain

Shaft 14 - 60 in shaft 1 3 percent steel in column.lp6o

1	500.000	33614.108	0.00300000

Note note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318-08, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are spirals or tied hoops.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318-08, Section 9.3.2.2 or the value required by the design standard being followed.

Pile Section No. 2:

Dimensions and Properties of Drilled Shaft:

Length of Section	=	73.00000000	ft
Shaft Diameter	=	60.00000000	in
Concrete Cover Thickness	=	3.00000000	in
Number of Reinforcing Bars	=	29	bars
Yield Stress of Reinforcing Bars	=	60.00000000	ksi
Modulus of Elasticity of Reinforcing Bars	=	29000.	ksi
Gross Area of Shaft	=	2827.43338823	sq. in.
Total Area of Reinforcing Steel	=	36.83000000	sq. in.
Area Ratio of Steel Reinforcement	=	1.30	percent
Edge-to-Edge Bar Spacing	=	4.43111584	in
Rebar Offset	=	0.0000000	in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	14069.865	kips
Tensile Load for Cracking of Concrete	=	-1416.005	kips
Nominal Axial Tensile Capacity	=	-2209.800	kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.27000	1.27000	26.36500	0.00000
2	1.27000	1.27000	25.74860	5.66770
3	1.27000	1.27000	23.92823	11.07038
4	1.27000	1.27000	20.98899	15.95542
5	1.27000	1.27000	17.06834	20.09440
6	1.27000	1.27000	12.34959	23.29380
7	1.27000	1.27000	7.05338	25.40400
8	1.27000	1.27000	1.42737	26.32633
9	1.27000	1.27000	-4.26538	26.01768
10	1.27000	1.27000	-9.75869	24.49247
11	1.27000	1.27000	-14.79570	21.82202
12	1.27000	1.27000	-19.14087	18.13120
13	1.27000	1.27000	-22.59104	13.59258
14	1.27000	1.27000	-24.98488	8.41838
15	1.27000	1.27000	-26.21045	2.85056
16	1.27000	1.27000	-26.21045	-2.85056
17	1.27000	1.27000	-24.98488	-8.41838
18	1.27000	1.27000	-22.59104	-13.59258
19	1.27000	1.27000	-19.14087	-18.13120

20	1.27000	1.27000	-14.79570	-21.82202
21	1.27000	1.27000	-9.75869	-24.49247
22	1.27000	1.27000	-4.26538	-26.01768
23	1.27000	1.27000	1.42737	-26.32633
24	1.27000	1.27000	7.05338	-25.40400
25	1.27000	1.27000	12.34959	-23.29380
26	1.27000	1.27000	17.06834	-20.09440
27	1.27000	1.27000	20.98899	-15.95542
28	1.27000	1.27000	23.92823	-11.07038
29	1.27000	1.27000	25.74860	-5.66770

Concrete Properties:

Compressive Strength of Concrete	=	5.0000000 ksi
Modulus of Elasticity of Concrete	=	4030.5086528 ksi
Modulus of Rupture of Concrete	=	-0.5303301 ksi
Compression Strain at Peak Stress	=	0.0021089
Tensile Strain at Fracture of Concrete	=	-0.0001150
Maximum Coarse Aggregate Size	=	0.7500000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	500.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318-08 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than than 0.003. See ACI 318-08, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 500.000 kips

Bending Curvature rad/in.	Bending Moment in-kip	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in	Max Concrete Stress ksi	Max Steel Stress ksi	Run Msg
0.000000417	1365.8849550	3278123892.	114.5877627	0.0000477	0.0000227	0.2232535	1.3809771	
0.000000833	2731.7655451	3278118654.	72.3250211	0.0000603	0.0000103	0.2805553	1.7406047	

0.000001250	4097.5837568		3278067005.	58.2512659	0.0000728	-0.000002186	0.3375905
2.1007334							
0.000001667	5462.5544325		3277532660.	51.2235646	0.0000854	-0.0000146	0.3943486
2.4613056							
0.000002083	6824.5604545		3275789018.	47.0113403	0.0000979	-0.0000271	0.4508005
2.8221435							
0.000002500	8182.4908349		3272996334.	44.2052710	0.0001105	-0.0000395	0.5069277
3.1831322							
0.000002917	9535.9035785		3269452655.	42.2020505	0.0001231	-0.0000519	0.5627210
3.5442151							
0.000003333	10885.		3265380659.	40.7003005	0.0001357	-0.0000643	0.6181756
3.9053624							
0.000003750	12228.		3260930726.	39.5327073	0.0001482	-0.0000768	0.6732886
4.2665569							
0.000004167	13568.		3256203744.	38.5989374	0.0001608	-0.0000892	0.7280585
4.6277883							
0.000004583	14902.		3251268702.	37.8351702	0.0001734	-0.0001016	0.7824839
4.9890497							
0.000005000	16231.		3246174048.	37.1988746	0.0001860	-0.0001140	0.8365643
5.3503368							
0.000005417	16231.		2996468352.	31.3489439	0.0001698	-0.0001552	0.7656814
4.8772716		C					
0.000005833	16231.		2782434898.	30.5140613	0.0001780	-0.0001720	0.8008092
5.1112120		C					
0.000006250	16231.		2596939238.	29.7709175	0.0001861	-0.0001889	0.8352612
-5.4246462		C					
0.000006667	16231.		2434630536.	29.1037179	0.0001940	-0.0002060	0.8690843
-5.9152812		C					
0.000007083	16231.		2291416975.	28.5001399	0.0002019	-0.0002231	0.9023173
-6.4089713		C					
0.000007500	16231.		2164116032.	27.9509449	0.0002096	-0.0002404	0.9350094
-6.9054195		C					
0.000007917	16231.		2050215188.	27.4490423	0.0002173	-0.0002577	0.9672160
-7.4042824		C					
0.000008333	16231.		1947704429.	26.9890023	0.0002249	-0.0002751	0.9990002
-7.9051578		C					
0.000008750	16231.		1854956599.	26.5664304	0.0002325	-0.0002925	1.0304240
-8.4076433		C					
0.000009167	16231.		1770640390.	26.1758488	0.0002399	-0.0003101	1.0614761
-8.9118368		C					
0.000009583	16231.		1693656025.	25.8120323	0.0002474	-0.0003276	1.0921171
-9.4180310		C					
0.0000100	16231.		1623087024.	25.4763948	0.0002548	-0.0003452	1.1225491
-9.9248455		C					
0.0000104	16231.		1558163543.	25.1599882	0.0002621	-0.0003629	1.1525319
-10.4339619		C					
0.0000108	16231.		1498234176.	24.8673686	0.0002694	-0.0003806	1.1823737
-10.9432517		C					
0.0000113	16231.		1442744021.	24.5899422	0.0002766	-0.0003984	1.2117982
-11.4546563		C					
0.0000117	16231.		1391217449.	24.3326450	0.0002839	-0.0004161	1.2411240
-11.9659551		C					
0.0000121	16231.		1343244433.	24.0874615	0.0002911	-0.0004339	1.2700571
-12.4792270		C					
0.0000125	16257.		1300542787.	23.8580347	0.0002982	-0.0004518	1.2988484
-12.9927124		C					
0.0000129	16577.		1283357470.	23.6420021	0.0003054	-0.0004696	1.3274543
-13.5067250		C					
0.0000133	16894.		1267067848.	23.4353084	0.0003125	-0.0004875	1.3557245
-14.0223474		C					
0.0000138	17212.		1251751611.	23.2413954	0.0003196	-0.0005054	1.3838996
-14.5378685		C					
0.0000142	17528.		1237280481.	23.0578716	0.0003267	-0.0005233	

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1.4119074   -15.0538077  C
 0.0000146        17842.   1223485362.    22.8809499     0.0003337    -0.0005413
1.4395796   -15.5713899  C
 0.0000150        18157.   1210444330.    22.7140857     0.0003407    -0.0005593
1.4671584   -16.0888727  C
 0.0000154        18471.   1198096214.    22.5564640     0.0003477    -0.0005773
1.4946436   -16.6062558  C
 0.0000158        18783.   1186297688.    22.4044056     0.0003547    -0.0005953
1.5218503   -17.1248937  C
 0.0000163        19094.   1175041944.    22.2586493     0.0003617    -0.0006133
1.5488553   -17.6442365  C
 0.0000171        19717.   1154146126.    21.9890617     0.0003756    -0.0006494
1.6025893   -18.6826273  C
 0.0000179        20336.   1135021175.    21.7403258     0.0003895    -0.0006855
1.6556080   -19.7232141  C
 0.0000188        20953.   1117489287.    21.5118071     0.0004033    -0.0007217
1.7080733   -20.7648298  C
 0.0000196        21569.   1101413698.    21.3034252     0.0004172    -0.0007578
1.7601752   -21.8060547  C
 0.0000204        22182.   1086471178.    21.1064992     0.0004309    -0.0007941
1.8114321   -22.8505686  C
 0.0000213        22794.   1072666107.    20.9255461     0.0004447    -0.0008303
1.8623224   -23.8947572  C
 0.0000221        23406.   1059871899.    20.7588607     0.0004584    -0.0008666
1.9128535   -24.9385545  C
 0.0000229        24015.   1047911576.    20.6015705     0.0004721    -0.0009029
1.9627435   -25.9841646  C
 0.0000238        24622.   1036724060.    20.4539821     0.0004858    -0.0009392
2.0121108   -27.0306947  C
 0.0000246        25229.   1026267742.    20.3169520     0.0004995    -0.0009755
2.0611229   -28.0768312  C
 0.0000254        25835.   1016470582.    20.1894441     0.0005131    -0.0010119
2.1097788   -29.1225722  C
 0.0000263        26440.   1007251750.    20.0694902     0.0005268    -0.0010482
2.1579778   -30.1687255  C
 0.0000271        27043.    998524629.    19.9544011     0.0005404    -0.0010846
2.2055299   -31.2168557  C
 0.0000279        27646.    990294856.    19.8466779     0.0005541    -0.0011209
2.2527293   -32.2645853  C
 0.0000288        28247.    982519077.    19.7456823     0.0005677    -0.0011573
2.2995751   -33.3119123  C
 0.0000296        28848.    975158820.    19.6508480     0.0005813    -0.0011937
2.3460662   -34.3588349  C
 0.0000304        29449.    968179832.    19.5616710     0.0005950    -0.0012300
2.3922017   -35.4053510  C
 0.0000313        30048.    961540224.    19.4768712     0.0006087    -0.0012663
2.4378924   -36.4522104  C
 0.0000321        30646.    955195322.    19.3947507     0.0006222    -0.0013028
2.4829930   -37.5006756  C
 0.0000329        31243.    949151629.    19.3172229     0.0006359    -0.0013391
2.5277409   -38.5487259  C
 0.0000338        31839.    943386738.    19.2439497     0.0006495    -0.0013755
2.5721349   -39.5963592  C
 0.0000346        32435.    937880405.    19.1746256     0.0006631    -0.0014119
2.6161741   -40.6435733  C
 0.0000354        33030.    932614287.    19.1089742     0.0006768    -0.0014482
2.6598573   -41.6903660  C
 0.0000363        33624.    927571729.    19.0467441     0.0006904    -0.0014846
2.7031835   -42.7367352  C
 0.0000371        34218.    922737571.    18.9877067     0.0007041    -0.0015209
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 0.0000412        37174.    901183983.    18.7272743     0.0007725    -0.0017025
2.9547778   -49.0136230  C
 0.0000421        37763.    897331160.    18.6818737     0.0007862    -0.0017388
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3.0355623   -51.1043383  C
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 0.0000446        39525.    886544648.    18.5579442     0.0008274    -0.0018476
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 0.0000454        40111.    883182597.    18.5203563     0.0008411    -0.0018839
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 0.0000462        40697.    879926630.    18.4844651     0.0008549    -0.0019201
3.1927820   -55.2803361  C
 0.0000471        41281.    876771037.    18.4501823     0.0008687    -0.0019563
3.2311740   -56.3231885  C
 0.0000479        41865.    873710505.    18.4174260     0.0008825    -0.0019925
3.2691985   -57.3655767  C
 0.0000487        42449.    870740084.    18.3861198     0.0008963    -0.0020287
3.3068543   -58.4074980  C
 0.0000496        43031.    867855155.    18.3561925     0.0009102    -0.0020648
3.3441401   -59.4489497  C
 0.0000529        45354.    857074834.    18.2468847     0.0009656    -0.0022094
3.4892665   -60.0000000  CY
 0.0000562        47416.    842944869.    18.1233684     0.0010194    -0.0023556
3.6239401   -60.0000000  CY
 0.0000596        48924.    821104868.    17.9537470     0.0010697    -0.0025053
3.7438556   -60.0000000  CY
 0.0000629        50166.    797339294.    17.7744383     0.0011183    -0.0026567
3.8543587   -60.0000000  CY
 0.0000662        51216.    773078745.    17.5891473     0.0011653    -0.0028097
3.9563295   -60.0000000  CY
 0.0000696        52126.    749111326.    17.4039889     0.0012110    -0.0029640
4.0510172   -60.0000000  CY
 0.0000729        52936.    725976635.    17.2260388     0.0012561    -0.0031189
4.1398096   -60.0000000  CY
 0.0000762        53650.    703601755.    17.0519310     0.0013002    -0.0032748
4.2225719   -60.0000000  CY
 0.0000796        54285.    682112697.    16.8789547     0.0013433    -0.0034317
4.2992497   -60.0000000  CY
 0.0000829        54865.    661693740.    16.7148494     0.0013859    -0.0035891
4.3712452   -60.0000000  CY
 0.0000862        55395.    642264691.    16.5585569     0.0014282    -0.0037468
4.4386717   -60.0000000  CY
 0.0000896        55867.    623627858.    16.4035688     0.0014695    -0.0039055
4.5008900   -60.0000000  CY
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4.5590688   -60.0000000  CY
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4.6127568   -60.0000000  CY
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4.6628069   -60.0000000  CY
 0.0001029        57454.    558258926.    15.8488867     0.0016311    -0.0045439
4.7091069   -60.0000000  CY
 0.0001063        57775.    543764173.    15.7193511     0.0016702    -0.0047048
4.7510155   -60.0000000  CY
 0.0001096        58066.    529880251.    15.5945808     0.0017089    -0.0048661
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4.7893339   -60.0000000  CY
 0.0001129        58353.    516778141.    15.4780559     0.0017477    -0.0050273
4.8245405   -60.0000000  CY
 0.0001163        58633.    504370165.    15.3686604     0.0017866    -0.0051884
4.8565720   -60.0000000  CY
 0.0001196        58885.    492420132.    15.2602085     0.0018249    -0.0053501
4.8849348   -60.0000000  CY
 0.0001229        59106.    480859359.    15.1500223     0.0018622    -0.0055128
4.9095802   -60.0000000  CY
 0.0001263        59320.    469863753.    15.0460278     0.0018996    -0.0056754
4.9312851   -60.0000000  CY
 0.0001296        59533.    459418890.    14.9484022     0.0019371    -0.0058379
4.9500783   -60.0000000  CY
 0.0001329        59743.    449480244.    14.8566126     0.0019747    -0.0060003
4.9659245   -60.0000000  CY
 0.0001363        59936.    439893604.    14.7673624     0.0020121    -0.0061629
4.9786719   -60.0000000  CY
 0.0001396        60109.    430633825.    14.6792064     0.0020490    -0.0063260
4.9883454   -60.0000000  CY
 0.0001429        60264.    421675065.    14.5890607     0.0020850    -0.0064900
4.9949879   -60.0000000  CY
 0.0001462        60418.    413111397.    14.5038552     0.0021212    -0.0066538
4.9988773    60.0000000  CY
 0.0001496        60569.    404917601.    14.4233532     0.0021575    -0.0068175
4.9983576    60.0000000  CY
 0.0001529        60718.    397064418.    14.3473963     0.0021940    -0.0069810
4.9968914    60.0000000  CY
 0.0001562        60862.    389516857.    14.2749069     0.0022305    -0.0071445
4.9995905    60.0000000  CY
 0.0001596        60997.    382227501.    14.2050200     0.0022669    -0.0073081
4.9936382    60.0000000  CY
 0.0001629        61119.    375153363.    14.1366875     0.0023031    -0.0074719
4.9971683    60.0000000  CY
 0.0001662        61230.    368302340.    14.0680598     0.0023388    -0.0076362
4.9995736    60.0000000  CY
 0.0001696        61332.    361665814.    13.9990731     0.0023740    -0.0078010
4.9952459    60.0000000  CY
 0.0001729        61433.    355274211.    13.9336873     0.0024094    -0.0079656
4.9955841    60.0000000  CY
 0.0001762        61532.    349118781.    13.8713644     0.0024448    -0.0081302
4.9986841    60.0000000  CY
 0.0001796        61631.    343186280.    13.8119411     0.0024804    -0.0082946
4.9999642    60.0000000  CY
 0.0001829        61727.    337458421.    13.7556875     0.0025161    -0.0084589
4.9915600    60.0000000  CY
 0.0002029        62207.    306564222.    13.4484229     0.0027289    -0.0094461
4.9972308    60.0000000  CY
 0.0002229        62549.    280593936.    13.1866259     0.0029395    -0.0104355
4.9983101    60.0000000  CY
 0.0002429        62805.    258545030.    12.9962461     0.0031570    -0.0114180
4.9977199    60.0000000  CYT
 0.0002629        62955.    239449563.    12.8367866     0.0033750    -0.0124000
4.9937125    60.0000000  CYT
 0.0002829        63060.    222891794.    12.7038537     0.0035941    -0.0133809
4.9817507    60.0000000  CYT
 0.0003029        63142.    208447630.    12.6017724     0.0038173    -0.0143577
4.9996254    60.0000000  CYT
```

Summary of Results for Nominal (Unfactored) Moment Capacity for Section 2

Shaft 14 - 60 in shaft 1 3 percent steel in column.lp6o
Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	500.000	62620.210	0.00300000

Note note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318-08, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are spirals or tied hoops.

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318-08, Section 9.3.2.2 or the value required by the design standard being followed.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Shear and Moment (Loading Type 1)

Shear force at pile head = 25000.000 lbs
Applied moment at pile head = 0.000 in-lbs
Axial thrust load on pile head = 500000.000 lbs

Depth X inches	Deflect. y inches	Bending Moment in-lbs	Shear Force lbs	Slope S radians	Total Stress psi*	Bending Stiffness lb-in^2	Soil Res. Es*h lb/inch	Soil Spr. Lat. Load p lb/in lb/inch	Distrib.
0.00	1.7020	5.955E-05	25000.	-0.003424	0.000	1.320E+12	0.000	0.000	0.000
8.000	1.6746	213698.	25000.	-0.003424	0.000	1.320E+12	0.000	0.000	0.000
16.000	1.6472	427390.	25000.	-0.003422	0.000	1.320E+12	0.000	0.000	0.000
24.000	1.6198	641073.	25000.	-0.003419	0.000	1.320E+12	0.000	0.000	0.000
32.000	1.5925	854739.	25000.	-0.003414	0.000	1.320E+12	0.000	0.000	0.000
40.000	1.5652	1068385.	25000.	-0.003408	0.000	1.320E+12	0.000	0.000	0.000
48.000	1.5380	1282005.	25000.	-0.003401	0.000	1.320E+12	0.000	0.000	0.000
56.000	1.5108	1495594.	25000.	-0.003393	0.000	1.320E+12	0.000	0.000	0.000
64.000	1.4837	1709147.	25000.	-0.003383	0.000	1.320E+12	0.000	0.000	0.000
72.000	1.4567	1922658.	25000.	-0.003372	0.000	1.320E+12	0.000	0.000	0.000
80.000	1.4297	2136123.	25000.	-0.003360	0.000	1.320E+12	0.000	0.000	0.000
88.000	1.4029	2349536.	25000.	-0.003346	0.000	1.320E+12			

```
0.000       0.000       0.000
    96.000      1.3762   2562892.     25000.  -0.003331      0.000  1.320E+12
0.000       0.000       0.000
   104.000      1.3496   2776186.     25000.  -0.003315      0.000  1.320E+12
0.000       0.000       0.000
   112.000      1.3232   2989412.     25000.  -0.003298      0.000  1.320E+12
0.000       0.000       0.000
   120.000      1.2969   3202567.     25000.  -0.003279      0.000  1.320E+12
0.000       0.000       0.000
   128.000      1.2707   3415643.     25000.  -0.003259      0.000  1.320E+12
0.000       0.000       0.000
   136.000      1.2447   3628637.     25000.  -0.003237      0.000  1.320E+12
0.000       0.000       0.000
   144.000      1.2189   3841543.     25000.  -0.003215      0.000  1.320E+12
0.000       0.000       0.000
   152.000      1.1933   4054355.     25000.  -0.003191      0.000  1.320E+12
0.000       0.000       0.000
   160.000      1.1679   4267070.     25000.  -0.003166      0.000  1.320E+12
0.000       0.000       0.000
   168.000      1.1426   4479681.     25000.  -0.003139      0.000  1.320E+12
0.000       0.000       0.000
   176.000      1.1176   4692183.     25000.  -0.003111      0.000  1.320E+12
0.000       0.000       0.000
   184.000      1.0928   4904572.     25000.  -0.003082      0.000  1.319E+12
0.000       0.000       0.000
   192.000      1.0683   5116841.     25000.  -0.003052      0.000  1.319E+12
0.000       0.000       0.000
   200.000      1.0440   5328987.     25000.  -0.003020      0.000  1.319E+12
0.000       0.000       0.000
   208.000      1.0200   5541003.     25000.  -0.002987      0.000  1.319E+12
0.000       0.000       0.000
   216.000      0.9962   5752885.     25000.  -0.002953      0.000  1.318E+12
0.000       0.000       0.000
   224.000      0.9727   5964627.     25000.  -0.002917      0.000  1.318E+12
0.000       0.000       0.000
   232.000      0.9495   6176224.     25000.  -0.002881      0.000  1.317E+12
0.000       0.000       0.000
   240.000      0.9266   6387671.     25000.  -0.002842      0.000  1.317E+12
0.000       0.000       0.000
   248.000      0.9041   6598963.     25000.  -0.002803      0.000  1.317E+12
0.000       0.000       0.000
   256.000      0.8818   6810095.     25000.  -0.002762      0.000  1.316E+12
0.000       0.000       0.000
   264.000      0.8599   7021061.     25000.  -0.002720      0.000  1.316E+12
0.000       0.000       0.000
   272.000      0.8383   7231856.     25000.  -0.002677      0.000  1.315E+12
0.000       0.000       0.000
   280.000      0.8170   7442475.     25000.  -0.002632      0.000  1.315E+12
0.000       0.000       0.000
   288.000      0.7962   7652914.     25000.  -0.002586      0.000  1.314E+12
0.000       0.000       0.000
   296.000      0.7757   7863165.     25000.  -0.002539      0.000  1.314E+12
0.000       0.000       0.000
   304.000      0.7555   8073226.     25000.  -0.002491      0.000  1.313E+12
0.000       0.000       0.000
   312.000      0.7358   8283089.     25000.  -0.002441      0.000  1.313E+12
0.000       0.000       0.000
   320.000      0.7165   8492751.     25000.  -0.002390      0.000  1.312E+12
0.000       0.000       0.000
   328.000      0.6976   8702206.     25000.  -0.002353      0.000  3.272E+12
0.000       0.000       0.000
   336.000      0.6788   8911575.     25000.  -0.002331      0.000  3.271E+12
0.000       0.000       0.000
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344.000	0.6603	9120858.	25000.	-0.002309	0.000	3.270E+12	0.000	0.000	0.000
352.000	0.6419	9330051.	25000.	-0.002287	0.000	3.270E+12	0.000	0.000	0.000
360.000	0.6237	9539153.	25000.	-0.002264	0.000	3.269E+12	0.000	0.000	0.000
368.000	0.6057	9748161.	25000.	-0.002240	0.000	3.269E+12	0.000	0.000	0.000
376.000	0.5878	9957074.	25000.	-0.002216	0.000	3.268E+12	0.000	0.000	0.000
384.000	0.5702	10165890.	25000.	-0.002191	0.000	3.267E+12	0.000	0.000	0.000
392.000	0.5528	10374606.	25000.	-0.002166	0.000	3.267E+12	0.000	0.000	0.000
400.000	0.5356	10583220.	25000.	-0.002141	0.000	3.266E+12	0.000	0.000	0.000
408.000	0.5185	10791730.	25000.	-0.002114	0.000	3.266E+12	0.000	0.000	0.000
416.000	0.5017	11000135.	25000.	-0.002088	0.000	3.265E+12	0.000	0.000	0.000
424.000	0.4851	11208432.	25000.	-0.002061	0.000	3.264E+12	0.000	0.000	0.000
432.000	0.4688	11416620.	25000.	-0.002033	0.000	3.263E+12	0.000	0.000	0.000
440.000	0.4526	11624695.	25000.	-0.002005	0.000	3.263E+12	0.000	0.000	0.000
448.000	0.4367	11832656.	25000.	-0.001976	0.000	3.262E+12	0.000	0.000	0.000
456.000	0.4210	12040501.	25000.	-0.001947	0.000	3.261E+12	0.000	0.000	0.000
464.000	0.4055	12248228.	25000.	-0.001917	0.000	3.261E+12	0.000	0.000	0.000
472.000	0.3903	12455835.	25000.	-0.001886	0.000	3.260E+12	0.000	0.000	0.000
480.000	0.3754	12663320.	25000.	-0.001856	0.000	3.259E+12	0.000	0.000	0.000
488.000	0.3606	12870680.	25000.	-0.001824	0.000	3.259E+12	0.000	0.000	0.000
496.000	0.3462	13077914.	25000.	-0.001792	0.000	3.258E+12	0.000	0.000	0.000
504.000	0.3320	13285019.	25000.	-0.001760	0.000	3.257E+12	0.000	0.000	0.000
512.000	0.3180	13491994.	25000.	-0.001727	0.000	3.256E+12	0.000	0.000	0.000
520.000	0.3043	13698836.	24978.	-0.001694	0.000	3.256E+12	-5.5706	146.4417	0.000
528.000	0.2909	13905187.	24874.	-0.001660	0.000	3.255E+12	-20.3564	559.8131	0.000
536.000	0.2778	14110099.	24630.	-0.001625	0.000	3.254E+12	-40.6081	1169.5865	0.000
544.000	0.2649	14312273.	24200.	-0.001590	0.000	3.253E+12	-67.0539	2025.0629	0.000
552.000	0.2523	14510015.	23545.	-0.001555	0.000	3.253E+12	-96.5103	3060.0141	0.000
560.000	0.2400	14701437.	22642.	-0.001519	0.000	3.252E+12	-129.4056	4313.2317	0.000
568.000	0.2280	14884433.	21502.	-0.001483	0.000	3.251E+12	-155.3727	5451.4839	0.000
576.000	0.2163	15057338.	20143.	-0.001446	0.000	3.251E+12	-184.4658	6822.8119	0.000
584.000	0.2049	15218289.	18556.	-0.001409	0.000	3.250E+12	-212.3689	8292.6409	0.000
592.000	0.1938	15365499.	16739.	-0.001371	0.000	3.249E+12			

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-241.8805  9987.0294      0.000
   600.000     0.1829  15497077.     14680.  -0.001333      0.000  3.249E+12
-272.9245     11935.      0.000
   608.000     0.1724  15611035.     12372.  -0.001295      0.000  3.248E+12
-303.8833     14099.      0.000
   616.000     0.1622  15705392.  9824.8265  -0.001256      0.000  3.248E+12
-332.9923     16421.      0.000
   624.000     0.1523  15778281.  7144.6307  -0.001217      0.000  3.248E+12
-337.0566     17701.      0.000
   632.000     0.1427  15829444.  4441.6336  -0.001178      0.000  3.248E+12
-338.6926     18981.      0.000
   640.000     0.1335  15858774.  1734.6546  -0.001139      0.000  3.248E+12
-338.0521     20261.      0.000
   648.000     0.1245  15866313.  -958.6997  -0.001100      0.000  3.247E+12
-335.2864     21541.      0.000
   656.000     0.1159  15852237. -3622.0295  -0.001061      0.000  3.248E+12
-330.5460     22821.      0.000
   664.000     0.1075  15816850. -6240.1342  -0.001022      0.000  3.248E+12
-323.9801     24101.      0.000
   672.000     0.0995  15760573. -8799.0005  -0.000983      0.000  3.248E+12
-315.7364     25381.      0.000
   680.000     0.0918  15683933.    -11286.  -0.000945      0.000  3.248E+12
-305.9608     26661.      0.000
   688.000     0.0844  15587557.    -13689.  -0.000906      0.000  3.249E+12
-294.7970     27941.      0.000
   696.000     0.0773  15472160.    -15998.  -0.000868      0.000  3.249E+12
-282.3861     29221.      0.000
   704.000     0.0705  15338539.    -18203.  -0.000830      0.000  3.249E+12
-268.8669     30501.      0.000
   712.000     0.0640  15187558.    -21371.  -0.000792      0.000  3.250E+12
-523.2046     65368.      0.000
   720.000     0.0578  15002943.    -25447.  -0.000755      0.000  3.251E+12
-495.7704     68568.      0.000
   728.000     0.0519  14786452.    -29294.  -0.000719      0.000  3.252E+12
-466.0348     71768.      0.000
   736.000     0.0463  14539988.    -32895.  -0.000682      0.000  3.253E+12
-434.3115     74968.      0.000
   744.000     0.0410  14265586.    -36236.  -0.000647      0.000  3.254E+12
-400.9015     78168.      0.000
   752.000     0.0360  13965385.    -39304.  -0.000612      0.000  3.255E+12
-366.0926     81368.      0.000
   760.000     0.0312  13641617.    -42089.  -0.000578      0.000  3.256E+12
-330.1578     84568.      0.000
   768.000     0.0267  13296585.    -43759.  -0.000545      0.000  3.257E+12
-87.2441     26102.      0.000
   776.000     0.0225  12945839.    -44443.  -0.000513      0.000  3.258E+12
-83.8063     29788.      0.000
   784.000     0.0185  12589602.    -45098.  -0.000482      0.000  3.260E+12
-79.8883     34491.      0.000
   792.000     0.0148  12228129.    -45719.  -0.000451      0.000  3.261E+12
-75.3668     40741.      0.000
   800.000     0.0113  11861712.    -46300.  -0.000422      0.000  3.262E+12
-70.0434     49550.      0.000
   808.000   0.008051  11490696.    -46835.  -0.000393      0.000  3.263E+12
-63.5634     63161.      0.000
   816.000   0.005019  11115499.    -47310.  -0.000365      0.000  3.265E+12
-55.1745     87951.      0.000
   824.000   0.002204  10736662.    -47700.  -0.000339      0.000  3.266E+12
-42.3387    153663.      0.000
   832.000  -0.000400  10355010.    -47774.  -0.000313      0.000  3.267E+12
23.8187    476619.      0.000
   840.000  -0.002801   9974781.    -47496.  -0.000288      0.000  3.268E+12
45.7809    130758.      0.000
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848.000	-0.005007	9597385.	-47090.	-0.000264	0.000	3.269E+12	55.5791	88806.
856.000	-0.007025	9223452.	-46619.	-0.000241	0.000	3.270E+12	62.2283	70868.
864.000	-0.008862	8853410.	-46101.	-0.000219	0.000	3.271E+12	67.2437	60702.
872.000	-0.0105	8487586.	-45547.	-0.000198	0.000	3.272E+12	71.2167	54125.
880.000	-0.0120	8126237.	-44964.	-0.000177	0.000	3.273E+12	74.4486	49531.
888.000	-0.0134	7769573.	-44575.	-0.000158	0.000	3.274E+12	22.8230	13663.
896.000	-0.0146	7414294.	-44262.	-0.000139	0.000	3.274E+12	55.5566	30544.
904.000	-0.0156	7062498.	-43802.	-0.000122	0.000	3.275E+12	59.4661	30508.
912.000	-0.0165	6714439.	-43313.	-0.000105	0.000	3.276E+12	62.8505	30476.
920.000	-0.0173	6370337.	-42798.	-8.889E-05	0.000	3.276E+12	65.7384	30449.
928.000	-0.0179	6030379.	-42263.	-7.375E-05	0.000	3.277E+12	68.1576	30427.
936.000	-0.0185	5694725.	-41709.	-5.944E-05	0.000	3.277E+12	70.1350	30408.
944.000	-0.0189	5363504.	-41142.	-4.594E-05	0.000	3.278E+12	71.6965	30394.
952.000	-0.0192	5036819.	-40564.	-3.325E-05	0.000	3.278E+12	72.8676	30383.
960.000	-0.0194	4714749.	-39978.	-2.135E-05	0.000	3.278E+12	73.6727	30375.
968.000	-0.0195	4397347.	-39386.	-1.023E-05	0.000	3.278E+12	74.1358	30371.
976.000	-0.0196	4084647.	-38793.	1.241E-07	0.000	3.278E+12	74.2801	30370.
984.000	-0.0195	3776662.	-38199.	9.717E-06	0.000	3.278E+12	74.1284	30371.
992.000	-0.0194	3473383.	-37608.	1.856E-05	0.000	3.278E+12	73.7030	30375.
1000.000	-0.0192	3174788.	-37021.	2.668E-05	0.000	3.278E+12	73.0256	30381.
1008.000	-0.0190	2880835.	-36156.	3.406E-05	0.000	3.278E+12	143.1938	60341.
1016.000	-0.0187	2596019.	-34471.	4.075E-05	0.000	3.278E+12	277.9660	119018.
1024.000	-0.0183	2328967.	-32268.	4.676E-05	0.000	3.278E+12	272.9610	119114.
1032.000	-0.0179	2079362.	-30107.	5.214E-05	0.000	3.278E+12	267.2980	119224.
1040.000	-0.0175	1846844.	-27993.	5.693E-05	0.000	3.278E+12	261.0432	119344.
1048.000	-0.0170	1631014.	-25932.	6.117E-05	0.000	3.278E+12	254.2581	119475.
1056.000	-0.0165	1431441.	-23927.	6.491E-05	0.000	3.278E+12	246.9997	119614.
1064.000	-0.0160	1247662.	-21982.	6.818E-05	0.000	3.278E+12	239.3209	119761.
1072.000	-0.0154	1079188.	-20099.	7.102E-05	0.000	3.278E+12	231.2705	119915.
1080.000	-0.0149	925504.	-18283.	7.346E-05	0.000	3.278E+12	222.8935	120075.
1088.000	-0.0143	786076.	-16534.	7.555E-05	0.000	3.278E+12	214.2308	120240.
1096.000	-0.0136	660352.	-14856.	7.732E-05	0.000	3.278E+12		

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205.3199    120409.      0.000
  1104.000    -0.0130    547761.    -13250.  7.879E-05      0.000  3.278E+12
196.1948    120582.      0.000
  1112.000    -0.0124    447722.    -11718.  8.000E-05      0.000  3.278E+12
186.8860    120758.      0.000
  1120.000    -0.0117    359639.    -10260.  8.099E-05      0.000  3.278E+12
177.4208    120937.      0.000
  1128.000    -0.0111    282907. -8879.4510  8.177E-05      0.000  3.278E+12
167.8234    121117.      0.000
  1136.000    -0.0104    216913. -7575.6971  8.238E-05      0.000  3.278E+12
158.1150    121300.      0.000
  1144.000  -0.009767    161037. -6349.9810  8.284E-05      0.000  3.278E+12
148.3140    121483.      0.000
  1152.000  -0.009103    114651. -5202.9816  8.318E-05      0.000  3.278E+12
138.4359    121668.      0.000
  1160.000  -0.008436     77124. -4135.2627  8.342E-05      0.000  3.278E+12
128.4938    121853.      0.000
  1168.000  -0.007768     47819. -3147.2936  8.357E-05      0.000  3.278E+12
118.4984    122039.      0.000
  1176.000  -0.007099     26098. -2239.4675  8.366E-05      0.000  3.278E+12
108.4581    122226.      0.000
  1184.000  -0.006429     11318. -1412.1191  8.370E-05      0.000  3.278E+12
98.3790    122412.      0.000
  1192.000  -0.005760  2834.7323  -665.5412  8.372E-05      0.000  3.278E+12
88.2654    122599.      0.000
  1200.000  -0.005090      0.000      0.000  8.372E-05      0.000  3.278E+12
78.1199     61393.      0.000
```

* This analysis makes computations of pile response using nonlinear moment-curvature relationships.
  The above values of total stress are computed for combined axial and bending stress and do not
  equal the actual stresses in concrete and steel in the range of nonlinear bending.

Output Verification: Computed forces and moments are within specified convergence limits.

Output Summary for Load Case No. 1:

```
Pile-head deflection             =      1.7019899 inches
Computed slope at pile head      =     -0.0034244 radians
Maximum bending moment           =      15866313. inch-lbs
Maximum shear force              =        -47774. lbs
Depth of maximum bending moment  =    648.0000000 inches below pile head
Depth of maximum shear force     =    832.0000000 inches below pile head
Number of iterations             =              9
Number of zero deflection points =              1
```

Summary of Pile Response(s)

Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, lbs, and Load 2 = Moment, in-lbs
Load Type 2: Load 1 = Shear, lbs, and Load 2 = Slope, radians

Shaft 14 - 60 in shaft 1 3 percent steel in column.lp6o
Load Type 3: Load 1 = Shear, lbs, and Load 2 = Rotational Stiffness, in-lbs/radian
Load Type 4: Load 1 = Top Deflection, inches, and Load 2 = Moment, in-lbs
Load Type 5: Load 1 = Top Deflection, inches, and Load 2 = Slope, radians

Load Case No.	Load Type No.	Pile-head Condition 1 V(lbs) or Maximum Shear lbs	Pile-head Condition 2 y(inches) or in-lb, rad., in-lb/rad. Rotation radians	Axial Loading lbs	Pile-head Deflection inches	Maximum Moment in-lbs
1	1	V = 25000.	M = 0.000	500000.	1.70198995	15866313.
		-47774.	-0.00342444			

The analysis ended normally.