City of Miami

ADDENDUM No. 6

February 26, 2019

REQUEST FOR PROPOSALS No. 18-19-005

DESIGN-BUILD SERVICES FOR DINNER KEY MARINA REPAIRS AND RESTORATION PROJECT

TO: ALL PROSPECTIVE PROPOSERS:

The following changes, additions, clarifications, and/or deletions amend the above-captioned Request for Proposals (RFP) and shall become an integral part of the proposal submitted and the Contract to be executed for **Design-Build Services for Dinner Key Marina Repairs and Restoration Project, RFP No. 18-19-005** (the "**Project**"). Please note the contents herein and affix it to the documents you have on hand.

All attachments (if any) are available on the Office of Capital Improvements (OCI) website and are part of this Addendum.

MODIFICATIONS:

1. The Proposal Due Date for Step 2 Submittal (Technical Proposal + Price Proposal) from the sole responsive Proposer, Kearns Construction Company (KCC), has been extended to **Monday, March 18, 2019 at 3:00 p.m.**

REQUESTS FOR INFORMATION (RFIs):

RFI No. 3, submitted by Kearns Construction Co. on February 4, 2019

Q2.1. Page E-501, Note 6: For pedestals supplied with 100 (amp) receptacles, provide a minimum rated 500A service buss arrangement.

This buss size is several times greater than what is required by NEC code or by physical application, and as such may not be available from all pedestal manufacturers. If this is not something that the manufacturer can provide, can we substitute a UL listed pedestal with a buss size that complies with the NEC requirements for that specific application?

A2.1. Yes, a UL approved pedestal is acceptable.

Q2.2. Page E-501, Note 9: Contractor needs to crimp terminals to line wires and place on provided stud lug connector.

The lugging configuration shown on the diagram is common to only one pedestal manufacturer that we are familiar with. The common method is to provide set screw wire terminals within the pedestals. Are we to instruct our pedestal manufacturer to redesign their pedestals to use threaded studs instead of wire terminals?

A2.2. For pedestals that do not provide lugs, electrical contractor shall crimp a ferrule to wire ends to prevent wire fraying and separation.

Q2.3. Page E-601, Note 5: Provide NEMA 6P, SS Disconnects for each Pier Feed, size based on load calculations. Reuse existing conduits from existing disconnect location(s) to each pier. Seal conduits watertight into 6P enclosure(s).

It appears that the main service disconnects are rated as watertight (6P). If this means that they are rated for direct water submersion, would that serve to meet the FEMA flood criteria requirement without elevating them to+ 16 feet, or is it the City's desire to do both?

A2.3. At time of DCP the intention was that the electrical contractor would be responsible to coordinate equipment elevation exceptions relative to the flood plain with the Authority Having Jurisdiction (AHJ). Please provide pricing based on matching the equipment elevation exception. Pedestals purchased with an Aluminum body (as addressed in RFI 4 Exhibit 1, Question (1)), a lower cost option can be considered.

Q2.4. Addendum 3; Page 13; Questions Q37, Q38, Q39, and Answers A37, A38, and A39:

Q37: What are the performance requirements for the card access system?

Q38: What are the performance requirements for the WIFI system?

Q39: What are the performance requirements for the security camera system?

Answer to questions Q37, Q38, and Q39:

The City has a contract with a Quality Wiring to install and monitor the City's security systems and other low voltage systems. It is a standard practice, for all City projects, that OCI and the design consultant coordinate low voltage work with Quality Wiring, and provide just empty conduits and pull boxes as necessary for the work to be completed "by others " (Quality Wiring). The response makes reference to coordinating the low voltage systems with "OCI." We are not sure to whom the term "OCI" is actually referring. Are these initials referring to Quality Wiring, or is this a separate entity? If so, who are they and how do we contact them? Also, can we get the specific contact information (name, phone number, email address) for the person from Quality Wiring whom we should speak with to arrange our coordination efforts?

A. The response makes reference to coordinating the low voltage systems with "OCI." We are not sure to whom the term "OCI" is actually referring. Are these initials referring to Quality Wiring, or is this a separate entity? If so, who are they and how do we contact them? Also, can we get the specific contact information (name, phone number, email address) for the person from Quality Wiring whom we should speak with to arrange our coordination efforts.

B. In the response A37, there is the wording "security systems and other low voltage systems." Questions Q38 & Q39 also speak specifically of WIFI and security cameras along with the card access system and answers A38 and A39 specifically include these items within the scope of work being provided by Quality Wiring. However, there are other low voltage systems. There is a fire alarm system and there are WIFI electric meters being provided as a built-in function of the Marine Power Pedestals. Will Quality Wiring be providing the Fire Alarm System and will they be in charge of wiring and connecting the Power Pedestal WIFI metering system?

A2.4. A. "OCI" stands for City of Miami's "Office of Capital Improvements." The contact information for Quality Wiring is Anthony Gonzalez, who can be reached via phone at

(305) 595-5691 (Office), or at (786) 609-7604 (Mobile). Quality Wiring's office is located at 10145 NW 19th Street, Doral, Florida 33172

B. Quality Wiring shall provide communications design and components. The Design-Build team will coordinate with Quality wiring to provide infrastructure required to install equipment to Quality Wiring requirements. Additionally, the Design-Build team will provide electrical power requirements as noted in single line diagrams. The Design-Build team will coordinate design and required infrastructure with the City and Fire Marshall and submit drawings to City/Fire Marshall for approval. This may allow Design-Build team to reuse some conduits and current infrastructure. However, at the current time, there is no connection to a central alarm system or into the Dinner Key Marina main building, so this must be included in the design. If the City chooses to incorporate Additive Alternate #4 (specifically, the pedestal power monitoring communications system), this addition will require no additional infrastructure at this time. This function is not intended to be connected to a network.

Q5. The first paragraph for the submission of the Step 2 proposal (Exhibit 5, attached) states the following:

> "*The Prosper shall demonstrate knowledge of the project objectives / goals and existing field conditions, identify potential design and construction/build issues, and present and comprehensive plan for completing the specified work established in Section 2.0 RFP Scope of Services.*"

We believe that the existing grating can be improved greatly. The current grating has excessive deflection and the grating wiggles under dynamic loads. This deflection causes excessive wear on the fiberglass concrete docks and creates a tripping hazard. The addition of an Aluminum I composite beam down the center of Piers 1-7 would reduce the clear span from 7'-0" to less than 3'-6" (utilities could still pass under the new beam). The aluminum beams would be supported by concrete pedestals spaced 8'-0" on center. The net effect would be a significant reduction in deflection. In addition, adopting a 2" deep bi-directional grating costs less and outperforms the specified grating. We encourage the City and the City's Consultants to review this proposal and see an as-built condition of the 2" deep bi-directional grating. Alternatively, KCC could add a wooden beam down the center of the dock supported by aluminum brackets (Exhibit 5B and 5C, attached). The RFP documents prohibit the proposer from altering the bid form. Thus, KCC would like to present this proposal and associated cost as a contractor proposed alternate to the required bid form. May KCC include value added alternates as an attachment to the required bid form?

A5. 1. A bi-directional grating may be submitted as a bid alternate to the specified grating.

2. The grating design shall be designed to meet live load deflection requirements. A beam along the centerline of the grating may be designed to improve the existing grating.

3. Yes, the Design-Build team may include value added alternates as an attachment to the bid form. Add alternates shall include sufficient explanation and backup information for the City to review the added alternates.

Q6. We suggest that the City consider using one grating for both the main piers and Additive Alternate# 2-Finger Pier Upgrade. This would enhance the appearance of the docks.

A6. The grating design and product selection is the responsibility of the Design-Build team. The City will consider using the same grating type, provided that it meets the live load and deflection criteria.

Q7. Bid Additive Alternate# 2 (Exhibit 7A, attached) includes replacing 99 finger piers using "prestressed concrete piles, aluminum, or FRP composite framing, with FRP grating." The current finger pier design (Exhibit 7B, attached) includes a 4'-0" wide dock with 12" wooden piles semi-recessed into the finger pier. The net effect is that the dear span (between piles) is only 3'- 0" wide.

For Bid Additive Alternate #2, we suggest that the finger piers be 3'- 0" wide without the semi-recessed piles (dock piles should not intersect the horizontal aluminum beams). Two pairs of fender piles (four total) are added to protect both boat and dock. The clear span of the finger pier would remain unchanged. Is this proposal acceptable?

A7. For Bid Alternate #2, it is not acceptable to reduce the finger pier width to 3-ft.

Q8. Bid Additive Alternate #2 requires the use of "pre-stressed concrete piles, aluminum, or FRP composite framing with FRP grating." The as-built conditions and the plans (Exhibit 8, attached), require that the first span be a ramp with a 12/1 slope. Making the transition between the ramp and horizontal can be difficult with aluminum or composite materials. May KCC place the Alternate #3 finger piers horizontal without the ramp? (The sea level is rising, and boats are getting bigger. Higher finger piers would respond to both conditions.)

A8. Yes, it is acceptable to provide Bid Additive Alternate #2 with the finger piers at the same elevation as the main walkway.

Q9. For Bid Additive Alternate #2, can KCC build a horizontal finger pier with step(s) up to the main pier?

A9. No, steps are not acceptable at the finger pier.

Q16. After the project is completed, will KCC be responsible for existing work that was not altered during construction?

A16. If there are specific items that Design-Build team has noted that require repair or alteration, these items shall be submitted to the City for review. If broken items are not repaired, then the Design-Build Team may be responsible for "incomplete" work.

Q18. The M & N Hurricane Irma Assessment Report (Exhibit 18A, attached), schedules fifty-five (55) mooring piles to be replaced and 47 fender piles to be replaced (55 + 47 = 102 total piles). The bid form (Exhibit 18B1 attached) lists only 40 timber mooring piles to be replaced. Please clarify the quantity and type of wooden timber piles to be replaced.

A18. The Design-Build team shall submit a price for the quantity listed in the bid table. Estimates include unit costs, and if additional mooring or fender piles are identified during the Design-Build team's field investigation to need replacement, these items shall be submitted to the City for review and the quantities increased (or decreased) based on the City approval.

Q19. The M & N Hurricane Irma Assessment Report (Exhibit 19A, attached) lists 25 pile caps in "Serious" condition. The pile cap repair work is not included in the bid form for the base bid (Exhibit 19B, attached). All pile cap repair work is listed on the Alternate Bid Plans (S-121 through S-128). No pile cap repair work is included in the base bid plans. Is this correct? If incorrect, please revise the bid form for the base bid to include the repair of the Hurricane damaged pile caps?

A19. Yes, this is correct. The base bid is for repair of "hurricane-related damage." The pile cap damage was typically corrosion related deterioration (See Additive Alternate #1). A line item was added to the bid form for replacement of pile caps at Contractor's option and as approved by the City.

Q20. The M & N Hurricane Irma Assessment Report (Exhibit 20, attached) states that several pile caps "will require demolition and reconstruction with cast-in-place caps." This base bid work is not identified on the bid form. Please revise the bid form to include this work in the base bid.

A20. Pile caps with widespread corrosion related deterioration were identified as "demolition and reconstruction." This work was considered non-hurricane related, therefore, not base bid. See Additive Alternate #1.

Q21. The M & N Hurricane Irma Assessment Report (Exhibit 21A & 21B, attached) states, 11 Minor to moderate concrete spalls and cracks were observed in the slabs and in the secondary pours above the pile caps). The deterioration will need to be repaired..." Please revise the bid form to include this work in the base bid.

A21. See Additive Alternate #1 for concrete repair bid items included in the DCP Drawings. Per Section 1.2.2.2 of the D/B RFP, "D/B Team shall provide a design-level inspection to catalog the defects and the locations, dimensions, and quantities of required repairs." The M&N Hurricane Irma Assessment Report did not include a "design level inspection." It is the responsibility of the D/B Team to complete the design level inspection and repair the actual defects. If additional concrete deterioration that is not indicated in the DCP Drawings is identified during Design-Build team's design level inspection, these items shall be submitted to the City for review. If additional concrete repairs are determined prior to bid, these may be included as an additive bid item. A concrete repair unit price (cost per cubic foot) was added to the Bid Schedule with an estimated quantity.

Q24. The M & N Hurricane Irma Assessment Report, Appendix D (Exhibit 24, attached), specify the concrete repair procedures. The required procedures include the sandblasting of the existing corroded reinforcement steel. We anticipate that DERM will prohibit the sandblasting of steel over water. Where possible, KCC suggests removing and replacing (drilling and doweling) the corroded reinforcement steel as an alternative method. Is the replacing of corroded reinforcement steel and acceptable alternate to sandblasting?

A24. Reinforcement shall be replaced if section loss is greater than 25%, or as determined by the D/B Team. Reinforcement with corrosion damage shall be cleaned to remove corrosion using a DERM approved method that does not impact the marine environment. For most over-water repair projects, a suspended platform can be utilized to collect concrete and dust debris, or a system of floats can be utilized to perform the same function. The reinforcement may be painted with zinc rich primer after removal of rust scale in-lieu of sandblasting. If the D/B team has a preferred method of removing and replacing the reinforcing and it is potentially more cost-effective and will minimize constructability issues with the regulatory agencies, then the City will consider an alternate. This type of

repair approach has a unit cost for Pile Cap Concrete Repairs (per cf). The intent is to repair and restore the concrete to its original condition for as long a service life as possible.

Q25. Page 08 of the RFP's Amendment No.3 states the soil boring and geotechnical information will be provided to all short-listed proposers after the Step 1 process. Please provide the soil boring and geotechnical report as referenced in that Amendment.

A25. The geotechnical report was recently finalized, and it is included in this Addendum.

Q28. Does the "clock start ticking" after all required permits are secured? A prior response to this question is incomplete.

A28. The project schedule, once agreed upon prior to contract award, will include start and completion dates for both main phases, design and construction. After contract execution, an authorization to proceed will be given to the successful Design-Build team to begin the design phase. Once all construction-related permits have been obtained, the Design-Build team will receive a Notice to Proceed to start construction.

Q30. Who will pay for destructive and material testing? The RFP's Amendment No.3 states "The Design-Build Firm shall be responsible for all material testing." Does this also mean that the Design-Build Firm will also pay the bill?

A30. We assume "destructive testing" pertains to the partial demolition of concrete components for spall and crack repairs. The Design-Build team will provide clarification relative to the limits and extend of this type of testing. Material testing will be required as outlined in the DCP, and the qualifications for the specialty engineer were required in the procurement documents. The City generally requires a specialty inspector to inspect reinforced concrete prior to placement. This would include concrete repairs, and the specialty engineer will need to confirm the limits of partial demolition in accordance with the repair procedures. Similarly, appropriate concrete testing is required for placed concrete. These inspections will be the responsibility of the Design-Build team. The City inspectors for the building department may not have adequate insurance for working over water. All tests shall be performed by the Design-Build team. All costs for testing performed by the Design-Build team shall be at the Design-Build team's expense. All reports are to be sent directly to the City's Project Manager with a copy to the Design-Build team. The City may, in its sole and absolute discretion, test materials and products at its own cost. However, should such materials or products fail to pass the test and/or meet the requirements of the Contract Documents, the Design-Build team shall reimburse the City for the cost of such tests and repair or replace said materials or products. In such instances the City may deduct such cost from any payments pending to the Design-Build team. The City may require that the Design-Build team provide the name and qualification of the company(ies) providing the testing services, inclusive of the testing laboratory(ies). The City, in its sole discretion, may accept or reject the use of any company or laboratory that it determines does not possess the required licenses or expertise to perform their portion of the Work.

Q31. Page 3 of the Dinner Key Marina Repairs Design Criteria Package (Exhibit 31, attached) states, "the Owner shall provide a survey identify submerged debris throughout the marina." Please provide the submerged marine debris survey.

A31. The City has not conducted a survey. The D/B team will be required to perform a survey and remove submerged debris. A unit cost for submerged debris removal is included in the Base Bid, a unit cost for debris removal and disposal per dumpster will be added to the bid form.

Q32. The project specifies aluminum cleats. Aluminum cleats are weak and tend to fail during storm events. Failing cleats can cause significant damage to both docks and vessels. We suggest using heavy-duty hot dip galvanized cleats attached to concrete with stainless steel bolts. Is this acceptable? If the broken cleats require replacement with a heavy-duty hot dip galvanized unit, please provide a bid alternate to replace the existing aluminum cleats that are not damaged?

A32. HDG steel cleats with stainless steel bolts are acceptable in-lieu of aluminum cleats.

Q35. The Dinner Key Marina Repairs Design Criteria Package (Exhibit 35, attached), states that M & N will apply for the environmental permits. What is the current status of the FDEP permits?

A35. The design criteria professional has applied for the three regulatory permits required from DERM, U.S. Army Corps of Engineers, and Florida DEP. The DEP exemption has been issued, and a completeness letter has been received from DERM. The City is compiling a comprehensive response. The U.S. Army Corps of Engineers permitting is ongoing.

Q36. What is the current status of the Army Corps permits?

A36. Please refer to A35., above.

Q37. What is the status of the DERM preliminary Class I permit?

A37. Please refer to A35., above.

Q38. The M & N Hurricane Irma Assessment report states that the concrete walkway spans (beams) were damaged in the storm. The current bid from does not include the repairs of the damaged concrete walkway spans (The current bid form does include the replacement of 13 concrete walkway spans). Please revise the bid form to include the base bid repairs to the concrete walkway spans.

A38. The intent of the walkway repairs was to replace, not repair, the damaged walkway spans. Design-Build team may include a value added alternate for repair in-lieu of replacement as an attachment to the bid form. Add alternates shall include sufficient explanation and backup information for the City to review the added alternates.

Q39. Many of the wooden cross bracing for finger piers are in direct contact with water. The wooden cross bracing that are in direct contact with water must be treated for direct contact. We suggest revising the project requirements to include treating wood for direct contact with water where applicable.

A39. Cross bracing shall be treated for direct contact with seawater. Additionally, bracing may be wrapped to protect from marine borer damage.

Q40. Please review and respond to the list of questions from Firepack dated February 4, 2019.

1. What will be the Point of Connection for the permitted work?
2. Will any of the underground components such as the backflow, fire department connection, or lines/fittings/thrust blocks need to be replaced?
4. Will this job operate on phased permits?
5. Will the City require any specialized coatings or is this up to the engineer?

A40. 1. Field verify points of connection and coordinate with the Fire Marshall. The Intent of the DCP is limit the work from approximately 5' behind the bulkhead (or to nearest coupling, as appropriate) waterward east to the extents of the piers.

2. The City recently replaced the backflow preventors, and refer to the above response. Contractor shall field verify and coordinate with City and Fire Marshall if hydrants or other appurtenances landward of the bulkhead may need maintenance or replacement.

4. The construction work will be phased, but the master permit will be for the full project scope.

5. Team and reviewed/approved by the City and AHJ. Refer to the coating (commercial latex paint) specified in the DCP for the fire line piping.

Q42. The RFP's Addendum 3, item 3 (specifically page 5) reference is given to a "Section (7) Insurance however, a section 7 does not exist in the RFP. Please clarify or provide.

A42. Please disregard any reference indicated above. Insurance requirements will remain as described in the RFP document, as amended.

Q43. On DCP Sheet G-002, General Note #7, the D I B Team shall, on a daily basis remove from the site debris resulting from the demolition I construction. This requirement seems impractical and perhaps should only apply to areas outside the active work zone.

A43. The City concurs.

Q44. On DCP Sheet G-002, Debris Removal #5 a side scan sonar bathymetric survey is requested indicting no debris remains. Will the City be providing a side scan sonar survey for pre- construction conditions? Will the City acknowledge I accept debris surveys for each phase for phased TCO's?

A44. A preconstruction side scan sonar was not completed. Yes, the debris survey can be completed for each phase.

Q46. Are new ladders required by this RFP? If required, please specify and quantify.

A46. See DCP drawings, or provide at a maximum spacing of 400-ft on center along each pier, or per life safety requirements.

RFI No. 4, submitted by Kearns Construction Co. on February 8, 2019

Q1. The first paragraph of the submission of the Step 2 proposal states the following:

> *The proposer shall demonstrate knowledge of the project objectives / goals and existing field conditions, identify potential design and construction / build issues and present a compressive plan for completing the specified work established in Section 2.0 RFP Scope of Services.*

KCC believes that the City should consider including an alternate that changes all existing aluminum cleats to heavy-duty galvanized steel. We believe that where the greatest Hurricane Irma storm damage occurred was at the same location of the greatest cleat failures. During storm events, broken cleats free moored vessels that then cause damage to both docks and vessels. Pier No. 1 is where the greatest Hurricane Irma storm damage occurred. The following table list the location of the broken / missing aluminum cleats:

Pier No.	# Broken	Total # of Cleats	% of Broken Cleats
1	74	99	75%
2	5	115	04%
3	11	178	06%
4	11	173	06%
5	6	175	03%
6	2	152	01%
7	1	135	01%
8	6	100	06%
9	3	70	04%

Hurricane Irma impacted the Southeast Florida Area as a Category 1storm. Pier No 1had the greatest storm exposure. Consequently, Pier 1had the greatest damage to both dock and vessels. Had Hurricane Irma been a stronger storm, the impacts to Dinner Key Marina would have been far greater. Having the boats secured with stronger cleats is an improved first line of defense for Dinner Key Marina and we believe steel cleats should be installed throughout the facility.

A1. HDG steel cleats are an equivalent substitute for the aluminum cleats specified in the DCP drawings. Additive Alternative #9 was added to the bid schedule to replace the remaining aluminum cleats with heavy-duty HDG steel cleats.

Q2. Are the existing concrete walkway span prestressed or post-tensioned? It appears that the existing concrete walkway spans are post-tensioned {blue tendon plastic coating). If post- tensioned, are the tendons bonded or unbonded?

A2. As-built record drawings of the concrete walkways were not available, so it is unknown if the walkways are prestressed or post-tensioned (bonded or unbonded). Plastic coatings near the ends of the strands are sometimes used for prestressed beams to debond the ends to prevent localized damage to the ends of the beam. Due to the span lengths and based on site observations of damaged walkways, the walkways are believed to be prestressed.

Q3. KCC suggests using double light-gauge straps in lieu of the thru-bolted straps detailed on Plan C / S-501. The detail on Plan S-501 is expensive and not typical.

A3. The DCP drawings show concept level timber dock construction details. The details are shown to indicate a load path shall be provided from the decking, to stringers, to pile caps, to piles. The timber design including, bolt sizes, tie-down strap types/sizes, etc. is the responsibility of the D/B Team. Timber connection hardware shall be galvanized steel. If "light-gauge" straps (less than 3/8-inch thick) are used, they shall be stainless.

Q4. Plan S-502, Note No.3 states, "REPLACE CORRODED REINFORCING BARS. PROVIDE REINFORCING TO MATCH SIZE. LOCATION AND SPACING OF EXITING REINF BARS". We suggest using corrosion resistant MMFX of high-strength steel (grade 100). Standard rebar is grade 60. The proposed MMX (grade 100) is sixty seven percent (67%) stronger than standard rebar. For strand replacement and poured-in-place concrete repairs, may KCC reduce the bar diameter size to compensate for the higher-strength steel?

A4. Yes, the D/B Team may provide alternative reinforcement that meets the design loads for the walkway spans. MMFX is not required.

Q5. The DCP plans require the plastic wrapping of timber piles. The permitting agencies require the wrapping of timber piles to reduce the release of toxins back into the environment. Greenheart piles are free from preservatives and typically do not require plastic wrapping. The City's greenheart pile specification does not require plastic wrapping. Please confirm that the greenheart piles listed in Bid Alternate No. No.5 (RFP's Addendum No.3) do not require plastic wrapping.

A5. Concur; greenheart piles do not require plastic wrapping.

RFI No. 5, submitted by Kearns Construction Co. on February 11, 2019

Q. Is Additive Alternate #2 - Finger Pier Upgrade an "additional cost" (net add) alternate for the above referenced project (see attached)? An "additional cost" alternate (net add) will require the subtraction of the base bid Timber Finger Pier Replacements and the addition of the alternate finger pier replacements (prestressed concrete piles, aluminum or FRP composite framing, with FRP grating) to achieve an "additional cost" alternate (net add alternate).

The other structural alternates (Alternate #5 -Alternate #8) use the phrase, "additional cost." Additive Alternate #2 does not use the phrase "additional cost." Additive Alternate #2 -Finger Pier Upgrade states, "Provide a lump sum price to upgrade Finger Piers indicated as replacement in the DCP Drawings to be replaced using prestressed concrete piles, aluminum or FRP composite framing, with FRP grating." Unless instructed otherwise, KCC believes that Additive Alternate #2 is an "additional cost" (net add) alternate.

A. It is acceptable to provide the "additional cost" (net add) for Bid Alternate #2. The Bid schedule will be revised to indicate, "Provide the additional cost (net add) a lump sum price to upgrade Finger Piers indicated as "replacement" in the DCP Drawings to be replaced using prestressed concrete piles, aluminum or FRP composite framing, with FRP grating.

Attachment

- Geotechnical Services for the Dinner Key Marina Improvements, Report prepared by HP Consultants, Inc., dated February 8, 2019, 114 pages.

THIS ADDENDUM IS AN ESSENTIAL PORTION OF THE CONTRACT DOCUMENT AND SHALL BE MADE A PART THEREOF.

Annie Perez, CPPO, Director
Department of Procurement, City of Miami

Geotechnical services for the
Dinner Key Marina improvements
Miami, FL

Misc. Marine and Coastal Engineering Services
City of Miami RFP 15-16-011
M&N Job # 9450-08 Task Work Order # 05

Geotechnical Report

Prepared for

Moffatt & Nichol
Miami, FL

February 08, 2019

HPCI Project No.: CE-M&N-CityMia-18-01

HP Consultants Inc.

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February 08, 2019

Tim Blankenship, PE
Moffatt & Nichol
2937 SW 27th Avenue, Suite 101A
Coconut Grove, Florida 33133

Sub: Geotechnical services for the Dinner Key Marina improvements: Final report

Ref: City of Miami RFP 15-16-011, Misc. Marine and Coastal Engineering Services
M&N Job # 9450-08, Task Work Order No. 5
HPCI Project No.: GE-M&N-CityMia-18-01

Dear Mr. Blankenship:

We are pleased to submit this and four more original copies of this report on our services for the *Dinner Key Marina improvements* project.

We greatly appreciate the opportunity to work on this phase of the project and are looking forward to assisting you on the subsequent phases and other forthcoming projects.

Sincerely,

A.S. Kumbhojkar, Ph.D., P.E., F. ASCE
President and Principal Engineer
Florida PE # 41067

Attachments: As above

GEOTECHNICAL SERVICES FOR THE DINNER KEY MARINA IMPROVEMENTS

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Table E-1.11: Capacity calculation for 16” circular, tapered pile for B-3 profile		Appendix-E
Table E-1.12: Capacity calculation for 16” circular, tapered pile for B-4 profile		Appendix-E
Table E-1.13: Capacity calculation for 18” circular, tapered pile for B-1 profile		Appendix-E
Table E-1.14: Capacity calculation for 18” circular, tapered pile for B-2 profile		Appendix-E
Table E-1.15: Capacity calculation for 18” circular, tapered pile for B-3 profile		Appendix-E
Table E-1.16: Capacity calculation for 18” circular, tapered pile for B-3 profile		Appendix-E

GEOTECHNICAL SERVICES FOR THE DINNER KEY MARINA IMPROVEMENTS

1.0 INTRODUCTION

HP Consultants Inc. (HPCI) is submitting this report on the *Geotechnical services* for *the Dinner Key Marina improvements* project (the "Project"). HPCI provided these services to Moffatt & Nichol's (M&N) as its subconsultant *for providing Miscellaneous Marine & Coastal Engineering Services (RFP 15-16-011)* to the City of Miami, FL. (the "City"). Mr. Tim Blankenship, PE, M&N served as the Project Manager. He authorized us to begin the work on 11/05/2018. We sent Mr. Blankenship an initial report on 12/09/2018. This design report incorporates the information from the initial report.

1.1 Project information and data

Mr. Blankenship provided us an aerial view of the site showing general locations of the borings. It is included in Appendix-A as Figure A-1. He advised us that the geotechnical services were in support of the "Design-Build" (D-B) procurement for the improvements to the Dinner Key Marina. The improvements included replacement of piles damaged during hurricanes. The pre-stressed concrete piles were to be used possibly for the main piers and as an option for finger docks. Timber piles were to be used as fender/ mooring piles, for timber docks, and for floating dock piles as an option. The piles were to be designed by using programs such as L-Pile and we were to provide geotechnical design parameters and axial capacities of the piles.

1.2 Scope of our work

The purpose of our services was to collect data on the offshore subsurface conditions in the vicinity of Dinner Key Marina and assist M&N on the geotechnical aspects of the proposed design-build project, as needed.

The scope of our work (the "scope") included the following tasks:

1. Conduct site reconnaissance, mark boring locations in the field, and obtain utility clearance through Sunshine 811
2. Conduct four Standard Penetration Test (SPT) borings to 50' depth
3. Conduct laboratory identification and classification tests, as needed, and classify soils
4. Develop a geotechnical design report providing design parameters and axial pile Capacities for timber and concrete piles.

We have completed these tasks.

2.0 SITE INVESTIGATION AND LABORATORY TESTING

2.1 Project location

The project site is located at 3400 Pan American Drive, Miami, FL. 33133 in the Dinner Key Marina.

2.2 Site conditions

The Marina includes seven piers with docking stations for boats (Figures A-1 and A-2 in Appendix-A). The exploration site was the offshore area in the vicinity of these piers. The depth of the water in the proposed drilling area was about 10'. The sea waters were generally calm at the time of our work and did not require jacking up the barge for drilling.

2.3 Geological history

Regional geology

The South Florida region- M-Dade, Broward, Monroe, and Palm Beach Counties- is underlain by about 11,800-ft of limestone and dolostone. M-Dade County is divided into four geological regions: Everglades Trough, Atlantic Coastal Ridge, Southern Slope, and Gulf Coast Lagoons. Tamiami/Hawthorn, Caloosahatchee, Anastasia, and Ft. Thompson formations, Miami and Key Largo Limestone, Pamlico sand and Holocene[1] sediments are the key elements of the regional stratigraphy. They are not present in all four geological regions and order of their stratigraphy over the depth is not always chronological.

The materials in the top 200-ft±, particularly the Miami and Key Largo Limestone deposits and Ft. Thompson and Anastasia formations have been subjected to chemical erosion during the Pleistocene[2] epoch. The resulting Karst landform is characterized by randomly distributed solution channels, cavities, and vugs. M-Dade County however is not known (to us) for sinkholes that are commonly associated with the Karst topography. The present subsurface profile includes erosion and intermittent depositions. The degree and extent of erosion and deposition can vary significantly and randomly at micro-level even within a well-characterized soil unit at macro level. Near-surface soils in the County have been altered en masse for agriculture and urban development; the present day on-land soil profile is typically topped by a few inches to many ft. deep backfill materials. The offshore areas near the land may or may not be subjected to manmade alterations.

[1] The Holocene is the current geological epoch. It began approximately 11,650 years, before present after the last glacial period which concluded with the Holocene glacial retreat.

[2] Geologic time, from about 1.6 million to the beginning of Holocene epoch, the end of which is characterized by the disappearance of continental ice sheets.

Local geology:

Figure B-1(Appendix-B) shows the geological cross section across M-Dade County and the adjacent portion of the Biscayne Bay[3]. The project site is located in the Biscayne Bay east of the Atlantic Coastal ridge region of M-Dade County. The key subsurface layers at the site are Holocene sediments, Miami Limestone, Ft. Thompson formation, and Key Largo limestone. The Miami Limestone is underlain successively by Ft. Thompson and Key Largo formations in the onshore and coastal areas. The inter-fingering between Ft. Thompson and Key Largo formations (Figure B-1) however can reverse their order of stratigraphic sequence. Brief descriptions of these layers are given below.

Holocene sediments: Up to 18-ft. thick Holocene sediments occur near the present coastline. The deposit typically begins at elevations generally less than 5-ft. The sediments include quartz sands, carbonate sands and muds, and organics.

Miami Limestone: Miami Limestone is porous and permeable. It appears in two different facies[4]: oolitic and bryozoan. The oolitic facies consists of white to orangish gray, poorly to moderately indurated (hardened) sandy, oolitic limestone (grainstone) with scattered concentrations of fossils. The bryozoan facies consists of white to orangish gray, poorly to well indurated, sandy, fossiliferous limestone (grainstone and packstone). Beds of sand are also sometimes present as unindurated sediments and indurated limey sandstones. Fossils present include mollusks, bryozoans, and corals. Molds and casts of fossils are common. This layer can be up to 40-ft thick. It is present at the ground level at some locations but usually lies below recent deposits such as Holocene sediments, marine deposits, Pamlico sand and man-made fill.

Fort (Ft.) Thompson formation: The Ft. Thompson formation is composed of interbedded sand, marl, sandstone, and limestone of fresh-water and marine origin. This formation shows features of karst topography (vugs, cavities, porosity, flow channels, etc.). The occurrence of limestone in the Ft. Thompson formation is attributed to fluctuations of the water table accompanied by cementation with calcium carbonate. It can be hard and strong, but due to the cavities and presence of sands and silts, even a hard to drill limestone may not always provide the bulk and expected strength of non-karst intact/solid limestone found elsewhere in the world. Although this layer can be up to 80-ft thick, it was likely to be much thinner at the Project site.

Key Largo Limestone: The Key Largo Limestone is a fossil coral reef much like the present day reefs offshore from the Keys. It is a white to light gray, moderately to well indurated, fossiliferous, coralline limestone composed of coral heads encased in a calcarenitic matrix. Little to no siliciclastic sediment is found in these sediments. Fossils

[3] NRCS/USGS database on near-surface profiles does not include offshore areas such as the Dinner Key Marina
[4] rock features indicating formations

present include corals, mollusks, and bryozoans. It is highly porous and permeable and is part of the Biscayne Aquifer of the surficial aquifer system.

2.4 Other historical data

Appendix-B includes the pile installation data at Pier 3.

2.5 Utility clearance

We marked the boring locations at the site and obtained utility clearance through Sunshine 811. There were no private utilities in the vicinity of the boring locations.

2.6 Subsurface exploration

Four 50' deep SPT borings (B-1, B-2, B-3, and B-4) were conducted per ASTM[5] D1586 using mud-rotary drilling technique. A barge-mounted CME-45 drilling rig was used. It was equipped with an automatic hammer. We sampled subsurface continuously in the top 10' of the SPT borings following FDOT practice and at 5' intervals thereafter to the termination depth. The SPT spoon sample materials were placed in sealed containers and were taken to the laboratory for further evaluation.

We closed the boreholes upon completion of the drilling and testing. Figure A-2 shows the boring locations schematically.

2.7 Laboratory testing

The SPT samples were arranged in the order of their in-situ sequence to the extent possible. Material descriptions[6] and stratification were developed following Visual–Manual Procedure (ASTM Standard D2488[7]).

Four sand samples were oven dried and were successively tested for %-finer than #200 sieve (ASTM D1140) and particle-size distribution (ASTM D6913). The particle-size distribution curves are provided in Appendix-C. The wt. of fines obtained from the %-finer than #200 sieve test is included in the particle-size distribution. The tests gave the classification SP- poorly graded sand- for all four samples.

[5] American Society of Testing Materials

[6] The terms "gravel," "fine sand," "sand" and "silt" used throughout this report describe particle sizes.

[7] The soil samples are preserved and are available for inspection on request. We will discard them after 30-days from the date of the final report.

3.0 ENGINEERING EVALUATION

3.1 Subsurface conditions and soil classification

Appendix-D includes the subsurface profile and borelogs that describe material characteristics and stratification encountered in the SPT borings. They are drawn as a function of depth in reference (±0.00) to the local mudline at the boring location as the ground level (GL). The borelogs include material descriptions and soil classification based on ASTM D2487 and ASTM D2488.

The stratification shown in the subsurface profiles and borelogs is what we encountered in the field. The boundaries separating successive strata shown in the borelogs and profiles are idealized and approximate. The actual transitions may be gradual. Subsurface conditions may vary within a short distance from a boring location and the boring profile cannot show this change. Rotary drilling and SPT hammering often break the in-situ materials. The SPT tube limits the size of the sampled particles to its diameter, about 2". The circulation fluid removes at least some fine grained materials. Characterizations and classifications based on SPT spoon samples therefore may not be always precise in describing the in-situ composition of particle sizes and the classification of sampled materials but is usually representative.

3.2 Sea water level

The sea water level at the time of the drilling was about 10' above the sea bed/mudline at all four boring locations.

3.3 Assessment of soil conditions for the foundation design

About one-ft. thick (top) layer at the mudline consisting fine grained soils-with or without significant organic soil component (ML, OL)- encountered in all four boring profiles is unlikely to provide any significant strength.

The sand, where present within the top 10' to 15', is very loose and loose. It offers limited strength and has high compressibility. The limestone yielding low N values (<10) is treated as sand for strength assessment[8]. The portion between 25' to 30' depth in all four borings is a key example of such weak/highly porous limestone. Similarly, limestone yielding N values between 10 and 25 is treated as gravelly sand for strength assessment. The limestone characterized as sand and gravelly sand may provide better capacity than the sands with the similar N values but are compressible and susceptible to punching. The sandy layers between about 32' and 42'/46' depth are dense and very dense. They provide good resistance and end bearing, low compressibility and are suitable for anchoring the piles. The underlying Ft. Thompson offers additional protection

[8] Following FDOT's Soils and Foundations Manual

against punching. The Miami limestone encountered at depth between 8' and 22' in boring B-4 is characterized as Intermediate Geo material (IGM). It is suitable for anchoring/socketing the piles.

The Ft Thompson formation limestone from about 42' (46' depth at boring B-1) to the termination depth (50') gave N values >30. This IGM material is suitable for anchoring/ socketing the piles.

3.4 Geotechnical design parameters

The geotechnical design parameters are given in Table-1. The stratification in the table takes into account N values in addition to the profile encountered in the borings; it is therefore somewhat different from the subsurface profiles given in Appendix B.

Table-1: Estimated geotechnical design parameters for the soil and rock

Boring B-1			Boring B-2			Boring B-3			Boring B-4		
Depth (Ft.)	Material & SPT N	Properties	Depth (Ft.)	Material & SPT N	Properties	Depth (Ft.)	Material & SPT N	Properties	Depth (Ft.)	Material & SPT N	Properties
0-1	Organic silt (OL)	γ_{sat} = 100 pcf	0-1	Sandy silt (ML)	γ_{sat} = 100 pcf	0-1	Organic silt (OL)	γ_{sat} = 100 pcf	0-1	Sandy silt (ML)	γ_{sat} = 100 pcf
		C_u =0, c'=0, φ'=0			C_u =0, c'=0, φ'=0			C_u =0, c'=0, φ'=0			C_u =0, c'=0, φ'=0
	N=2			N=2			N=2			N=2	
1-4	Loose sand (SP)	γ_{sat} = 104 pcf	1-4	Limestone/	γ_{sat} = 105 pcf	1-9	Loose sand (SP)	γ_{sat} = 104 pcf	1-6	Limestone/	γ_{sat} = 105 pcf
		c'=0, φ'=30°		Sand	c'=0, φ'=28°			c'=0, φ'=30°		Sand	c'=0, φ'=30°
	N=7			N=4			N=8			N=7	
4-17	Very loose sand (SP)	γ_{sat} = 102 pcf	4-12	Loose sand (SP)	γ_{sat} = 104 pcf	9-21	Med. dense	γ_{sat} = 113 pcf	6-8	Loose sand (SP)	γ_{sat} = 104 pcf
		c'=0, φ'=25°			c'=0, φ'=30°		sand (SP)	c'=0, φ'=35°			c'=0, φ'=29°
	N=2			N=5			N=21			N=6	
17-22	Limestone/	γ_{sat} = 120 pcf	12-32	Limestone/	γ_{sat} = 105 pcf	21-32	Limestone/	γ_{sat} = 110 pcf	8-22	Limestone	γ_{sat} = 130 pcf
	Gravelly sand	c'=0, φ'=39°		Sand	c'=0, φ'=30°		Gravelly sand	c'=0, φ'=38°		(IGM)	q_u=20 & q_t=5 tsf
	N=25			N=8			N=20			N=48	φ'=40°
22-26	Limestone/	γ_{sat} = 110 pcf	32-42	Very Dense	γ_{sat} = 125 pcf	32-42	Very Dense	γ_{sat} = 125 pcf	22-28	Limestone/	γ_{sat} = 105 pcf
	Gravelly sand	c'=0, φ'=37°		sand	c'=0, φ'=39°		sand	c'=0, φ'=39°		Sand	c'=0, φ'=30°
	N=17			N=40			N=42			N=7	
26-32	Limestone/	γ_{sat} = 105 pcf	42-50	Limestone	γ_{sat} = 130 pcf	42-50	Limestone	γ_{sat} = 130 pcf	28-42	Dense	γ_{sat} = 115 pcf
	Sand	c'=0, φ'=30°		(IGM)	q_u=20 & q_t=5 tsf		(IGM)	q_u=20 & q_t=5 tsf		sand (SP)	c'=0, φ'=37°
	N=8			N=58			N=38			N=26	
32-46	Very Dense/	γ_{sat} = 120 pcf	NOTES	Limestone/ Gravelly sand	Limestone =treated as gravelly sand	pcf= lbs/ft^3 tsf= ton/ft^2			42-50	Limestone	γ_{sat} = 130 pcf
	Dense sand	c'=0, φ'=39°				γ_{sat} = Saturated unit weight				(IGM)	q_u=20 & q_t=5 tsf
	N=33			Limestone/ Sand	= Limestone treated as sand	Cu = Undrained shear strength				N=41	φ'=40°
46-50	Limestone	γ_{sat} = 130 pcf				c', φ'= Effective cohesion & friction angle respectively					
	(IGM)	q_u=20 & q_t=5 tsf		IGM	=Intermediate geo-material	qu, qt= Unconfined compressive & tensile strength respectively					
	N=49	φ'=40°				Multiply (automatic hammer) SPT N value by 1.24 for Safety hammer N					

3.5 Axial capacity assessment for piles

Pile capacity analyses are provided for driven timber and concrete piles. The pile capacities are given as a function of depth below the seabed levels (±0.00) at the four boring locations and include skin friction and end bearing.

3.5.1 Capacity of timber piles using effective stress method[9]

The capacity analyses are for tapered timber piles. The piles are identified by their (butt) diameters- 12", 14", 16", and 18"- at the mudline. All piles are assumed to be tapered at the uniform rate of 1" over 10' pile length (i.e., depth below the mudline). Pile diameters therefore decease with depth and the tip diameter of a pile is the diameter at the termination depth.

The analyses use the stratification and parameters (viz., saturated unit weights, γ_{sat}, and effective friction angles, φ') given in Table-1 and the empirical relations given Table-2 to assess the skin friction (β) and toe resistance (N_t) coefficients.

Table-2: Range of β and N_t Coefficients (Fellenius, 1991)[10]

Soil Type	φ'	β	N_t
Clay	25-30	0.23-0.40	03-30
Silt	28-34	0.27-0.50	20-40
Sand	32-40	0.30-0.60	30-150
Gravel	35-45	0.35-0.80	60-300

The results of the analyses are given in appendix E-1 in a tabular form. Each table is for a specific butt diameter and strength profile (Table-1). It provides β and N_t coefficients, ultimate skin friction, ultimate end bearing, and total ultimate capacity for piles of lengths from 1' to 50' below the mudline (0.0'). Design load using a factor of safety of 3 is also provided as an example.

3.5.2 Capacity of concrete piles using the program FB-Deep

All the piles identified for installation (Section 1.1) are driven piles. Only square concrete piles were analyzed since square piles were used in the construction of Pier-3.

The FB-deep analysis uses N values for estimating the skin friction and end bearing. These N values are given in Table-1. Other data used in the analysis are given below

[9] Applicable to both cohesive and cohesionless soils

[10] After Timber pile design and construction manual; Table-2 does not provide empirical relation for rocks in general and limestone (IGM, intermediate geo material) in particular. We therefore assigned the maximum permissible value of 40 degrees to the effective friction angle to IGM for assessing β and N_t. and treated the remaining Miami limestone layers as sand and gravelly sand.

Unit weight of concrete:	145 lbs./cubic ft. (pcf)
Ground level (mudline):	0.0’
Correction factor for N values:	1.24
Extension of Ft. Thompson to:	60.0’ (an assumption needed to facilitate end bearing calculation)
Stratification input method:	Option B (identifying material above and below the boundary at the change of stratum depth)
Pile sizes	Square piles of size 12”, 14”, 16” and 18”

The results of the analyses are given in appendix E-2. The FB-Deep output for concrete piles include plots and the numerical data printout for lengths from 1’ to 50’. Each output is for a specific pile sizer and strength profile (Table-1).

4.0 DESIGN AND CONSTRUCTION RECOMMENDATIONS

The recommendations in this section are based on the exploration results, axial capacity analyses, and our assessment given in Section 3. We have provided them as additional information. They are not obligatory in any manner; the design-builders may conduct their own investigation and analyses without depending on these recommendations and any other information given in this report.

We support the use of driven piles for the proposed offshore foundations for the piers, docks, fenders/moorings, floating docks and any other offshore structure. We do not recommend using auger cast piles and shallow foundations for offshore structures.

Although we prefer using pre-cast concrete piles to other materials for supporting the proposed structures, it is feasible to use timber piles. When used, the timber piles should be used for axial compressive capacity up to 15-ton, providing

- they are pre-treated according to Specification 955 of *FDOT Standard Specifications for Road and Bridge Construction,*
- they are socketed either in IGM limestone or anchored in dense/very dense sand, and
- the timber and pile structures can resist all the loads (axial, lateral, moments, impact, etc.) over the design life

1. The axial compressive capacities of circular tapered timber piles given in Appendix-E-1 are only for timber piles of the specific geometry used in the analyses. Similarly, axial compressive capacities of square concrete piles given in Appendix-E-2 are only for square concrete piles of the specific geometry used. Neither the capacities of timber piles nor their unit skin friction nor unit end bearing values are applicable to concrete piles, and vice versa, even if the piles are of the same size and shape, and have the same depths below the mudlines.

2. While designing piles and superstructure elevations, factor in sea level (submergence depth) commensurate with the hurricane conditions, long-term sea level rise, and local variation in the mudline elevations among other factors. Any change in the submergence depth however will not affect the effective stresses in the soil and rock beneath the mudline.

3. Apply appropriate factor of safety (not less than 2) to the ultimate skin friction and the mobilized end bearing given in the Appendices E-1 and E-2 to arrive at the design axial capacity. It is appropriate to use different factors of safety for skin friction and end bearing. The factor of safety for end bearing can be more than that for the skin friction.

4. The axial compressive loads may not govern the structural design of the piles. Do not depend on the axial capacity values given in Appendices E-1 and E-2 alone; design piles for appropriate vertical loads, lateral loads and bending moments (including but not limited to wind load, boat impact loads, hurricane induced uplift forces), after taking into account factors such has pile length, fixity conditions, pile cap connections, group behavior, permissible settlements and lateral movements.

5. Limit tensile allowable design load on a pile to 50% of the skin friction component of the allowable capacity (ultimate skin friction capacity/ factor of safety) minus its self-weight.

6. The pile design should take into consideration that the piles will remain in one of the most corrosive environment for concrete, steel, and timber. Refer *FDOT's Structures Manual for guidance.*

7. Use the recommendations in *Sections 953 and 955 of FDOT Standard Specifications for Road and Bridge Construction* as a resource for design and construction. *ASTM D25-12 (2017) Standard Specification for round timber piles* (or its later version, if any) and *Timber Piles, Design and Construction Manual* published by *Timber Piling Council* are other resources for timber pile design and construction. These resources may not address all of the safety concerns associated with timber use. Address additional safety, health, and environmental concerns and regulatory requirements per the City requirements and Industry standards.

8. While designing the piles, consider scour and effects of shifting of sands during storms and hurricanes. The effects should include but not limited to the loss of skin friction/ strength due to lowered mudline and reduction in effective overburden pressure. Our capacity analyses for timber piles have already discounted the skin friction in top one-ft. layer of silt and/or organics. However it may not be enough.

9. The limestone from depths of about 42' (46' at boring B-1) to 50' appears to be a good material to socket the piles in. Socketing however may require pre-drilling for timber and concrete piles. Piles, particularly the timber piles may also require preforming or pre-drilling in Miami limestone that is considered as IGM (Intermediate Geo Material).

10. The limestone in the depth ranges of about 25'± to 30'± does not appear suitable to serve as the base material for resting piles in. This layer is more likely to affect the design of timber piles.

11. Design pile groups for the minimum center to center distance between two adjacent piles not less than three-times the largest pile diameter in the group.

12. Comply with the project requirements of the City of Miami and Florida Building Code on all aspects of geotechnical design and construction.

13. Comply with the requirements in *Sections 455 of 2019 FDOT Standard Specifications for Road and Bridge Construction* as applicable. Also comply with *ASTM D25-12 (2017) Standard Specification for round timber piles* (or its later version, if any) and use *Timber Piles, Design, and Construction Manual* published by *Timber Piling Council* as a resource for timber pile construction. Address the safety concerns associated with timber use. Additional safety, health, and environmental concerns and regulatory requirements may need to be addressed.

14. Consider conducting pile load tests to assess the in-situ capacity of the piles prior to installing production piles. The piles not socketed in IGM Limestone need such testing than those are to be socketed.

5.0 REPORT LIMITATIONS

HP Consultants Inc. (HPCI) has provided its professional engineering services for the project: *Geotechnical services for the Dinner Key Marina improvements.* We have provided our findings and recommendations.

This report follows generally accepted geotechnical engineering principles and practices. HPCI is not responsible for the conclusions, opinions, or recommendations others may draw from the information in this report. No warranties are expressed, or implied. HPCI shall not be held responsible in any manner for the failure and nonperformance of proposed structures, if others change our recommendations for any reason and/or, if the failure and nonperformance are caused by structures, elements, actions and factors that are not a part of HPCI's work, or HPCI's recommendations are not properly implemented. HPCI is not responsible for the errors and omissions in the work of others that HPCI was required to use for its work. If any change(s) and variation(s) become evident during construction, or are desired during the course of this project, re-evaluation of our recommendations in this report may become necessary. HPCI should be given an opportunity to evaluate the consequences of the changes and variations.

The scope of our services did not include any environmental assessment, or investigation for the presence/absence of hazardous/toxic materials in the soil, and groundwater. Statements in this report if any, regarding odors, staining of soils, or other conditions observed, are strictly for the information of our client.

HPCI has prepared this report for the exclusive use of Moffatt & Nichol, the City of Miami, and its other subconsultants for *Dinner Key Marina improvements* identified in this report and shall not be used for any other project.

Appendix A Project location plans

Figure A-1: Site plan and general boring locations

Appendix B: Historic data

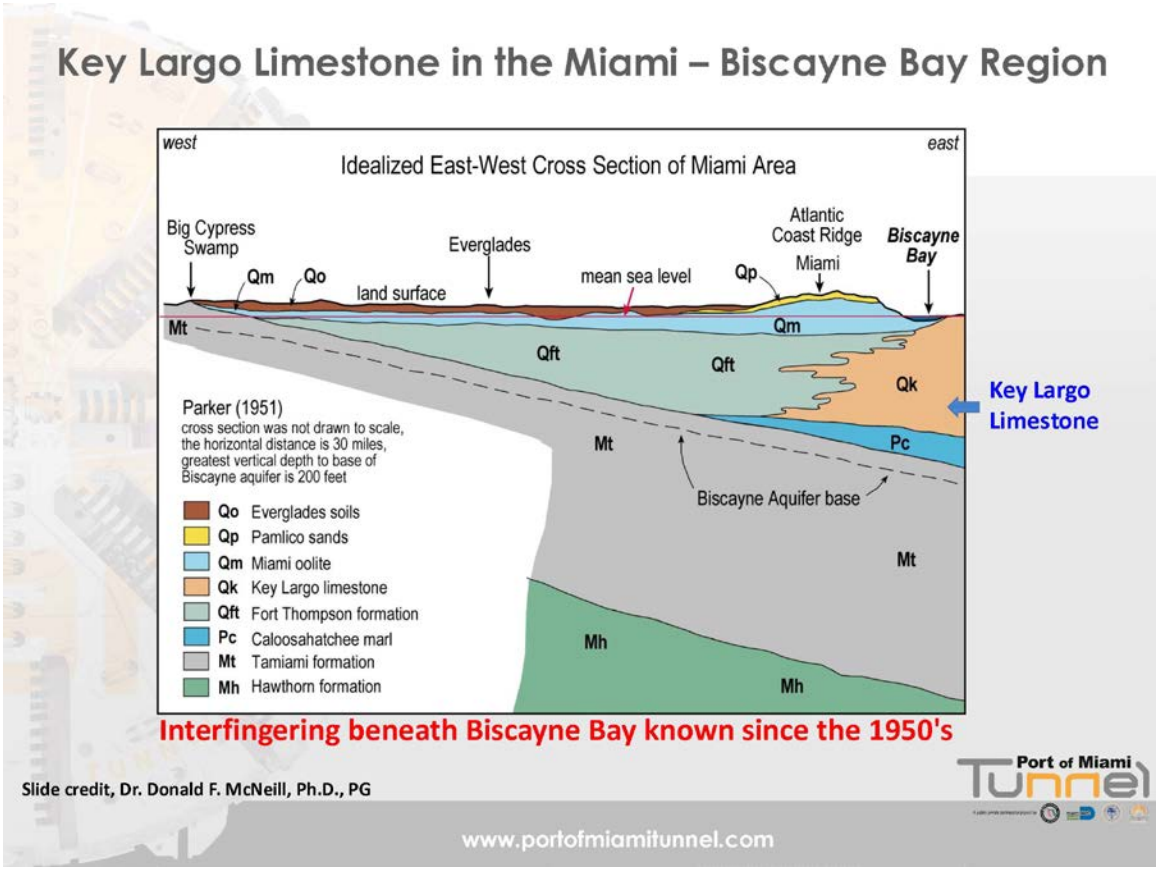


Figure B-1: Geological cross section across M-Dade County and adjacent Biscayne Bay

COASTAL SYSTEMS INTERNATIONAL, INC.
464 South Dixie Highway • Coral Gables, Florida 33146
Tel: 305-661-3655 • Fax: 305-661-1914
www.coastalsystemsint.com

LETTER OF TRANSMITTAL

COMM: 220200.06 **DATE:** May 4, 2009

TO: City of Miami
Department of Capital Improvements
444 S.W. 2nd Avenue, 8th Floor
Miami, Florida 33130
(305) 416-1206

ATTN: Mr. Carlos Vasquez

RE: **DINNER KEY MARINA (PIER 3)** **FROM:** Mr. Josiah M. Berg, P.E.

WE ARE SENDING YOU *(Via U.S. Mail):*

☒ Attached
☐ Under separate cover

☒ Plans ☐ Prints ☐ Permit Sketches ☐ Diskette
☐ Change Order ☐ Copy of Letter ☐ Specifications ☒ Other

Copies	Description
1	Pile Installation Monitoring Services

THESE ARE TRANSMITTED as checked below:

☐ For approval ☒ As requested ☐ Approved as submitted
☒ For your use ☐ Return for corrections ☐ Approved as noted
☐ For review & comment ☐ For bids due ☐ Other

REMARKS:

Should you have any questions, or require additional assistance, please do not hesitate to contact me at (305) 661-3655, ext. 260 or jmberg@coastalsystemsint.com.

Thank you,

Josiah

RECEIVED
MAY 7 2009
CAPITAL IMPROVEMENTS

File, JMB
F:\Project\220200.06\Correspondence\(09-03-09) LOT C Vasquez construction plans.doc

COASTAL SYSTEMS INTERNATIONAL, INC.
464 South Dixie Highway • Coral Gables, Florida 33146
Tel: 305-661-3655 • Fax: 305-661-1914
www.coastalsystemsint.com

220200.06

May 4, 2009

CITY OF MIAMI
Building Official

RE: PILE INSTALLATION MONITORING SERVICES FOR THE DINNER KEY MARINA PIER 3 REPAIRS PROJECT, MIAMI, FLORIDA
BUILDING PERMIT NUMBER: 09-5003543
CIP PROJECT NUMBER: B-30562

Dear Ladies and Gentlemen:

Presented herein are the results of the pile installation monitoring services provided by Coastal Systems International, Inc. (Coastal Systems) for the City of Miami (Client) for the Dinner Key Marina Pier 3 Repairs Project (Project).

A representative of Coastal Systems was on site to monitor the installation of (12) 45' long, 14" square prestressed concrete piles by Shoreline Foundation, Inc. on April 20, 21 and 22, 2009. The installation was performed with a barge-mounted crane and a APE Model D19-42 Single Action Diesel Hammer operating on Pump Setting 3. Piles were driven to or beyond their required tip elevation in accordance with the Project Construction Drawings and Specifications. Refer to the enclosed Figure 1 for the pile layout and referencing plan.

The following list of Attachments is included in this document:

- Attachment 1 –Pile Layout and Referencing System
- Attachment 2 - Pile Driving Logs
- Attachment 3 - Pile Hammer Data

The minimum required axial pile capacity of 25 tons was attained based on the ENR formula (refer to Attachment 3). This corresponds to a minimum blow count of 9 blows/foot on Pump Setting 3. Pile B3 had an approximate axial capacity of 13.6 tons, which was below the design requirements. However, the structural calculations were reviewed and the pier should perform to the design conditions despite this reduced capacity.

Should you have any questions or require additional assistance, please feel free to contact me at 305-661-3655.

Sincerely,
COASTAL SYSTEMS INTERNATIONAL, INC.
FL EB # 9087

Timothy K. Blankenship, P.E.
Director of Engineering
FL 55910

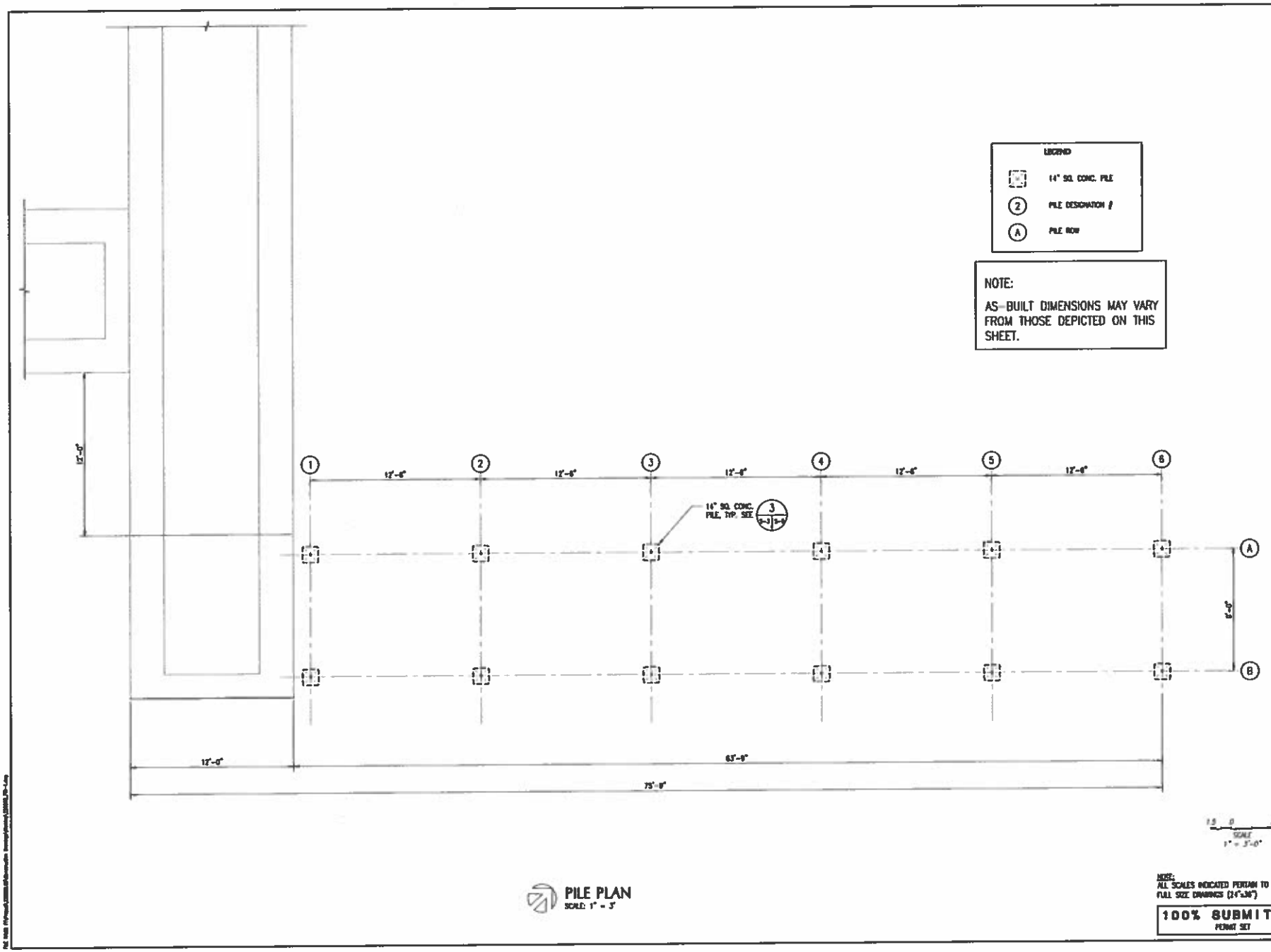
cc: Carlos Vasquez, City of Miami, CIP
Carlos Varela, Shoreline Foundation

TKB:mr

Enclosures

Cc: File, TKB, JMB, CM
F:\Project\220200.06\Correspondence\(09-05-04) LTR Building Dept pile installation monitoring services.doc

Attachment 1 - Pile Layout and Referencing System



COASTAL SYSTEMS INTERNATIONAL, INC
Coastal, Environmental, Civil Engineering and Management

THE CITY OF MIAMI DEPARTMENT OF CAPITAL IMPROVEMENTS

FIGURE 1
PILE LAYOUT & REFERENCE SYSTEMS

ATT-1

COASTAL SYSTEMS INTERNATIONAL

PILE DRIVING RECORD

Project: Dinner Key Marina
Location: Pier 3
Hammer: APE D19-42
Contractor: SFI
Engineer: CM
Coastal Job No: 220200.06

Pile 1 Location B2
Date 04/21/09 Pile Type 14"sq Conc.
Start/End 0750/0755 Tip EL. -39'

DEPTH	TIP ELEVATION	BLOWS	DEPTH	TIP ELEVATION	BLOWS	COMMENTS
1	-13.5	3/4	17	-29.5	15	Start Hammer Setting 1
2	-14.5	10	18	-30.5	12	Hammer Setting 2 @ El. -18'
3	-15.5	8	19	-31.5	15	Hammer Setting 3 @ El. 34'
4	-16.5	8	20	-32.5	10	
5	-17.5	5	21	-33.5	12	
6	-18.5	4	22	-34.5	25	
7	-19.5	2	23	-35.5	25	
8	-20.5	3	24	-36.5	22	
9	-21.5	5	25	-37.5	16	
10	-22.5	9	26	-38.5	15	
11	-23.5	11	27	-39	11/6	
12	-24.5	9				
13	-25.5	10				
14	-26.5	10				
15	-27.5	10				
16	-28.5	10				

ELEVATION REF: +5.19' (Top of Main Pier)
SKETCH/REMARKS: -10' (Approx. Dredge Elevation)
~3' Prepunch depth

Pile 2 Location B3
Date 04/21/09 Pile Type 14"sq Conc.
Start/End 0820/0825 Tip EL. -39'

DEPTH	TIP ELEVATION	BLOWS	DEPTH	TIP ELEVATION	BLOWS	Comments
1	-13.5	2/9	17	-29.5	13	Hammer Setting 3
2	-14.5	6	18	-30.5	13	
3	-15.5	11	19	-31.5	10	
4	-16.5	10	20	-32.5	10	
5	-17.5	8	21	-33.5	6	
6	-18.5	7	22	-34.5	12	
7	-19.5	8	23	-35.5	17	
8	-20.5	11	24	-36.5	13	
9	-21.5	15	25	-37.5	10	
10	-22.5	17	26	-38.5	6	
11	-23.5	16	27	-39	3	
12	-24.5	16				
13	-25.5	18				
14	-26.5	14				
15	-27.5	14				
16	-28.5	13				

ELEVATION REF: +5.19' (Top of Main Pier)
SKETCH/REMARKS: -10' (Approx. Dredge Elevation)
~3' Prepunch depth

COASTAL SYSTEMS INTERNATIONAL

PILE DRIVING RECORD

Project: Dinner Key Marina
Location: Pier 3
Hammer: APE D19-42
Contractor: SFI
Engineer: CM
Coastal Job No: 220200.06

Pile	3	Location	B4
Date	04/21/09	Pile Type	14"sq Conc.
Start/End	0830/0835	Tip EL.	-35.5'

DEPTH	TIP ELEVATION	BLOWS	DEPTH	TIP ELEVATION	BLOWS	COMMENTS
1	-13.5	2/9	17	-29.5	14	Hammer Setting 3
2	-14.5	4	18	-30.5	13	
3	-15.5	8	19	-31.5	16	
4	-16.5	7	20	-32.5	19	
5	-17.5	6	21	-33.5	18	
6	-18.5	5	22	-34.5	20	
7	-19.5	5	23	-35.5	21	
8	-20.5	1				
9	-21.5	3				
10	-22.5	5				
11	-23.5	17				
12	-24.5	12				
13	-25.5	10				
14	-26.5	18				
15	-27.5	15				
16	-28.5	14				

ELEVATION REF: +5.19' (Top of Main Pier)
SKETCH/REMARKS: -10' (Approx. Dredge Elevation)
~3' Prepunch depth

Pile	4	Location	A4
Date	04/21/09	Pile Type	14"sq Conc.
Start/End	0840/0845	Tip EL.	-35.5'

DEPTH	TIP ELEVATION	BLOWS	DEPTH	TIP ELEVATION	BLOWS	Comments
1	-13.5	2/6	17	-29.5	17	Hammer Setting 3
2	-14.5	9	18	-30.5	19	
3	-15.5	10	19	-31.5	17	
4	-16.5	8	20	-32.5	20	
5	-17.5	7	21	-33.5	20	
6	-18.5	5	22	-34.5	17	
7	-19.5	4	23	-35.5	17	
8	-20.5	3				
9	-21.5	5				
10	-22.5	11				
11	-23.5	15				
12	-24.5	17				
13	-25.5	16				
14	-26.5	19				
15	-27.5	14				
16	-28.5	14				

ELEVATION REF: +5.19' (Top of Main Pier)
SKETCH/REMARKS: -10' (Approx. Dredge Elevation)
~3' Prepunch depth

COASTAL SYSTEMS INTERNATIONAL

PILE DRIVING RECORD

Project: Dinner Key Marina
Location: Pier 3
Hammer: APE D19-42
Contractor: SFI
Engineer: CM
Coastal Job No: 220200.06

Pile	5	Location	B4
Date	04/21/09	Pile Type	14"sq Conc.
Start/End	0850/0855	Tip EL.	-35.5'

Pile	6	Location	A4
Date	04/21/09	Pile Type	14"sq Conc.
Start/End	0900/0905	Tip EL.	-35.5'

DEPTH	TIP ELEVATION	BLOWS	DEPTH	TIP ELEVATION	BLOWS	COMMENTS
1	-13.5	-	17	-29.5	14	Hammer Setting 3
2	-14.5	10	18	-30.5	16	
3	-15.5	11	19	-31.5	17	
4	-16.5	10	20	-32.5	17	
5	-17.5	8	21	-33.5	19	
6	-18.5	7	22	-34.5	20	
7	-19.5	5	23	-35.5	19	
8	-20.5	4				
9	-21.5	5				
10	-22.5	7				
11	-23.5	10				
12	-24.5	13				
13	-25.5	13				
14	-26.5	13				
15	-27.5	14				
16	-28.5	14				

DEPTH	TIP ELEVATION	BLOWS	DEPTH	TIP ELEVATION	BLOWS	Comments
1	-13.5	2/6	17	-29.5	16	Hammer Setting 3
2	-14.5	9	18	-30.5	13	
3	-15.5	10	19	-31.5	13	
4	-16.5	10	20	-32.5	9	
5	-17.5	8	21	-33.5	18	
6	-18.5	5	22	-34.5	26	
7	-19.5	6	23	-35.5	35	
8	-20.5	6				
9	-21.5	9				
10	-22.5	14				
11	-23.5	16				
12	-24.5	15				
13	-25.5	13				
14	-26.5	12				
15	-27.5	13				
16	-28.5	15				

ELEVATION REF: +5.19' (Top of Main Pier)
SKETCH/REMARKS: -10' (Approx. Dredge Elevation)
~3' Prepunch depth

ELEVATION REF: +5.19' (Top of Main Pier)
SKETCH/REMARKS: -10' (Approx. Dredge Elevation)
~3' Prepunch depth

COASTAL SYSTEMS INTERNATIONAL

PILE DRIVING RECORD

Project: Dinner Key Marina
Contractor: SFI
Location: Pier 3
Engineer: CM
Hammer: APE D19-42
Coastal Job No: 220200.06

Pile	7	Location	B1
Date	04/21/09	Pile Type	14"sq Conc.
Start/End	1025/1030	Tip EL.	-35.5'

DEPTH	TIP ELEVATION	BLOWS	DEPTH	TIP ELEVATION	BLOWS	COMMENTS
1	-13.5	-	17	-29.5	14	Hammer Setting 3
2	-14.5	-	18	-30.5	14	
3	-15.5	-	19	-31.5	12	
4	-16.5	2/9	20	-32.5	12	
5	-17.5	5	21	-33.5	11	
6	-18.5	8	22	-34.5	11	
7	-19.5	9	23	-35.5	15	
8	-20.5	8				
9	-21.5	11				
10	-22.5	12				
11	-23.5	16				
12	-24.5	20				
13	-25.5	23				
14	-26.5	19				
15	-27.5	21				
16	-28.5	17				

ELEVATION REF: +5.19' (Top of Main Pier)
SKETCH/REMARKS: -10' (Approx. Dredge Elevation)
1 Set in preexisting hole

Pile	8	Location	A1
Date	04/21/09	Pile Type	14"sq Conc.
Start/End	1030/1040	Tip EL.	-35.5'

DEPTH	TIP ELEVATION	BLOWS	DEPTH	TIP ELEVATION	BLOWS	Comments
1	-13.5	-	17	-29.5	19	Hammer Setting 3
2	-14.5	-	18	-30.5	25	
3	-15.5	-	19	-31.5	25	
4	-16.5	-	20	-32.5	25	
5	-17.5	2/10	21	-33.5	20	
6	-18.5	5	22	-34.5	21	
7	-19.5	8	23	-35.5	24	
8	-20.5	8				
9	-21.5	8				
10	-22.5	7				
11	-23.5	8				
12	-24.5	9				
13	-25.5	10				
14	-26.5	11				
15	-27.5	14				
16	-28.5	16				

ELEVATION REF: +5.19' (Top of Main Pier)
SKETCH/REMARKS: -10' (Approx. Dredge Elevation)
Set in preexisting hole

COASTAL SYSTEMS INTERNATIONAL

PILE DRIVING RECORD

Project: Dinner Key Marina
Location: Pier 3
Hammer: APE D19-42
Contractor: SFI
Engineer: CM
Coastal Job No: 220200.06

Pile	9	Location	B5
Date	04/22/09	Pile Type	14"sq Conc.
Start/End	0750/0755	Tip EL.	-34.5'

DEPTH	TIP ELEVATION	BLOWS	DEPTH	TIP ELEVATION	BLOWS	COMMENTS
1	-13.5	-	17	-29.5	10	Hammer Setting 3
2	-14.5	2/9	18	-30.5	11	
3	-15.5	7	19	-31.5	21	
4	-16.5	8	20	-32.5	13	
5	-17.5	6	21	-33.5	15	
6	-18.5	5	22	-34.5	14	
7	-19.5	3				
8	-20.5	4				
9	-21.5	3				
10	-22.5	4				
11	-23.5	7				
12	-24.5	7				
13	-25.5	6				
14	-26.5	6				
15	-27.5	6				
16	-28.5	8				

ELEVATION REF: +5.19' (Top of Main Pier)
SKETCH/REMARKS: -11' (Approx. Dredge Elevation)
~3' Prepunch depth

Pile	10	Location	A5
Date	04/22/09	Pile Type	14"sq Conc.
Start/End	0800/0805	Tip EL.	-33.5'

DEPTH	TIP ELEVATION	BLOWS	DEPTH	TIP ELEVATION	BLOWS	Comments
1	-13.5	-	17	-29.5	11	Hammer Setting 3
2	-14.5	-	18	-30.5	14	
3	-15.5	1/6	19	-31.5	11	
4	-16.5	7	20	-32.5	14	
5	-17.5	7	21	-33.5	15	
6	-18.5	6				
7	-19.5	4				
8	-20.5	2				
9	-21.5	2				
10	-22.5	6				
11	-23.5	8				
12	-24.5	9				
13	-25.5	8				
14	-26.5	9				
15	-27.5	9				
16	-28.5	11				

ELEVATION REF: +5.19' (Top of Main Pier)
SKETCH/REMARKS: -11' (Approx. Dredge Elevation)
~3' Prepunch depth

COASTAL SYSTEMS INTERNATIONAL

PILE DRIVING RECORD

Project: Dinner Key Marina
Location: Pier 3
Hammer: APE D19-42
Contractor: SFI
Engineer: CM
Coastal Job No: 220200.06

Pile	11	Location	B5
Date	04/22/09	Pile Type	14"sq Conc.
Start/End	0810/0815	Tip EL.	-32.5'

DEPTH	TIP ELEVATION	BLOWS	DEPTH	TIP ELEVATION	BLOWS	COMMENTS
1	-13.5	-	17	-29.5	20	Hammer Setting 3
2	-14.5	-	18	-30.5	19	
3	-15.5	-	19	-31.5	15	
4	-16.5	-	20	-32.5	13	
5	-17.5	-				
6	-18.5	5				
7	-19.5	4				
8	-20.5	4				
9	-21.5	4				
10	-22.5	7				
11	-23.5	11				
12	-24.5	11				
13	-25.5	13				
14	-26.5	17				
15	-27.5	20				
16	-28.5	20				

ELEVATION REF: +5.19' (Top of Main Pier)
SKETCH/REMARKS: -11' (Approx. Dredge Elevation)
~3' Prepunch depth

Pile	12	Location	A5
Date	04/22/09	Pile Type	14"sq Conc.
Start/End	0820/0825	Tip EL.	-33.5'

DEPTH	TIP ELEVATION	BLOWS	DEPTH	TIP ELEVATION	BLOWS	Comments
1	-13.5	-	17	-29.5	13	Hammer Setting 3
2	-14.5	-	18	-30.5	13	
3	-15.5	4/6	19	-31.5	13	
4	-16.5	7	20	-32.5	12	
5	-17.5	8	21	-33.5	16	
6	-18.5	8				
7	-19.5	8				
8	-20.5	5				
9	-21.5	8				
10	-22.5	11				
11	-23.5	11				
12	-24.5	15				
13	-25.5	16				
14	-26.5	15				
15	-27.5	13				
16	-28.5	11				

ELEVATION REF: +5.19' (Top of Main Pier)
SKETCH/REMARKS: -11' (Approx. Dredge Elevation)
~3' Prepunch depth

No picture available

Model D19-42 Diesel Hammer

Maximum obtainable energy	51,770 ft-lbs
Maximum obtainable stroke	148.3 inches
Pump setting 1: (minimum)	20,540 ft-lbs
Pump setting 2:	
Pump setting 3:	
Pump setting 4: (maximum)	42,598 ft-lbs
**Optional variable throttle gives infinite stroke control.	
Stroke at rated energy	10 ft 2 in
Energy at rated stroke	47,300 ft-lbs
Speed	37-53 bpm
Ram	4,190 lbs
Anvil	754 lbs
Hammer weight (includes trip device)	9,259 lbs
Typical operating (weight with drive cap)	11,344 lbs
Weight	900 lbs
Diameter	22.5 inches
Thickness	6 inches
Type	Monocast MC 901
Diameter	22.5 inches
Thickness	2 inches
Elastic-modulus	285 kips per square inch
Coeff. of restrituion	0.8
Weight (fits 8 by 26 inch leads)	1,350 lbs
Square box inserts size 10" through 20"	aprox. 1,400 lbs
Pipe inserts for pipe size 12" to 24" diameter	Consult factory
Fuel tank (runs on diesel or bio -diesel)	8.5 gal
Oil tank	2.4 gal
Diesel or Bio-diesel fuel	1.5 gal/hr
Lubrication	.26 gal/hr
**Grease once per 45 minutes of driving time	
Length overall	186.2 inches
Length over cylinder extension	219.3 inches
Impact block diameter	17.3 inches
Hammer width overall	19 inches
Minimum clearance for leads	14.2 inches
Standard lead size	8 X 26 inch
Hammer guiding for FEC ST-75 & ST-100 available	Consult factory

COASTAL SYSTEMS INTERNATIONAL, INC.

APPROVAL OF THIS SUBMITTAL IS SUBJECT TO THE PROVISIONS OF THE CONTRACT DRAWINGS AND SPECIFICATIONS THIS ACTION IS FOR GENERAL CONCURRENCE ONLY AND THE ENGINEER IS NOT RESPONSIBLE FOR ERRORS OR OMISSIONS.

- [x] APPROVED
- [ ] APPROVED WITH NOTATIONS INDICATED RESUBMITTAL NOT REQUIRED
- [ ] APPROVED WITH NOTATIONS INDICATED RESUBMIT WITH CORRECTIONS
- [ ] DISAPPROVED, RESUBMIT

[signature] 04/20/09

SUBMITTAL REVIEWED BY — DATE

SHORELINE FOUNDATION, INC. PROJECTS: M-08-352

OWNER: City of Miami

OWNER PROJECT #: B30325

DATE: 04-17-09

SPEC. DIV. #:

DRAWING #:

SUBMITTAL #: 10

PARA #:

REVIEWED BY:

BY:

APPROVED [ ]

APPROVED AS NOTED [ ]

REVISE AND RESUBMIT [ ]

COMPANY:

DATE:

APE MODEL D19-42 SINGLE ACTION DIESEL HAMMER

PILE LOAD IN TONS	PUMP SETTING 1 (blows/foot)	PUMP SETTING 2 (blows/foot)	PUMP SETTING 3 (blows/foot)	PUMP SETTING 4 (blows/foot)
15	10	7	5	5
20	13	9	7	6
25	17	12	9	8
30	21	15	11	10
35	25	17	13	11
40	30	20	15	13
45	34	23	17	15
50	39	26	19	16

PUMP SETTING 1 =	20540	ft-lbs
PUMP SETTING 2 =	28680	ft-lbs
PUMP SETTING 3 =	37665	ft-lbs
PUMP SETTING 4 =	42800	ft-lbs

$s = (2E / P) - 0.1$

P: Safe bearing load developed by the pile in pounds
E: Manufacturer's rating of energy developed by the hammer in foot-pounds
s: Penetration of the pile into the ground per blow in inches taken as the average over the last 10 blows. Penetration shall be measured at a time when there is no appreciable rebound of the hammer and the preceding blow was struck upon a sound pile head or driving block.

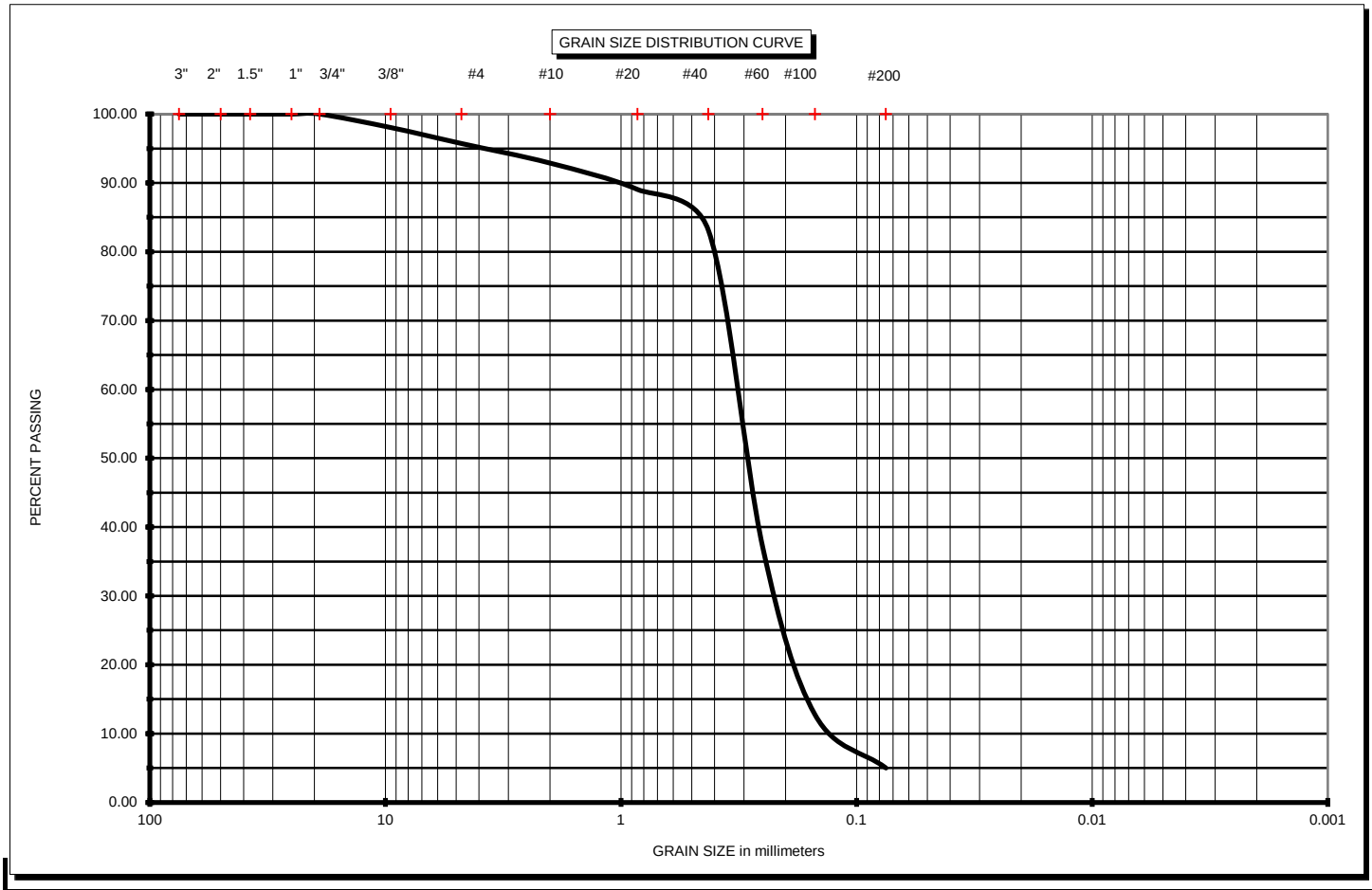
blows/foot = (12in/ft)/(s)

Appendix C Laboratory test results

GRAIN SIZE DISTRIBUTION

PROJECT NAME: Geotechnical services for the Dinner Key Marina improvements: Geotechnical Data Report

Boring no. **B-1**
Sample no. **3,4,5** **DATE:** 5-Dec-18
Depth interval (ft.) 4.0'-10.0'
CLIENT: Moffatt & Nichol
PROJECT #: GE-M&N-CityMia-18-01

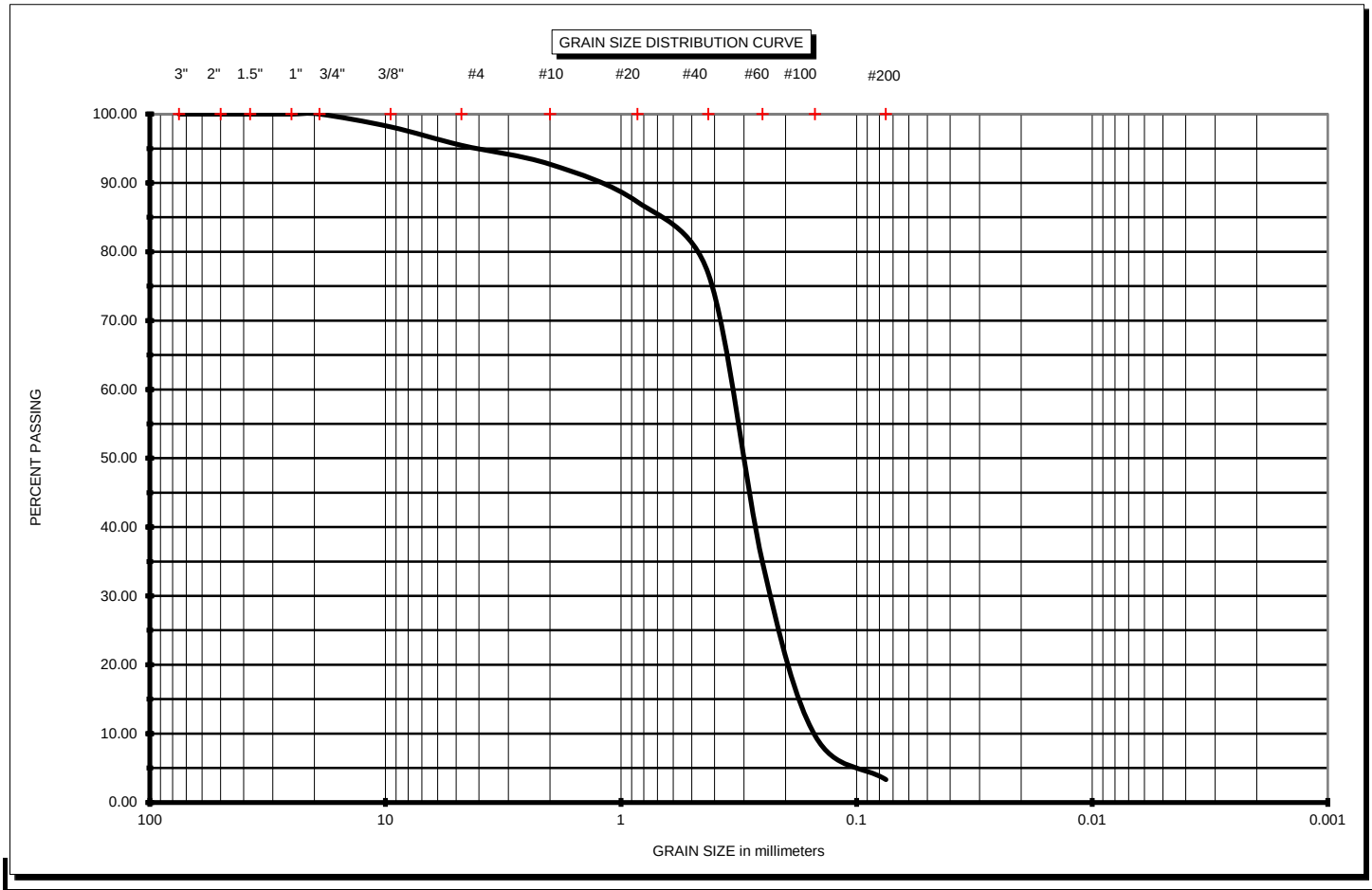


ASTM D 2487 Classification of Soil for Engineering Purposes			**Coarse Sand %**	**< #4 and > #10**	**2.84**	**Cu = D60 / D10**
Coarse Gravel %	**< 3" and > 3/4"**	**0.00**	**Medium Sand %**	**< #10 and > #40**	**9.79**	2.58
Fine Gravel %	**<3/4" and >#4**	**4.28**	**Fine Sand %**	**< #40 and > #200**	**78.09**	Cc = (D30)^2 / (D10 x D60)
	D 10 (mm) =	**0.12**	**Silt and clay %**	**<#200**	**5.00**	1.19
	D 60 (mm)=	**0.31**	**D 30 (mm)=**	**0.21**		
Soil class and description	Poorly graded(fine) sand (SP)					

GRAIN SIZE DISTRIBUTION

PROJECT NAME: Geotechnical services for the Dinner Key Marina improvements: Geotechnical Data Report

Boring no. **B-2**
Sample no. **3,4** **DATE:** 5-Dec-18
Depth interval (ft.) 4.0'-8.0'
CLIENT: Moffatt & Nichol
PROJECT #: GE-M&N-CityMia-18-01

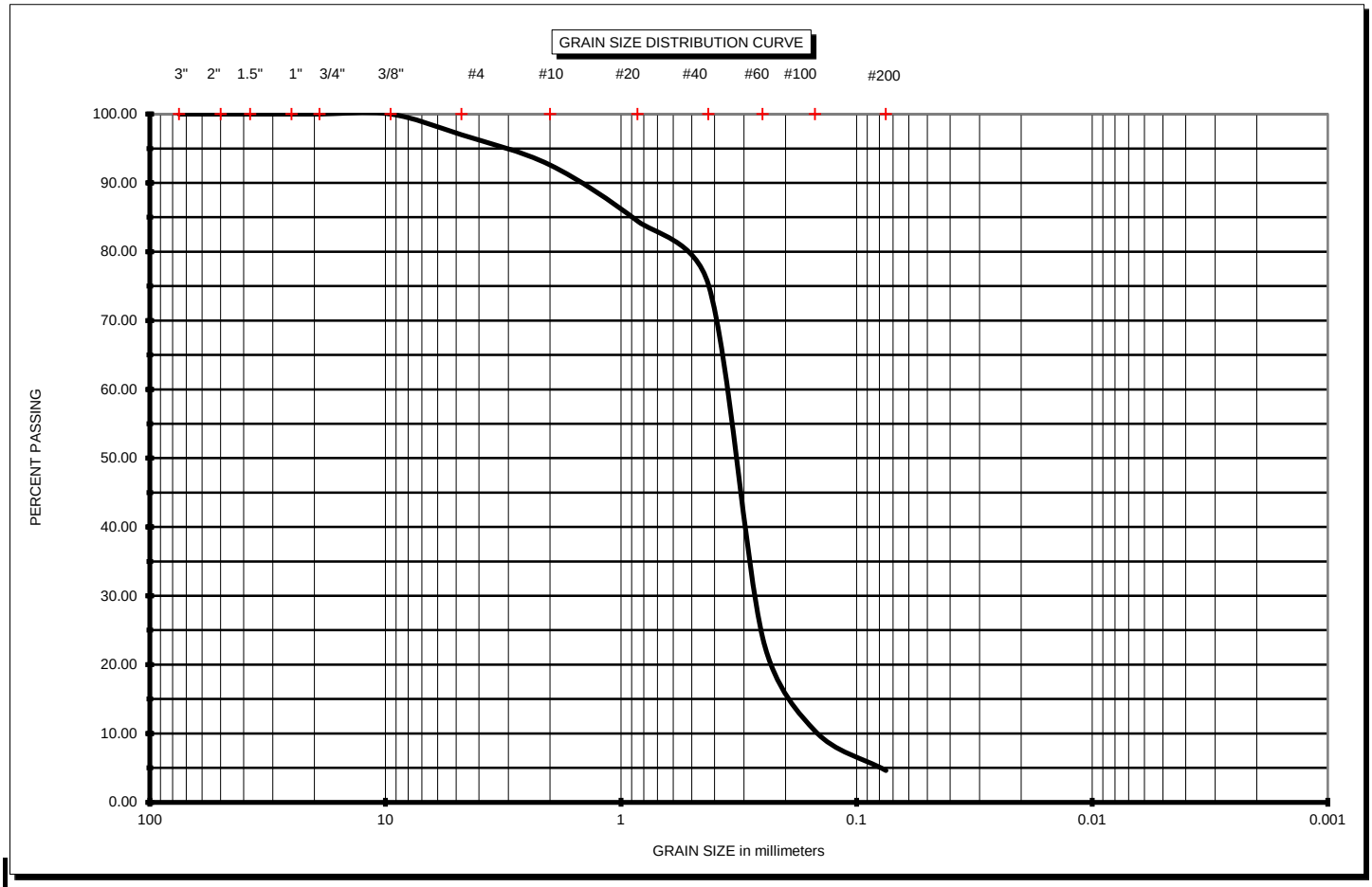


ASTM D 2487 Classification of Soil for Engineering Purposes			**Coarse Sand %**	**< #4 and > #10**	**2.75**	**Cu = D60 / D10**
Coarse Gravel %	**< 3" and > 3/4"**	**0.00**	**Medium Sand %**	**< #10 and > #40**	**15.97**	2.07
Fine Gravel %	**<3/4" and >#4**	**4.54**	**Fine Sand %**	**< #40 and > #200**	**73.43**	Cc = (D30)^2 / (D10 x D60)
	D 10 (mm) =	**0.15**	**Silt and clay %**	**<#200**	**3.31**	0.95
	D 60 (mm)=	**0.31**	**D 30 (mm)=**	**0.21**		
Soil class and description	Poorly graded(fine) sand (SP)					

GRAIN SIZE DISTRIBUTION

PROJECT NAME: Geotechnical services for the Dinner Key Marina improvements: Geotechnical Data Report

Boring no. **B-3**
Sample no. **6** **DATE:** 5-Dec-18
Depth interval (ft.) 13.0'-15.0'
CLIENT: Moffatt & Nichol
PROJECT #: GE-M&N-CityMia-18-01

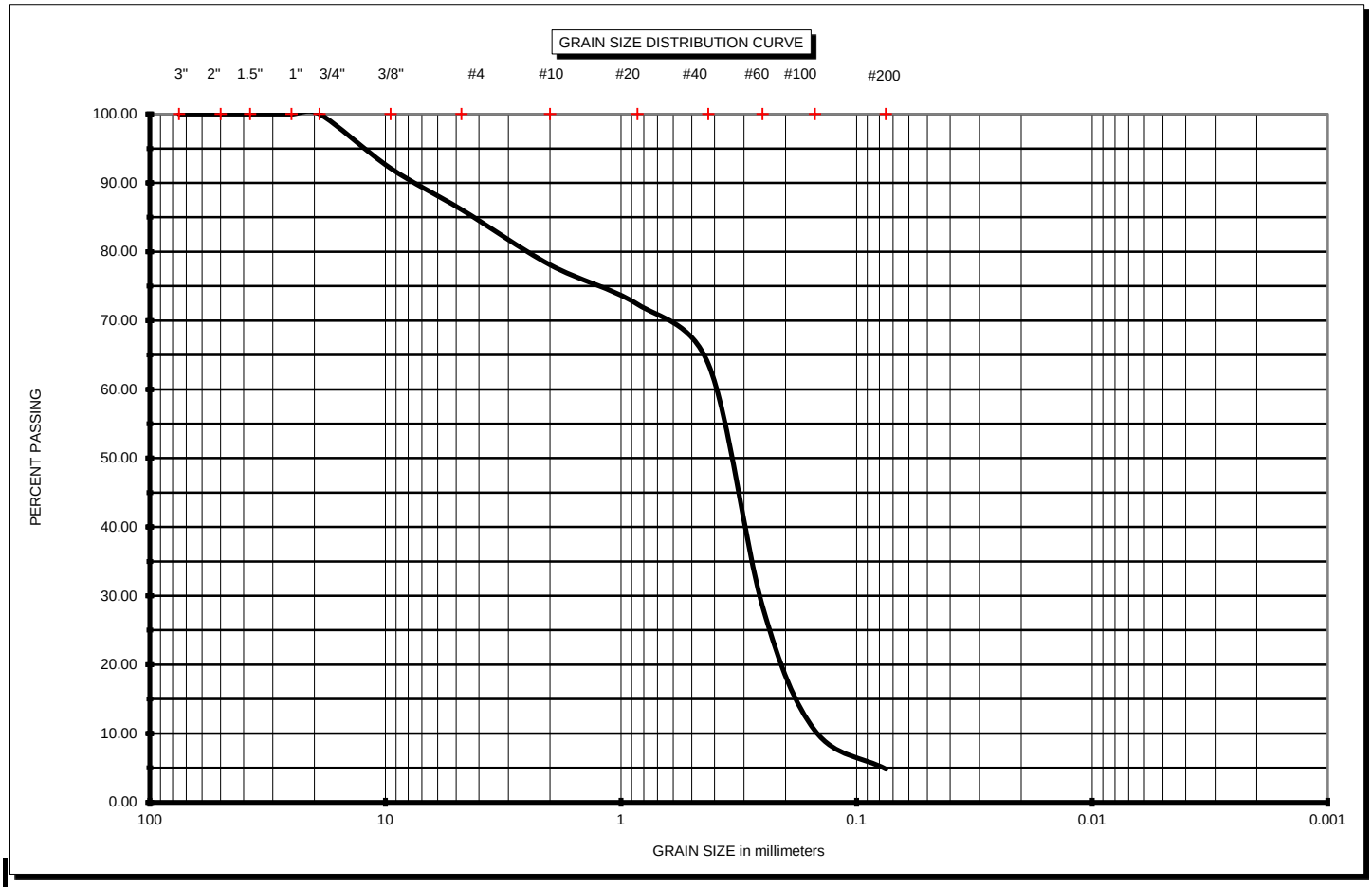


ASTM D 2487 Classification of Soil for Engineering Purposes			**Coarse Sand %**	**< #4 and > #10**	**4.39**	**Cu = D60 / D10**
Coarse Gravel %	**< 3" and > 3/4"**	**0.00**	**Medium Sand %**	**< #10 and > #40**	**17.42**	2.43
Fine Gravel %	**<3/4" and >#4**	**3.01**	**Fine Sand %**	**< #40 and > #200**	**70.57**	Cc = (D30)^2 / (D10 x D60)
	D 10 (mm) =	**0.14**	**Silt and clay %**	**<#200**	**4.61**	1.53
	D 60 (mm)=	**0.34**	**D 30 (mm)=**	**0.27**		
Soil class and description	Poorly graded(fine) sand (SP)					

GRAIN SIZE DISTRIBUTION

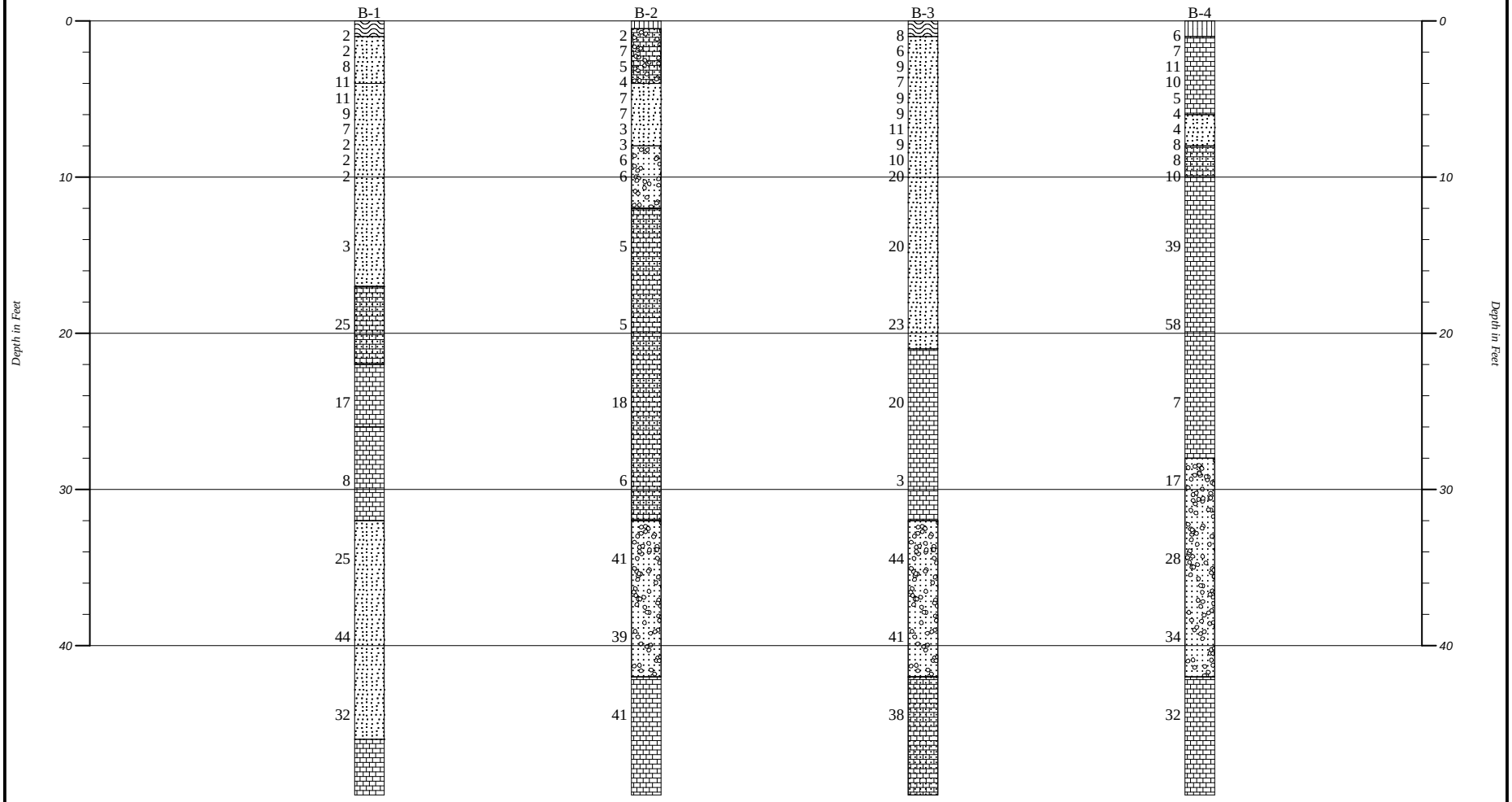
PROJECT NAME: Geotechnical services for the Dinner Key Marina improvements: Geotechnical Data Report

Boring no. **B-4**
Sample no. **4** **DATE:** 5-Dec-18
Depth interval (ft.) 6.0'-8.0'
CLIENT: Moffatt & Nichol
PROJECT #: GE-M&N-CityMia-18-01



ASTM D 2487 Classification of Soil for Engineering Purposes			**Coarse Sand %**	**< #4 and > #10**	**8.03**	**Cu = D60 / D10**
Coarse Gravel %	**< 3" and > 3/4"**	**0.00**	**Medium Sand %**	**< #10 and > #40**	**14.46**	2.79
Fine Gravel %	**<3/4" and >#4**	**13.88**	**Fine Sand %**	**< #40 and > #200**	**58.82**	Cc = (D30)^2 / (D10 x D60)
	D 10 (mm) =	**0.14**	**Silt and clay %**	**<#200**	**4.81**	1.24
	D 60 (mm)=	**0.39**	**D 30 (mm)=**	**0.26**		
Soil class and description	Poorly graded(fine) sand (SP)					

Appendix D Subsurface profile and SPT borelogs



Plan View

Strata symbols

- Low plasticity organic silts (OL)
- Poorly graded sand (SP)
- Limestone with sand
- Limestone
- Silt (ML)
- Weathered limestone
- Sand with limestone fragments

NOTE: WATER LEVEL ABOUT 10' ABOVE 0.0 (GL), REFER BORE LOGS FOR THE N VALUES OVER 48'-50'

HP Consultants Inc.

GENERALIZED SOIL PROFILE

HORIZONTAL SCALE:	DRAWN BY/APPROVED BY	DATE DRAWN
VERTICAL SCALE: 1"=10'	SK/AK	12/6/2018

Geo services for Dinner Key Marina improvements

PROJECT NO. GE-M&N-CityMia-18-01

FIGURE NUMBER

HP Consultants Inc. • Civil • Transportation • Geotechnical • Forensic • Accident Reconstruction

LOG OF BORING — BORING NO. B-1

PROJECT: Geo services for Dinner Key Marina improvements
PROJECT LOCATION: 3400 Pan American Dr., Mia, FL
CLIENT: Moffatt & Nichol
PROJECT NO.: GE-M&N-CityMia-18-01

DRILLING METHOD: Rotary mud drilling, CME-45,
LOGGED BY: LT
DRILLING DATE: 11/26/2018
GROUND ELEVATION: 0.0 @ GL
COMPLETION DEPTH: 50'
DEPTH TO WATER: -10.0'

Depth (meters)	Depth (feet)	Material Description	Blows per Ft.
		Low plasticity organic silt : Dark gray to black, very loose, silt and clay mixed w/ organics (OL)	2
			2
			8
1.6		Fine sand: Light gray, very loose to medium dense poorly graded sand (SP)	11
			11
	8		9
			7
			2
3.2		Fine sand : Light brown to light grayish brown, medium dense to very loose, poorly graded sand with a trace of silt (SP)	2
			2
			3
4.8	16		
6.4		Limestone with sand: Light gray to dark gray limestone fragments w/some sand	25
	24	Limestone: Light gray, limestone fragments	17
8			
		Limestone: Light yellowish gray limestone fragments	8
9.6	32		
			25
11.2		Fine sand: Light gray poorly graded sand with a few limestone fragments (SP) that increase in % over depth	
	40		44
12.8			
			32
14.4	48	Limestone: Yellowish light gray/brown limestone fragments	
		EOB	49
16			

Standard Penetration Test (ASTM D 1586) — • - N value — 10 20 30 40 50 60

Comments

This information pertains only to this boring and should not be interpreted as being indicative of the site

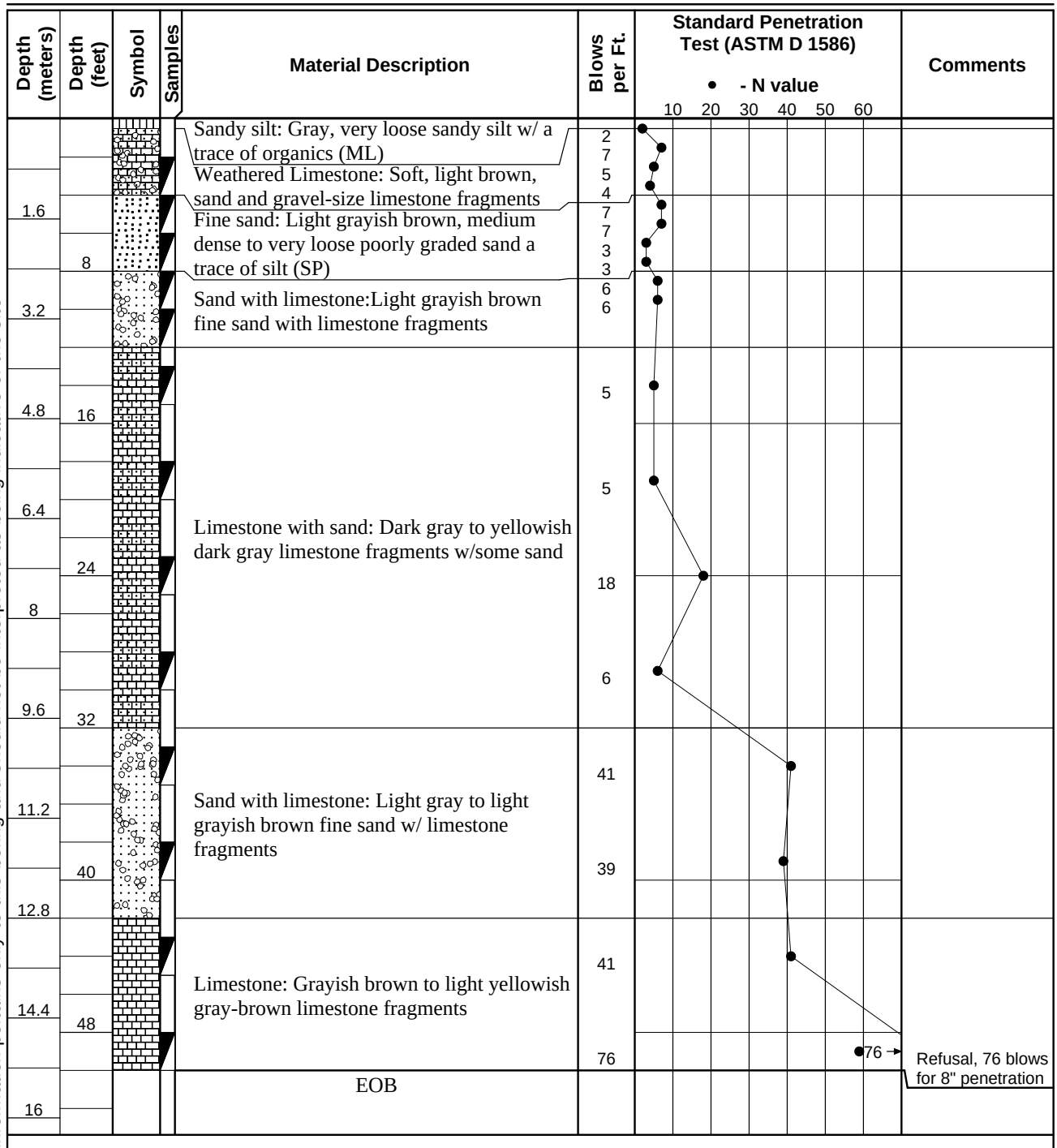
Gravel, sand, silt & clay sizes per ASTM. Samples were always wet. GL at about 10' below Water level

HP Consultants Inc. • Civil • Transportation • Geotechnical • Forensic • Accident Reconstruction

LOG OF BORING — BORING NO. B-2

PROJECT: Geo services for Dinner Key Marina improvements
PROJECT LOCATION: 3400 Pan American Dr., Mia, FL
CLIENT: Moffatt & Nichol
PROJECT NO.: GE-M&N-CityMia-18-01

DRILLING METHOD: Rotary mud drilling, CME-45,
LOGGED BY: LT
DRILLING DATE: 11/27/2018
GROUND ELEVATION: 0.0 @ GL
COMPLETION DEPTH: 50'
DEPTH TO WATER: -10.0'



This information pertains only to this boring and should not be interpreted as being indicative of the site

Gravel, sand, silt & clay sizes per ASTM. Samples were always wet. GL at about 10' below Water level

HP Consultants Inc. • Civil • Transportation • Geotechnical • Forensic • Accident Reconstruction

LOG OF BORING — BORING NO. B-3

PROJECT: Geo services for Dinner Key Marina improvements
PROJECT LOCATION: 3400 Pan American Dr., Mia, FL
CLIENT: Moffatt & Nichol
PROJECT NO.: GE-M&N-CityMia-18-01

DRILLING METHOD: Rotary mud drilling, CME-45,
LOGGED BY: LT
DRILLING DATE: 11/27/2018
GROUND ELEVATION: 0.0 @ GL
COMPLETION DEPTH: 50'
DEPTH TO WATER: -10.0'

Depth (meters)	Depth (feet)	Material Description	Blows per Ft.	Comments
		Low plasticity organic silt : Dark gray to black, medium dense, silt and clay mixed w/ organics (OL)	8	
			6	
			9	
1.6			7	
			9	
	8		9	
			11	
			9	
			10	
3.2		Fine sand: Light gray to light grayish brown, loose to medium dense poorly graded sand (SP)	20	
4.8	16		20	
6.4			23	
	24	Limestone: Dark gray and light brown limestone fragments	20	
8				
9.6	32		3	
		Sand with limestone: Light gray fine sand w/ limestone fragments increasing in % with depth	44	Refusal in the last 6" Two in. penetrations for 50 blows
11.2				
	40		41	
12.8				
		Limestone with sand: Light brown limestone fragments with sand	38	
14.4	48		29	Refusal in the last 6" Four in. penetrations for 50 blows
		EOB		
16				

Standard Penetration Test (ASTM D 1586) • - N value
10 20 30 40 50 60

This information pertains only to this boring and should not be interpreted as being indicative of the site

Gravel, sand, silt & clay sizes per ASTM. Samples were always wet. GL at about 10' below Water level

HP Consultants Inc. • Civil • Transportation • Geotechnical • Forensic • Accident Reconstruction

LOG OF BORING — BORING NO. B-4

PROJECT: Geo services for Dinner Key Marina improvements
PROJECT LOCATION: 3400 Pan American Dr., Mia, FL
CLIENT: Moffatt & Nichol
PROJECT NO.: GE-M&N-CityMia-18-01

DRILLING METHOD: Rotary mud drilling, CME-45,
LOGGED BY: LT
DRILLING DATE: 11/27/2018
GROUND ELEVATION: 0.0 @ GL
COMPLETION DEPTH: 50'
DEPTH TO WATER: -10.0'

Depth (meters)	Depth (feet)	Material Description	Blows per Ft.	Comments
		Sandy silt: Dark gray, medium dense sandy silt w/ some organics (ML)	6	
			7	
		Limestone: Light grayish brown limestone fragments	11	
			10	
1.6			5	
			4	
	8	Fine sand: Light brown, loose to medium dense poorly graded sand (SP)	4	
			8	
		Limestone with sand: Light brown limestone fragments with sand	8	
3.2			10	
4.8	16		39	
		Limestone: Light grayish brown limestone fragments		Refusal in the last 6" Four in. penetration for 50 blows
6.4			58	
	24			
8			7	
			17	
9.6	32			
		Sand with limestone: Light yellowish brown fine sand w/ limestone fragments	28	Refusal in the last 6" Four in. penetration for 50 blows
11.2				
	40		34	
12.8				
			32	Refusal in the last 6" Five in. penetration for 50 blows
14.4		Limestone: Light brown to almost while limestone fragments		
	48			
			50	Refusal. Two in. penetrations for 50 blows
16		EOB		

Standard Penetration Test (ASTM D 1586) • - N value
10 20 30 40 50 60

This information pertains only to this boring and should not be interpreted as being indicative of the site

Gravel, sand, silt & clay sizes per ASTM. Samples were always wet. GL at about 10' below Water level

Appendix E-1: Timber piles-capacity tables

Table E-1.1: Capacity calculation for 12" circular, tapered pile for B-1 profile

(Refer Table-1 for stratification and material properties)

Layer	depth	Soil type	Coefficient	Av. Dia. of	Total ultimate	N_t,Toe	Ultimate toe	Ultimate	Safe pile load
From	To		of friction	tapering pile	Skin friction	resistance	resistance	pile capacity	for FS=3
(ft)	(ft)		β	**d** (inch)	(ton)	Coefficient	$q_t * A_t$ (ton)	(ton)	(ton)
0	1	Silt	0.00	11.95	0.000	0	0.000	0.000	0.000
1	2	Loose sand	0.30	11.85	0.027	25	0.752	0.779	0.260
2	3	Loose sand	0.30	11.75	0.073	25	1.127	1.201	0.400
3	4	Loose sand	0.30	11.65	0.138	25	1.490	1.628	0.543
4	5	Very loose sand	0.23	11.55	0.201	20	1.457	1.659	0.553
5	6	Very loose sand	0.23	11.45	0.278	20	1.713	1.990	0.663
6	7	Very loose sand	0.23	11.35	0.367	20	1.958	2.326	0.775
7	8	Very loose sand	0.23	11.25	0.469	20	2.195	2.664	0.888
8	9	Very loose sand	0.23	11.15	0.584	20	2.422	3.005	1.002
9	10	Very loose sand	0.23	11.05	0.710	20	2.640	3.350	1.117
10	11	Very loose sand	0.23	10.95	0.848	20	2.849	3.697	1.232
11	12	Very loose sand	0.23	10.85	0.998	20	3.049	4.047	1.349
12	13	Very loose sand	0.23	10.75	1.160	20	3.240	4.400	1.467
13	14	Very loose sand	0.23	10.65	1.333	20	3.422	4.755	1.585
14	15	Very loose sand	0.23	10.55	1.516	20	3.596	5.112	1.704
15	16	Very loose sand	0.23	10.45	1.711	20	3.761	5.472	1.824
16	17	Very loose sand	0.23	10.35	1.916	20	3.918	5.834	1.945
17	18	LS/ Grav. Sand	0.55	10.25	2.437	60	12.509	14.945	4.982
18	19	LS/ Grav. Sand	0.55	10.15	2.995	60	13.226	16.221	5.407
19	20	LS/ Grav. Sand	0.55	10.05	3.589	60	13.908	17.497	5.832
20	21	LS/ Grav. Sand	0.55	9.95	4.218	60	14.555	18.773	6.258
21	22	LS/ Grav. Sand	0.55	9.85	4.882	60	15.168	20.050	6.683
22	23	LS/ Grav. Sand	0.45	9.75	5.450	50	12.994	18.444	6.148
23	24	LS/ Grav. Sand	0.45	9.65	6.040	50	13.325	19.365	6.455
24	25	LS/ Grav. Sand	0.45	9.55	6.649	50	13.635	20.284	6.761
25	26	LS/ Sand	0.45	9.45	7.279	50	13.923	21.202	7.067
26	27	LS/ Sand	0.30	9.35	7.712	28	7.913	15.625	5.208
27	28	LS/ Sand	0.30	9.25	8.155	28	8.019	16.174	5.391
28	29	LS/ Sand	0.30	9.15	8.608	28	8.115	16.723	5.574
29	30	LS/ Sand	0.30	9.05	9.072	28	8.201	17.273	5.758
30	31	LS/ Sand	0.30	8.95	9.545	28	8.278	17.823	5.941
31	32	LS/ Sand	0.30	8.85	10.028	28	8.345	18.373	6.124
32	33	Dense Sand	0.55	8.75	10.935	60	18.191	29.126	9.709
33	34	Dense Sand	0.55	8.65	11.868	60	18.472	30.340	10.113
34	35	Dense Sand	0.55	8.55	12.825	60	18.726	31.551	10.517
35	36	Dense Sand	0.55	8.45	13.807	60	18.953	32.759	10.920
36	37	Dense Sand	0.55	8.35	14.811	60	19.154	33.964	11.321
37	38	Dense Sand	0.55	8.25	15.837	60	19.329	35.166	11.722
38	39	Dense Sand	0.55	8.15	16.885	60	19.478	36.363	12.121
39	40	Dense Sand	0.55	8.05	17.953	60	19.604	37.557	12.519
40	41	Dense Sand	0.55	7.95	19.041	60	19.705	38.746	12.915
41	42	Dense Sand	0.55	7.85	20.148	60	19.782	39.930	13.310
42	43	Dense Sand	0.55	7.75	21.273	60	19.837	41.110	13.703
43	44	Dense Sand	0.55	7.65	22.415	60	19.870	42.284	14.095
44	45	Dense Sand	0.55	7.55	23.573	60	19.880	43.454	14.485
45	46	Dense Sand	0.55	7.45	24.747	60	19.870	44.617	14.872
46	47	Limestone (IGM)	0.60	7.35	26.047	150	49.815	75.862	25.287
47	48	Limestone (IGM)	0.60	7.25	27.367	150	49.893	77.260	25.753
48	49	Limestone (IGM)	0.60	7.15	28.707	150	49.911	78.618	26.206
49	50	Limestone (IGM)	0.60	7.05	30.066	150	49.870	79.936	26.645

Table E-1.2: Capacity calculation for 12" circular, tapered pile for B-2 profile

(Refer Table-1 for stratification and material properties)

Layer From (ft)	depth To (ft)	Soil type	Coefficient of friction β	Av. Dia. of tapering pile **d** (inch)	Total ultimate Skin friction (ton)	N_t,Toe resistance Coefficient	Ultimate toe resistance $q_t * A_t$ (ton)	Ultimate pile capacity (ton)	Safe pile load for FS=3 (ton)
0	1	silt	0.00	11.95	0.000	0	0.000	0.000	0.000
1	2	LS/ Loose Sand	0.28	11.85	0.026	25	0.761	0.787	0.262
2	3	LS/ Loose Sand	0.28	11.75	0.069	25	1.146	1.215	0.405
3	4	LS/ Loose Sand	0.28	11.65	0.131	25	1.517	1.648	0.549
4	5	Loose sand	0.30	11.55	0.215	25	1.866	2.082	0.694
5	6	Loose sand	0.30	11.45	0.318	25	2.203	2.520	0.840
6	7	Loose sand	0.30	11.35	0.438	25	2.526	2.964	0.988
7	8	Loose sand	0.30	11.25	0.575	25	2.838	3.413	1.138
8	9	Loose sand	0.30	11.15	0.730	25	3.137	3.866	1.289
9	10	Loose sand	0.30	11.05	0.901	25	3.424	4.324	1.441
10	11	Loose sand	0.30	10.95	1.088	25	3.699	4.787	1.596
11	12	Loose sand	0.30	10.85	1.291	25	3.962	5.253	1.751
12	13	LS/Med d. sand	0.30	10.75	1.511	25	4.221	5.732	1.911
13	14	LS/Med d. sand	0.30	10.65	1.746	28	5.005	6.751	2.250
14	15	LS/Med d. sand	0.30	10.55	1.996	28	5.270	7.266	2.422
15	16	LS/Med d. sand	0.30	10.45	2.262	28	5.522	7.784	2.595
16	17	LS/Med d. sand	0.30	10.35	2.542	28	5.761	8.304	2.768
17	18	LS/Med d. sand	0.30	10.25	2.837	28	5.988	8.826	2.942
18	19	LS/Med d. sand	0.30	10.15	3.146	28	6.203	9.350	3.117
19	20	LS/Med d. sand	0.30	10.05	3.469	28	6.406	9.875	3.292
20	21	LS/Med d. sand	0.30	9.95	3.805	28	6.598	10.403	3.468
21	22	LS/Med d. sand	0.30	9.85	4.154	28	6.778	10.932	3.644
22	23	LS/Med d. sand	0.30	9.75	4.516	28	6.946	11.462	3.821
23	24	LS/Med d. sand	0.30	9.65	4.891	28	7.103	11.994	3.998
24	25	LS/Med d. sand	0.30	9.55	5.277	28	7.250	12.527	4.176
25	26	LS/Med d. sand	0.30	9.45	5.676	28	7.385	13.061	4.354
26	27	LS/Med d. sand	0.30	9.35	6.085	28	7.510	13.596	4.532
27	28	LS/Med d. sand	0.30	9.25	6.506	28	7.625	14.131	4.710
28	29	LS/Med d. sand	0.30	9.15	6.938	28	7.730	14.667	4.889
29	30	LS/Med d. sand	0.30	9.05	7.380	28	7.824	15.204	5.068
30	31	LS/Med d. sand	0.30	8.95	7.832	28	7.909	15.741	5.247
31	32	LS/Med d. sand	0.30	8.85	8.294	28	7.984	16.278	5.426
32	33	Very dense sand	0.55	8.75	9.164	65	18.955	28.119	9.373
33	34	Very dense sand	0.55	8.65	10.063	65	19.343	29.406	9.802
34	35	Very dense sand	0.55	8.55	10.991	65	19.697	30.688	10.229
35	36	Very dense sand	0.55	8.45	11.945	65	20.019	31.965	10.655
36	37	Very dense sand	0.55	8.35	12.926	65	20.310	33.237	11.079
37	38	Very dense sand	0.55	8.25	13.933	65	20.570	34.503	11.501
38	39	Very dense sand	0.55	8.15	14.964	65	20.799	35.763	11.921
39	40	Very dense sand	0.55	8.05	16.019	65	20.999	37.017	12.339
40	41	Very dense sand	0.55	7.95	17.096	65	21.170	38.266	12.755
41	42	Very dense sand	0.55	7.85	18.195	65	21.312	39.507	13.169
42	43	Limestone (IGM)	0.60	7.75	19.418	150	49.569	68.987	22.996
43	44	Limestone (IGM)	0.60	7.65	20.667	150	49.887	70.554	23.518
44	45	Limestone (IGM)	0.60	7.55	21.939	150	50.138	72.077	24.026
45	46	Limestone (IGM)	0.60	7.45	23.234	150	50.324	73.558	24.519
46	47	Limestone (IGM)	0.60	7.35	24.550	150	50.447	74.997	24.999
47	48	Limestone (IGM)	0.60	7.25	25.887	150	50.508	76.395	25.465
48	49	Limestone (IGM)	0.60	7.15	27.243	150	50.509	77.752	25.917
49	50	Limestone (IGM)	0.60	7.05	28.618	150	50.451	79.069	26.356

Table E-1.3: Capacity calculation for 12" circular, tapered pile for B-3 profile

(Refer Table-1 for stratification and material properties)

Layer From (ft)	depth To (ft)	Soil type	Coefficient of friction β	Av. Dia. of tapering pile **d** (inch)	Total ultimate Skin friction (ton)	N_t,Toe resistance Coefficient	Ultimate toe resistance $q_t * A_t$ (ton)	Ultimate pile capacity (ton)	Safe pile load for FS=3 (ton)
0	1	silt	0.00	11.95	0.000	0	0.000	0.000	0.000
1	2	Loose sand	0.30	11.85	0.027	25	0.752	0.779	0.260
2	3	Loose sand	0.30	11.75	0.073	25	1.127	1.201	0.400
3	4	Loose sand	0.30	11.65	0.138	25	1.490	1.628	0.543
4	5	Loose sand	0.30	11.55	0.221	25	1.839	2.061	0.687
5	6	Loose sand	0.30	11.45	0.322	25	2.176	2.498	0.833
6	7	Loose sand	0.30	11.35	0.441	25	2.500	2.941	0.980
7	8	Loose sand	0.30	11.25	0.577	25	2.812	3.389	1.130
8	9	Loose sand	0.30	11.15	0.730	25	3.111	3.842	1.281
9	10	Med. dense sand	0.40	11.05	0.959	45	6.251	7.211	2.404
10	11	Med. dense sand	0.40	10.95	1.215	45	6.876	8.091	2.697
11	12	Med. dense sand	0.40	10.85	1.497	45	7.475	8.972	2.991
12	13	Med. dense sand	0.40	10.75	1.805	45	8.048	9.853	3.284
13	14	Med. dense sand	0.40	10.65	2.139	45	8.596	10.735	3.578
14	15	Med. dense sand	0.40	10.55	2.497	45	9.119	11.616	3.872
15	16	Med. dense sand	0.40	10.45	2.880	45	9.618	12.498	4.166
16	17	Med. dense sand	0.40	10.35	3.286	45	10.092	13.379	4.460
17	18	Med. dense sand	0.40	10.25	3.716	45	10.544	14.259	4.753
18	19	Med. dense sand	0.40	10.15	4.168	45	10.971	15.139	5.046
19	20	Med. dense sand	0.40	10.05	4.643	45	11.376	16.019	5.340
20	21	Med. dense sand	0.40	9.95	5.139	45	11.758	16.897	5.632
21	22	LS/Grav sand	0.60	9.85	5.914	50	13.425	19.339	6.446
22	23	LS/Grav sand	0.60	9.75	6.717	50	13.764	20.480	6.827
23	24	LS/Grav sand	0.60	9.65	7.548	50	14.079	21.627	7.209
24	25	LS/Grav sand	0.60	9.55	8.406	50	14.373	22.780	7.593
25	26	LS/Grav sand	0.60	9.45	9.291	50	14.646	23.937	7.979
26	27	LS/Grav sand	0.60	9.35	10.201	50	14.897	25.098	8.366
27	28	LS/Grav sand	0.60	9.25	11.136	50	15.128	26.264	8.755
28	29	LS/Grav sand	0.60	9.15	12.095	50	15.338	27.433	9.144
29	30	LS/Grav sand	0.60	9.05	13.077	50	15.529	28.606	9.535
30	31	LS/Grav sand	0.60	8.95	14.082	50	15.700	29.782	9.927
31	32	LS/Grav sand	0.60	8.85	15.109	50	15.852	30.961	10.320
32	33	Very dense sand	0.55	8.75	16.075	65	20.981	37.056	12.352
33	34	Very dense sand	0.55	8.65	17.068	65	21.322	38.391	12.797
34	35	Very dense sand	0.55	8.55	18.089	65	21.631	39.720	13.240
35	36	Very dense sand	0.55	8.45	19.135	65	21.908	41.043	13.681
36	37	Very dense sand	0.55	8.35	20.207	65	22.154	42.361	14.120
37	38	Very dense sand	0.55	8.25	21.303	65	22.370	43.673	14.558
38	39	Very dense sand	0.55	8.15	22.423	65	22.555	44.978	14.993
39	40	Very dense sand	0.55	8.05	23.565	65	22.712	46.277	15.426
40	41	Very dense sand	0.55	7.95	24.729	65	22.840	47.569	15.856
41	42	Very dense sand	0.55	7.85	25.913	65	22.941	48.854	16.285
42	43	Limestone (IGM)	0.60	7.75	27.228	150	53.231	80.460	26.820
43	44	Limestone (IGM)	0.60	7.65	28.567	150	53.455	82.022	27.341
44	45	Limestone (IGM)	0.60	7.55	29.929	150	53.613	83.542	27.847
45	46	Limestone (IGM)	0.60	7.45	31.312	150	53.707	85.019	28.340
46	47	Limestone (IGM)	0.60	7.35	32.716	150	53.739	86.454	28.818
47	48	Limestone (IGM)	0.60	7.25	34.139	150	53.710	87.849	29.283
48	49	Limestone (IGM)	0.60	7.15	35.580	150	53.622	89.202	29.734
49	50	Limestone (IGM)	0.60	7.05	37.039	150	53.477	90.516	30.172

Table E-1.4: Capacity calculation for 12" circular, tapered pile for B-4 profile

(Refer Table-1 for stratification and material properties)

Layer From (ft)	depth To (ft)	Soil type	Coefficient of friction β	Av. Dia. of tapering pile **d** (inch)	Total ultimate Skin friction (ton)	N_t,Toe resistance Coefficient	Ultimate toe resistance $q_t * A_t$ (ton)	Ultimate pile capacity (ton)	Safe pile load for FS=3 (ton)
0	1	silt	0.00	11.95	0.000	0	0.000	0.000	0.000
1	2	LS/sand	0.30	11.85	0.027	28	0.853	0.880	0.293
2	3	LS/sand	0.30	11.75	0.074	28	1.284	1.358	0.453
3	4	LS/sand	0.30	11.65	0.140	28	1.699	1.840	0.613
4	5	LS/sand	0.30	11.55	0.225	28	2.100	2.325	0.775
5	6	LS/sand	0.30	11.45	0.328	28	2.487	2.815	0.938
6	7	Loose Sand	0.28	11.35	0.441	25	2.544	2.985	0.995
7	8	Loose Sand	0.28	11.25	0.570	25	2.855	3.425	1.142
8	9	Limestone (IGM)	0.60	11.15	0.892	150	20.231	21.123	7.041
9	10	Limestone (IGM)	0.60	11.05	1.270	150	23.214	24.483	8.161
10	11	Limestone (IGM)	0.60	10.95	1.702	150	26.079	27.781	9.260
11	12	Limestone (IGM)	0.60	10.85	2.188	150	28.828	31.016	10.339
12	13	Limestone (IGM)	0.60	10.75	2.727	150	31.463	34.189	11.396
13	14	Limestone (IGM)	0.60	10.65	3.317	150	33.984	37.301	12.434
14	15	Limestone (IGM)	0.60	10.55	3.958	150	36.395	40.352	13.451
15	16	Limestone (IGM)	0.60	10.45	4.648	150	38.696	43.344	14.448
16	17	Limestone (IGM)	0.60	10.35	5.386	150	40.889	46.275	15.425
17	18	Limestone (IGM)	0.60	10.25	6.172	150	42.976	49.148	16.383
18	19	Limestone (IGM)	0.60	10.15	7.004	150	44.958	51.962	17.321
19	20	Limestone (IGM)	0.60	10.05	7.881	150	46.838	54.718	18.239
20	21	Limestone (IGM)	0.60	9.95	8.802	150	48.616	57.418	19.139
21	22	Limestone (IGM)	0.60	9.85	9.766	150	50.294	60.061	20.020
22	23	LS/ sand	0.30	9.75	10.265	28	9.504	19.768	6.589
23	24	LS/ sand	0.30	9.65	10.774	28	9.609	20.382	6.794
24	25	LS/ sand	0.30	9.55	11.294	28	9.703	20.997	6.999
25	26	LS/ sand	0.30	9.45	11.824	28	9.787	21.612	7.204
26	27	LS/ sand	0.30	9.35	12.365	28	9.861	22.226	7.409
27	28	LS/ sand	0.30	9.25	12.915	28	9.926	22.841	7.614
28	29	Dense sand	0.50	9.15	13.850	55	19.729	33.579	11.193
29	30	Dense sand	0.50	9.05	14.807	55	19.937	34.744	11.581
30	31	Dense sand	0.50	8.95	15.784	55	20.121	35.905	11.968
31	32	Dense sand	0.50	8.85	16.780	55	20.282	37.062	12.354
32	33	Dense sand	0.50	8.75	17.795	55	20.421	38.216	12.739
33	34	Dense sand	0.50	8.65	18.828	55	20.538	39.366	13.122
34	35	Dense sand	0.50	8.55	19.879	55	20.633	40.512	13.504
35	36	Dense sand	0.50	8.45	20.946	55	20.707	41.654	13.885
36	37	Dense sand	0.50	8.35	22.030	55	20.761	42.791	14.264
37	38	Dense sand	0.50	8.25	23.129	55	20.794	43.923	14.641
38	39	Dense sand	0.50	8.15	24.243	55	20.807	45.050	15.017
39	40	Dense sand	0.50	8.05	25.371	55	20.802	46.173	15.391
40	41	Dense sand	0.50	7.95	26.512	55	20.777	47.289	15.763
41	42	Dense sand	0.50	7.85	27.666	55	20.735	48.401	16.134
42	43	Limestone (IGM)	0.60	7.75	29.070	150	56.748	85.817	28.606
43	44	Limestone (IGM)	0.60	7.65	30.496	150	56.881	87.376	29.125
44	45	Limestone (IGM)	0.60	7.55	31.943	150	56.949	88.892	29.631
45	46	Limestone (IGM)	0.60	7.45	33.411	150	56.955	90.366	30.122
46	47	Limestone (IGM)	0.60	7.35	34.899	150	56.899	91.798	30.599
47	48	Limestone (IGM)	0.60	7.25	36.404	150	56.785	93.189	31.063
48	49	Limestone (IGM)	0.60	7.15	37.927	150	56.612	94.539	31.513
49	50	Limestone (IGM)	0.60	7.05	39.466	150	56.384	95.849	31.950

Table E-1.5: Capacity calculation for 14" circular, tapered pile for B-1 profile

(Refer Table-1 for stratification and material properties)

Layer From (ft)	depth To (ft)	Soil type	Coefficient of friction β	Av. Dia. of tapering pile **d** (inch)	Total ultimate Skin friction (ton)	N_t,Toe resistance Coefficient	Ultimate toe resistance $q_t * A_t$ (ton)	Ultimate pile capacity (ton)	Safe pile load for FS=3 (ton)
0	1	Silt	0.00	13.95	0.000	0	0.000	0.000	0.000
1	2	Loose sand	0.30	13.85	0.032	25	1.028	1.060	0.353
2	3	Loose sand	0.30	13.75	0.086	25	1.546	1.632	0.544
3	4	Loose sand	0.30	13.65	0.162	25	2.048	2.210	0.737
4	5	Very loose sand	0.23	13.55	0.236	20	2.008	2.244	0.748
5	6	Very loose sand	0.23	13.45	0.326	20	2.366	2.692	0.897
6	7	Very loose sand	0.23	13.35	0.431	20	2.713	3.144	1.048
7	8	Very loose sand	0.23	13.25	0.551	20	3.049	3.600	1.200
8	9	Very loose sand	0.23	13.15	0.686	20	3.373	4.059	1.353
9	10	Very loose sand	0.23	13.05	0.835	20	3.687	4.522	1.507
10	11	Very loose sand	0.23	12.95	0.999	20	3.990	4.989	1.663
11	12	Very loose sand	0.23	12.85	1.177	20	4.282	5.459	1.820
12	13	Very loose sand	0.23	12.75	1.368	20	4.564	5.932	1.977
13	14	Very loose sand	0.23	12.65	1.573	20	4.835	6.408	2.136
14	15	Very loose sand	0.23	12.55	1.792	20	5.096	6.888	2.296
15	16	Very loose sand	0.23	12.45	2.023	20	5.347	7.370	2.457
16	17	Very loose sand	0.23	12.35	2.268	20	5.588	7.856	2.619
17	18	LS/ Grav. Sand	0.55	12.25	2.890	60	17.895	20.786	6.929
18	19	LS/ Grav. Sand	0.55	12.15	3.558	60	18.983	22.541	7.514
19	20	LS/ Grav. Sand	0.55	12.05	4.271	60	20.028	24.298	8.099
20	21	LS/ Grav. Sand	0.55	11.95	5.027	60	21.030	26.057	8.686
21	22	LS/ Grav. Sand	0.55	11.85	5.826	60	21.990	27.816	9.272
22	23	LS/ Grav. Sand	0.45	11.75	6.510	50	18.904	25.415	8.472
23	24	LS/ Grav. Sand	0.45	11.65	7.222	50	19.456	26.678	8.893
24	25	LS/ Grav. Sand	0.45	11.55	7.959	50	19.980	27.940	9.313
25	26	LS/ Sand	0.45	11.45	8.723	50	20.478	29.200	9.733
26	27	LS/ Sand	0.30	11.35	9.247	28	11.683	20.930	6.977
27	28	LS/ Sand	0.30	11.25	9.786	28	11.885	21.671	7.224
28	29	LS/ Sand	0.30	11.15	10.338	28	12.074	22.413	7.471
29	30	LS/ Sand	0.30	11.05	10.905	28	12.251	23.156	7.719
30	31	LS/ Sand	0.30	10.95	11.484	28	12.416	23.900	7.967
31	32	LS/ Sand	0.30	10.85	12.076	28	12.569	24.645	8.215
32	33	Dense Sand	0.55	10.75	13.191	60	27.516	40.706	13.569
33	34	Dense Sand	0.55	10.65	14.339	60	28.063	42.402	14.134
34	35	Dense Sand	0.55	10.55	15.520	60	28.575	44.095	14.698
35	36	Dense Sand	0.55	10.45	16.734	60	29.052	45.786	15.262
36	37	Dense Sand	0.55	10.35	17.978	60	29.496	47.475	15.825
37	38	Dense Sand	0.55	10.25	19.253	60	29.907	49.160	16.387
38	39	Dense Sand	0.55	10.15	20.558	60	30.285	50.843	16.948
39	40	Dense Sand	0.55	10.05	21.892	60	30.631	52.522	17.507
40	41	Dense Sand	0.55	9.95	23.254	60	30.945	54.198	18.066
41	42	Dense Sand	0.55	9.85	24.642	60	31.228	55.870	18.623
42	43	Dense Sand	0.55	9.75	26.057	60	31.481	57.538	19.179
43	44	Dense Sand	0.55	9.65	27.498	60	31.703	59.202	19.734
44	45	Dense Sand	0.55	9.55	28.963	60	31.897	60.860	20.287
45	46	Dense Sand	0.55	9.45	30.453	60	32.062	62.514	20.838
46	47	Limestone (IGM)	0.60	9.35	32.106	150	80.850	112.956	37.652
47	48	Limestone (IGM)	0.60	9.25	33.791	150	81.461	115.252	38.417
48	49	Limestone (IGM)	0.60	9.15	35.506	150	81.990	117.495	39.165
49	50	Limestone (IGM)	0.60	9.05	37.250	150	82.437	119.687	39.896

Table E-1.6: Capacity calculation for 14" circular, tapered pile for B-2 profile

(Refer Table-1 for stratification and material properties)

Layer depth		Soil type	Coefficient	Av. Dia. of	Total ultimate	N_t,Toe	Ultimate toe	Ultimate	Safe pile load
From	To		of friction	tapering pile	Skin friction	resistance	resistance	pile capacity	for FS=3
(ft)	(ft)		β	**d** (inch)	(ton)	Coefficient	$q_t * A_t$ (ton)	(ton)	(ton)
0	1	silt	0.00	13.95	0.000	0	0.000	0.000	0.000
1	2	LS/ Loose Sand	0.28	13.85	0.030	25	1.041	1.071	0.357
2	3	LS/ Loose Sand	0.28	13.75	0.081	25	1.571	1.652	0.551
3	4	LS/ Loose Sand	0.28	13.65	0.153	25	2.086	2.239	0.746
4	5	Loose sand	0.30	13.55	0.252	25	2.572	2.824	0.941
5	6	Loose sand	0.30	13.45	0.373	25	3.043	3.416	1.139
6	7	Loose sand	0.30	13.35	0.514	25	3.500	4.014	1.338
7	8	Loose sand	0.30	13.25	0.676	25	3.942	4.617	1.539
8	9	Loose sand	0.30	13.15	0.858	25	4.369	5.226	1.742
9	10	Loose sand	0.30	13.05	1.060	25	4.782	5.841	1.947
10	11	Loose sand	0.30	12.95	1.281	25	5.180	6.462	2.154
11	12	Loose sand	0.30	12.85	1.522	25	5.565	7.087	2.362
12	13	LS/Med d. sand	0.30	12.75	1.782	25	5.947	7.729	2.576
13	14	LS/Med d. sand	0.30	12.65	2.062	28	7.072	9.134	3.045
14	15	LS/Med d. sand	0.30	12.55	2.360	28	7.469	9.828	3.276
15	16	LS/Med d. sand	0.30	12.45	2.676	28	7.850	10.526	3.509
16	17	LS/Med d. sand	0.30	12.35	3.011	28	8.216	11.227	3.742
17	18	LS/Med d. sand	0.30	12.25	3.363	28	8.567	11.930	3.977
18	19	LS/Med d. sand	0.30	12.15	3.733	28	8.903	12.636	4.212
19	20	LS/Med d. sand	0.30	12.05	4.120	28	9.225	13.345	4.448
20	21	LS/Med d. sand	0.30	11.95	4.523	28	9.533	14.056	4.685
21	22	LS/Med d. sand	0.30	11.85	4.944	28	9.826	14.770	4.923
22	23	LS/Med d. sand	0.30	11.75	5.380	28	10.106	15.486	5.162
23	24	LS/Med d. sand	0.30	11.65	5.832	28	10.371	16.203	5.401
24	25	LS/Med d. sand	0.30	11.55	6.299	28	10.623	16.923	5.641
25	26	LS/Med d. sand	0.30	11.45	6.782	28	10.862	17.644	5.881
26	27	LS/Med d. sand	0.30	11.35	7.279	28	11.088	18.367	6.122
27	28	LS/Med d. sand	0.30	11.25	7.791	28	11.301	19.092	6.364
28	29	LS/Med d. sand	0.30	11.15	8.317	28	11.500	19.818	6.606
29	30	LS/Med d. sand	0.30	11.05	8.857	28	11.688	20.545	6.848
30	31	LS/Med d. sand	0.30	10.95	9.410	28	11.863	21.273	7.091
31	32	LS/Med d. sand	0.30	10.85	9.976	28	12.025	22.002	7.334
32	33	Very dense sand	0.55	10.75	11.045	65	28.672	39.717	13.239
33	34	Very dense sand	0.55	10.65	12.153	65	29.385	41.538	13.846
34	35	Very dense sand	0.55	10.55	13.297	65	30.057	43.354	14.451
35	36	Very dense sand	0.55	10.45	14.478	65	30.687	45.165	15.055
36	37	Very dense sand	0.55	10.35	15.694	65	31.277	46.971	15.657
37	38	Very dense sand	0.55	10.25	16.944	65	31.827	48.772	16.257
38	39	Very dense sand	0.55	10.15	18.228	65	32.338	50.567	16.856
39	40	Very dense sand	0.55	10.05	19.545	65	32.811	52.356	17.452
40	41	Very dense sand	0.55	9.95	20.893	65	33.245	54.139	18.046
41	42	Very dense sand	0.55	9.85	22.272	65	33.643	55.915	18.638
42	43	Limestone (IGM)	0.60	9.75	23.812	150	78.663	102.475	34.158
43	44	Limestone (IGM)	0.60	9.65	25.386	150	79.598	104.984	34.995
44	45	Limestone (IGM)	0.60	9.55	26.995	150	80.444	107.439	35.813
45	46	Limestone (IGM)	0.60	9.45	28.638	150	81.203	109.840	36.613
46	47	Limestone (IGM)	0.60	9.35	30.312	150	81.876	112.188	37.396
47	48	Limestone (IGM)	0.60	9.25	32.018	150	82.465	114.483	38.161
48	49	Limestone (IGM)	0.60	9.15	33.754	150	82.972	116.726	38.909
49	50	Limestone (IGM)	0.60	9.05	35.519	150	83.398	118.917	39.639

Table E-1.7: Capacity calculation for 14" circular, tapered pile for B-3 profile

(Refer Table-1 for stratification and material properties)

Layer From (ft)	depth To (ft)	Soil type	Coefficient of friction β	Av. Dia. of tapering pile **d** (inch)	Total ultimate Skin friction (ton)	N_t,Toe resistance Coefficient	Ultimate toe resistance $q_t * A_t$ (ton)	Ultimate pile capacity (ton)	Safe pile load for FS=3 (ton)
0	1	silt	0.00	13.95	0.000	0	0.000	0.000	0.000
1	2	Loose sand	0.30	13.85	0.032	25	1.028	1.060	0.353
2	3	Loose sand	0.30	13.75	0.086	25	1.546	1.632	0.544
3	4	Loose sand	0.30	13.65	0.162	25	2.048	2.210	0.737
4	5	Loose sand	0.30	13.55	0.259	25	2.535	2.794	0.931
5	6	Loose sand	0.30	13.45	0.378	25	3.007	3.384	1.128
6	7	Loose sand	0.30	13.35	0.518	25	3.464	3.981	1.327
7	8	Loose sand	0.30	13.25	0.678	25	3.906	4.584	1.528
8	9	Loose sand	0.30	13.15	0.858	25	4.334	5.192	1.731
9	10	Med. dense sand	0.40	13.05	1.129	45	8.731	9.860	3.287
10	11	Med. dense sand	0.40	12.95	1.431	45	9.631	11.062	3.687
11	12	Med. dense sand	0.40	12.85	1.766	45	10.499	12.265	4.088
12	13	Med. dense sand	0.40	12.75	2.131	45	11.338	13.469	4.490
13	14	Med. dense sand	0.40	12.65	2.527	45	12.146	14.673	4.891
14	15	Med. dense sand	0.40	12.55	2.954	45	12.924	15.877	5.292
15	16	Med. dense sand	0.40	12.45	3.409	45	13.673	17.082	5.694
16	17	Med. dense sand	0.40	12.35	3.894	45	14.392	18.287	6.096
17	18	Med. dense sand	0.40	12.25	4.408	45	15.084	19.491	6.497
18	19	Med. dense sand	0.40	12.15	4.949	45	15.746	20.696	6.899
19	20	Med. dense sand	0.40	12.05	5.518	45	16.381	21.900	7.300
20	21	Med. dense sand	0.40	11.95	6.114	45	16.989	23.103	7.701
21	22	LS/Grav sand	0.60	11.85	7.046	50	19.464	26.510	8.837
22	23	LS/Grav sand	0.60	11.75	8.014	50	20.024	28.038	9.346
23	24	LS/Grav sand	0.60	11.65	9.017	50	20.557	29.574	9.858
24	25	LS/Grav sand	0.60	11.55	10.055	50	21.062	31.118	10.373
25	26	LS/Grav sand	0.60	11.45	11.127	50	21.541	32.668	10.889
26	27	LS/Grav sand	0.60	11.35	12.232	50	21.994	34.226	11.409
27	28	LS/Grav sand	0.60	11.25	13.369	50	22.420	35.789	11.930
28	29	LS/Grav sand	0.60	11.15	14.538	50	22.821	37.359	12.453
29	30	LS/Grav sand	0.60	11.05	15.737	50	23.197	38.935	12.978
30	31	LS/Grav sand	0.60	10.95	16.967	50	23.549	40.516	13.505
31	32	LS/Grav sand	0.60	10.85	18.226	50	23.876	42.102	14.034
32	33	Very dense sand	0.55	10.75	19.412	65	31.737	51.149	17.050
33	34	Very dense sand	0.55	10.65	20.635	65	32.393	53.028	17.676
34	35	Very dense sand	0.55	10.55	21.894	65	33.008	54.902	18.301
35	36	Very dense sand	0.55	10.45	23.189	65	33.582	56.771	18.924
36	37	Very dense sand	0.55	10.35	24.517	65	34.117	58.634	19.545
37	38	Very dense sand	0.55	10.25	25.879	65	34.612	60.491	20.164
38	39	Very dense sand	0.55	10.15	27.273	65	35.069	62.342	20.781
39	40	Very dense sand	0.55	10.05	28.699	65	35.487	64.187	21.396
40	41	Very dense sand	0.55	9.95	30.156	65	35.869	66.025	22.008
41	42	Very dense sand	0.55	9.85	31.642	65	36.214	67.856	22.619
42	43	Limestone (IGM)	0.60	9.75	33.297	150	84.475	117.772	39.257
43	44	Limestone (IGM)	0.60	9.65	34.986	150	85.290	120.276	40.092
44	45	Limestone (IGM)	0.60	9.55	36.708	150	86.018	122.727	40.909
45	46	Limestone (IGM)	0.60	9.45	38.463	150	86.660	125.123	41.708
46	47	Limestone (IGM)	0.60	9.35	40.248	150	87.218	127.466	42.489
47	48	Limestone (IGM)	0.60	9.25	42.064	150	87.693	129.757	43.252
48	49	Limestone (IGM)	0.60	9.15	43.908	150	88.087	131.995	43.998
49	50	Limestone (IGM)	0.60	9.05	45.780	150	88.401	134.182	44.727

Table E-1.8: Capacity calculation for 14" circular, tapered pile for B-4 profile

(Refer Table-1 for stratification and material properties)

Layer From (ft)	depth To (ft)	Soil type	Coefficient of friction β	Av. Dia. of tapering pile **d** (inch)	Total ultimate Skin friction (ton)	N_t,Toe resistance Coefficient	Ultimate toe resistance $q_t * A_t$ (ton)	Ultimate pile capacity (ton)	Safe pile load for FS=3 (ton)
0	1	silt	0.00	13.95	0.000	0	0.000	0.000	0.000
1	2	LS/sand	0.30	13.85	0.032	28	1.166	1.198	0.399
2	3	LS/sand	0.30	13.75	0.087	28	1.760	1.847	0.616
3	4	LS/sand	0.30	13.65	0.164	28	2.336	2.500	0.833
4	5	LS/sand	0.30	13.55	0.263	28	2.895	3.158	1.053
5	6	LS/sand	0.30	13.45	0.385	28	3.436	3.820	1.273
6	7	Loose Sand	0.28	13.35	0.517	25	3.524	4.041	1.347
7	8	Loose Sand	0.28	13.25	0.669	25	3.965	4.635	1.545
8	9	Limestone (IGM)	0.60	13.15	1.049	150	28.178	29.227	9.742
9	10	Limestone (IGM)	0.60	13.05	1.495	150	32.423	33.918	11.306
10	11	Limestone (IGM)	0.60	12.95	2.006	150	36.527	38.534	12.845
11	12	Limestone (IGM)	0.60	12.85	2.582	150	40.494	43.076	14.359
12	13	Limestone (IGM)	0.60	12.75	3.221	150	44.324	47.545	15.848
13	14	Limestone (IGM)	0.60	12.65	3.922	150	48.019	51.941	17.314
14	15	Limestone (IGM)	0.60	12.55	4.684	150	51.580	56.264	18.755
15	16	Limestone (IGM)	0.60	12.45	5.506	150	55.010	60.516	20.172
16	17	Limestone (IGM)	0.60	12.35	6.387	150	58.310	64.697	21.566
17	18	Limestone (IGM)	0.60	12.25	7.326	150	61.481	68.808	22.936
18	19	Limestone (IGM)	0.60	12.15	8.322	150	64.526	72.849	24.283
19	20	Limestone (IGM)	0.60	12.05	9.374	150	67.446	76.820	25.607
20	21	Limestone (IGM)	0.60	11.95	10.480	150	70.243	80.723	26.908
21	22	Limestone (IGM)	0.60	11.85	11.640	150	72.917	84.558	28.186
22	23	LS/ sand	0.30	11.75	12.241	28	13.827	26.068	8.689
23	24	LS/ sand	0.30	11.65	12.856	28	14.029	26.885	8.962
24	25	LS/ sand	0.30	11.55	13.485	28	14.218	27.703	9.234
25	26	LS/ sand	0.30	11.45	14.127	28	14.395	28.522	9.507
26	27	LS/ sand	0.30	11.35	14.783	28	14.559	29.342	9.781
27	28	LS/ sand	0.30	11.25	15.453	28	14.710	30.163	10.054
28	29	Dense sand	0.50	11.15	16.593	55	29.354	45.946	15.315
29	30	Dense sand	0.50	11.05	17.760	55	29.782	47.542	15.847
30	31	Dense sand	0.50	10.95	18.955	55	30.180	49.136	16.379
31	32	Dense sand	0.50	10.85	20.177	55	30.549	50.726	16.909
32	33	Dense sand	0.50	10.75	21.424	55	30.889	52.313	17.438
33	34	Dense sand	0.50	10.65	22.696	55	31.201	53.897	17.966
34	35	Dense sand	0.50	10.55	23.992	55	31.485	55.478	18.493
35	36	Dense sand	0.50	10.45	25.313	55	31.742	57.054	19.018
36	37	Dense sand	0.50	10.35	26.656	55	31.971	58.627	19.542
37	38	Dense sand	0.50	10.25	28.021	55	32.174	60.196	20.065
38	39	Dense sand	0.50	10.15	29.409	55	32.351	61.760	20.587
39	40	Dense sand	0.50	10.05	30.817	55	32.503	63.319	21.106
40	41	Dense sand	0.50	9.95	32.245	55	32.629	64.874	21.625
41	42	Dense sand	0.50	9.85	33.693	55	32.731	66.424	22.141
42	43	Limestone (IGM)	0.60	9.75	35.459	150	90.056	125.514	41.838
43	44	Limestone (IGM)	0.60	9.65	37.258	150	90.757	128.015	42.672
44	45	Limestone (IGM)	0.60	9.55	39.089	150	91.372	130.460	43.487
45	46	Limestone (IGM)	0.60	9.45	40.951	150	91.901	132.852	44.284
46	47	Limestone (IGM)	0.60	9.35	42.843	150	92.348	135.191	45.064
47	48	Limestone (IGM)	0.60	9.25	44.764	150	92.713	137.477	45.826
48	49	Limestone (IGM)	0.60	9.15	46.712	150	92.999	139.711	46.570
49	50	Limestone (IGM)	0.60	9.05	48.688	150	93.206	141.894	47.298

Table E-1.9: Capacity calculation for 16" circular, tapered pile for B-1 profile

(Refer Table-1 for stratification and material properties)

Layer From (ft)	depth To (ft)	Soil type	Coefficient of friction β	Av. Dia. of tapering pile **d** (inch)	Total ultimate Skin friction (ton)	N_t,Toe resistance Coefficient	Ultimate toe resistance $q_t * A_t$ (ton)	Ultimate pile capacity (ton)	Safe pile load for FS=3 (ton)
0	1	Silt	0.00	15.95	0.000	0	0.000	0.000	0.000
1	2	Loose sand	0.30	15.85	0.036	25	1.348	1.384	0.461
2	3	Loose sand	0.30	15.75	0.098	25	2.030	2.128	0.709
3	4	Loose sand	0.30	15.65	0.185	25	2.694	2.880	0.960
4	5	Very loose sand	0.23	15.55	0.271	20	2.647	2.917	0.972
5	6	Very loose sand	0.23	15.45	0.374	20	3.125	3.499	1.166
6	7	Very loose sand	0.23	15.35	0.494	20	3.590	4.085	1.362
7	8	Very loose sand	0.23	15.25	0.633	20	4.042	4.675	1.558
8	9	Very loose sand	0.23	15.15	0.788	20	4.482	5.270	1.757
9	10	Very loose sand	0.23	15.05	0.960	20	4.909	5.869	1.956
10	11	Very loose sand	0.23	14.95	1.149	20	5.323	6.472	2.157
11	12	Very loose sand	0.23	14.85	1.355	20	5.725	7.080	2.360
12	13	Very loose sand	0.23	14.75	1.576	20	6.115	7.691	2.564
13	14	Very loose sand	0.23	14.65	1.814	20	6.492	8.306	2.769
14	15	Very loose sand	0.23	14.55	2.067	20	6.857	8.925	2.975
15	16	Very loose sand	0.23	14.45	2.336	20	7.211	9.547	3.182
16	17	Very loose sand	0.23	14.35	2.620	20	7.553	10.173	3.391
17	18	LS/ Grav. Sand	0.55	14.25	3.344	60	24.243	27.588	9.196
18	19	LS/ Grav. Sand	0.55	14.15	4.122	60	25.777	29.899	9.966
19	20	LS/ Grav. Sand	0.55	14.05	4.953	60	27.260	32.213	10.738
20	21	LS/ Grav. Sand	0.55	13.95	5.835	60	28.693	34.528	11.509
21	22	LS/ Grav. Sand	0.55	13.85	6.769	60	30.076	36.845	12.282
22	23	LS/ Grav. Sand	0.45	13.75	7.570	50	25.920	33.490	11.163
23	24	LS/ Grav. Sand	0.45	13.65	8.404	50	26.743	35.147	11.716
24	25	LS/ Grav. Sand	0.45	13.55	9.269	50	27.534	36.803	12.268
25	26	LS/ Sand	0.45	13.45	10.166	50	28.293	38.459	12.820
26	27	LS/ Sand	0.30	13.35	10.783	28	16.184	26.967	8.989
27	28	LS/ Sand	0.30	13.25	11.417	28	16.508	27.926	9.309
28	29	LS/ Sand	0.30	13.15	12.069	28	16.817	28.886	9.629
29	30	LS/ Sand	0.30	13.05	12.738	28	17.111	29.849	9.950
30	31	LS/ Sand	0.30	12.95	13.423	28	17.390	30.813	10.271
31	32	LS/ Sand	0.30	12.85	14.124	28	17.655	31.779	10.593
32	33	Dense Sand	0.55	12.75	15.446	60	38.763	54.209	18.070
33	34	Dense Sand	0.55	12.65	16.810	60	39.651	56.461	18.820
34	35	Dense Sand	0.55	12.55	18.215	60	40.497	58.712	19.571
35	36	Dense Sand	0.55	12.45	19.661	60	41.301	60.961	20.320
36	37	Dense Sand	0.55	12.35	21.146	60	42.063	63.209	21.070
37	38	Dense Sand	0.55	12.25	22.670	60	42.785	65.455	21.818
38	39	Dense Sand	0.55	12.15	24.232	60	43.466	67.698	22.566
39	40	Dense Sand	0.55	12.05	25.831	60	44.108	69.939	23.313
40	41	Dense Sand	0.55	11.95	27.466	60	44.711	72.177	24.059
41	42	Dense Sand	0.55	11.85	29.137	60	45.275	74.411	24.804
42	43	Dense Sand	0.55	11.75	30.842	60	45.801	76.643	25.548
43	44	Dense Sand	0.55	11.65	32.582	60	46.289	78.871	26.290
44	45	Dense Sand	0.55	11.55	34.354	60	46.741	81.095	27.032
45	46	Dense Sand	0.55	11.45	36.158	60	47.156	83.315	27.772
46	47	Limestone (IGM)	0.60	11.35	38.165	150	119.363	157.528	52.509
47	48	Limestone (IGM)	0.60	11.25	40.214	150	120.728	160.942	53.647
48	49	Limestone (IGM)	0.60	11.15	42.304	150	121.989	164.293	54.764
49	50	Limestone (IGM)	0.60	11.05	44.434	150	123.147	167.581	55.860

Table E-1.10: Capacity calculation for 16" circular, tapered pile for B-2 profile

(Refer Table-1 for stratification and material properties)

Layer From (ft)	depth To (ft)	Soil type	Coefficient of friction β	Av. Dia. of tapering pile **d** (inch)	Total ultimate Skin friction (ton)	N_t,Toe resistance Coefficient	Ultimate toe resistance $q_t * A_t$ (ton)	Ultimate pile capacity (ton)	Safe pile load for FS=3 (ton)
0	1	silt	0.00	15.95	0.000	0	0.000	0.000	0.000
1	2	LS/ Loose Sand	0.28	15.85	0.034	25	1.365	1.399	0.466
2	3	LS/ Loose Sand	0.28	15.75	0.093	25	2.064	2.156	0.719
3	4	LS/ Loose Sand	0.28	15.65	0.175	25	2.744	2.920	0.973
4	5	Loose sand	0.30	15.55	0.289	25	3.391	3.680	1.227
5	6	Loose sand	0.30	15.45	0.427	25	4.020	4.447	1.482
6	7	Loose sand	0.30	15.35	0.590	25	4.631	5.221	1.740
7	8	Loose sand	0.30	15.25	0.776	25	5.226	6.002	2.001
8	9	Loose sand	0.30	15.15	0.986	25	5.805	6.790	2.263
9	10	Loose sand	0.30	15.05	1.219	25	6.366	7.585	2.528
10	11	Loose sand	0.30	14.95	1.475	25	6.911	8.386	2.795
11	12	Loose sand	0.30	14.85	1.753	25	7.440	9.193	3.064
12	13	LS/Med d. sand	0.30	14.75	2.054	25	7.967	10.021	3.340
13	14	LS/Med d. sand	0.30	14.65	2.377	28	9.496	11.873	3.958
14	15	LS/Med d. sand	0.30	14.55	2.723	28	10.050	12.773	4.258
15	16	LS/Med d. sand	0.30	14.45	3.090	28	10.586	13.676	4.559
16	17	LS/Med d. sand	0.30	14.35	3.479	28	11.105	14.584	4.861
17	18	LS/Med d. sand	0.30	14.25	3.889	28	11.606	15.495	5.165
18	19	LS/Med d. sand	0.30	14.15	4.320	28	12.090	16.409	5.470
19	20	LS/Med d. sand	0.30	14.05	4.771	28	12.557	17.327	5.776
20	21	LS/Med d. sand	0.30	13.95	5.242	28	13.006	18.248	6.083
21	22	LS/Med d. sand	0.30	13.85	5.733	28	13.439	19.172	6.391
22	23	LS/Med d. sand	0.30	13.75	6.244	28	13.856	20.099	6.700
23	24	LS/Med d. sand	0.30	13.65	6.773	28	14.256	21.029	7.010
24	25	LS/Med d. sand	0.30	13.55	7.322	28	14.640	21.962	7.321
25	26	LS/Med d. sand	0.30	13.45	7.889	28	15.008	22.896	7.632
26	27	LS/Med d. sand	0.30	13.35	8.474	28	15.360	23.834	7.945
27	28	LS/Med d. sand	0.30	13.25	9.076	28	15.697	24.773	8.258
28	29	LS/Med d. sand	0.30	13.15	9.697	28	16.018	25.715	8.572
29	30	LS/Med d. sand	0.30	13.05	10.334	28	16.324	26.658	8.886
30	31	LS/Med d. sand	0.30	12.95	10.988	28	16.615	27.603	9.201
31	32	LS/Med d. sand	0.30	12.85	11.659	28	16.892	28.550	9.517
32	33	Very dense sand	0.55	12.75	12.927	65	40.392	53.319	17.773
33	34	Very dense sand	0.55	12.65	14.242	65	41.520	55.762	18.587
34	35	Very dense sand	0.55	12.55	15.603	65	42.598	58.201	19.400
35	36	Very dense sand	0.55	12.45	17.010	65	43.625	60.635	20.212
36	37	Very dense sand	0.55	12.35	18.461	65	44.603	63.064	21.021
37	38	Very dense sand	0.55	12.25	19.955	65	45.532	65.488	21.829
38	39	Very dense sand	0.55	12.15	21.492	65	46.414	67.906	22.635
39	40	Very dense sand	0.55	12.05	23.071	65	47.248	70.319	23.440
40	41	Very dense sand	0.55	11.95	24.691	65	48.035	72.725	24.242
41	42	Very dense sand	0.55	11.85	26.350	65	48.776	75.126	25.042
42	43	Limestone (IGM)	0.60	11.75	28.205	150	114.446	142.650	47.550
43	44	Limestone (IGM)	0.60	11.65	30.106	150	116.218	146.324	48.775
44	45	Limestone (IGM)	0.60	11.55	32.052	150	117.880	149.932	49.977
45	46	Limestone (IGM)	0.60	11.45	34.042	150	119.433	153.475	51.158
46	47	Limestone (IGM)	0.60	11.35	36.074	150	120.878	156.952	52.317
47	48	Limestone (IGM)	0.60	11.25	38.149	150	122.217	160.366	53.455
48	49	Limestone (IGM)	0.60	11.15	40.264	150	123.451	163.715	54.572
49	50	Limestone (IGM)	0.60	11.05	42.419	150	124.583	167.002	55.667

Table E-1.11: Capacity calculation for 16" circular, tapered pile for B-3 profile

(Refer Table-1 for stratification and material properties)

Layer From (ft)	depth To (ft)	Soil type	Coefficient of friction β	Av. Dia. of tapering pile **d** (inch)	Total ultimate Skin friction (ton)	N_t,Toe resistance Coefficient	Ultimate toe resistance $q_t * A_t$ (ton)	Ultimate pile capacity (ton)	Safe pile load for FS=3 (ton)
0	1	silt	0.00	15.95	0.000	0	0.000	0.000	0.000
1	2	Loose sand	0.30	15.85	0.036	25	1.348	1.384	0.461
2	3	Loose sand	0.30	15.75	0.098	25	2.030	2.128	0.709
3	4	Loose sand	0.30	15.65	0.185	25	2.694	2.880	0.960
4	5	Loose sand	0.30	15.55	0.297	25	3.341	3.639	1.213
5	6	Loose sand	0.30	15.45	0.433	25	3.971	4.405	1.468
6	7	Loose sand	0.30	15.35	0.594	25	4.584	5.178	1.726
7	8	Loose sand	0.30	15.25	0.779	25	5.179	5.958	1.986
8	9	Loose sand	0.30	15.15	0.987	25	5.758	6.744	2.248
9	10	Med. dense sand	0.40	15.05	1.298	45	11.625	12.923	4.308
10	11	Med. dense sand	0.40	14.95	1.648	45	12.849	14.496	4.832
11	12	Med. dense sand	0.40	14.85	2.034	45	14.037	16.071	5.357
12	13	Med. dense sand	0.40	14.75	2.457	45	15.190	17.647	5.882
13	14	Med. dense sand	0.40	14.65	2.916	45	16.307	19.223	6.408
14	15	Med. dense sand	0.40	14.55	3.410	45	17.390	20.800	6.933
15	16	Med. dense sand	0.40	14.45	3.939	45	18.439	22.378	7.459
16	17	Med. dense sand	0.40	14.35	4.502	45	19.453	23.956	7.985
17	18	Med. dense sand	0.40	14.25	5.100	45	20.434	25.534	8.511
18	19	Med. dense sand	0.40	14.15	5.730	45	21.382	27.112	9.037
19	20	Med. dense sand	0.40	14.05	6.394	45	22.297	28.691	9.564
20	21	Med. dense sand	0.40	13.95	7.089	45	23.179	30.269	10.090
21	22	LS/Grav sand	0.60	13.85	8.178	50	26.622	34.800	11.600
22	23	LS/Grav sand	0.60	13.75	9.311	50	27.455	36.767	12.256
23	24	LS/Grav sand	0.60	13.65	10.487	50	28.256	38.743	12.914
24	25	LS/Grav sand	0.60	13.55	11.705	50	29.025	40.730	13.577
25	26	LS/Grav sand	0.60	13.45	12.964	50	29.762	42.726	14.242
26	27	LS/Grav sand	0.60	13.35	14.263	50	30.468	44.731	14.910
27	28	LS/Grav sand	0.60	13.25	15.602	50	31.142	46.745	15.582
28	29	LS/Grav sand	0.60	13.15	16.981	50	31.786	48.767	16.256
29	30	LS/Grav sand	0.60	13.05	18.397	50	32.400	50.797	16.932
30	31	LS/Grav sand	0.60	12.95	19.852	50	32.983	52.835	17.612
31	32	LS/Grav sand	0.60	12.85	21.343	50	33.537	54.880	18.293
32	33	Very dense sand	0.55	12.75	22.750	65	44.709	67.459	22.486
33	34	Very dense sand	0.55	12.65	24.202	65	45.770	69.972	23.324
34	35	Very dense sand	0.55	12.55	25.700	65	46.780	72.480	24.160
35	36	Very dense sand	0.55	12.45	27.242	65	47.741	74.983	24.994
36	37	Very dense sand	0.55	12.35	28.827	65	48.653	77.480	25.827
37	38	Very dense sand	0.55	12.25	30.455	65	49.516	79.971	26.657
38	39	Very dense sand	0.55	12.15	32.124	65	50.333	82.456	27.485
39	40	Very dense sand	0.55	12.05	33.834	65	51.102	84.935	28.312
40	41	Very dense sand	0.55	11.95	35.583	65	51.825	87.408	29.136
41	42	Very dense sand	0.55	11.85	37.371	65	52.503	89.874	29.958
42	43	Limestone (IGM)	0.60	11.75	39.365	150	122.901	162.266	54.089
43	44	Limestone (IGM)	0.60	11.65	41.404	150	124.530	165.934	55.311
44	45	Limestone (IGM)	0.60	11.55	43.487	150	126.049	169.537	56.512
45	46	Limestone (IGM)	0.60	11.45	45.613	150	127.460	173.073	57.691
46	47	Limestone (IGM)	0.60	11.35	47.780	150	128.765	176.545	58.848
47	48	Limestone (IGM)	0.60	11.25	49.989	150	129.965	179.953	59.984
48	49	Limestone (IGM)	0.60	11.15	52.236	150	131.061	183.298	61.099
49	50	Limestone (IGM)	0.60	11.05	54.522	150	132.057	186.579	62.193

Table E-1.12: Capacity calculation for 16" circular, tapered pile for B-4 profile

(Refer Table-1 for stratification and material properties)

Layer	depth	Soil type	Coefficient	Av. Dia. of	Total ultimate	N_t,Toe	Ultimate toe	Ultimate	Safe pile load
From	To		of friction	tapering pile	Skin friction	resistance	resistance	pile capacity	for FS=3
(ft)	(ft)		β	**d** (inch)	(ton)	Coefficient	$q_t * A_t$ (ton)	(ton)	(ton)
0	1	silt	0.00	15.95	0.000	0	0.000	0.000	0.000
1	2	LS/sand	0.30	15.85	0.037	28	1.529	1.565	0.522
2	3	LS/sand	0.30	15.75	0.099	28	2.311	2.411	0.804
3	4	LS/sand	0.30	15.65	0.188	28	3.074	3.262	1.087
4	5	LS/sand	0.30	15.55	0.302	28	3.816	4.118	1.373
5	6	LS/sand	0.30	15.45	0.441	28	4.538	4.979	1.660
6	7	Loose Sand	0.28	15.35	0.594	25	4.663	5.257	1.752
7	8	Loose Sand	0.28	15.25	0.769	25	5.258	6.027	2.009
8	9	Limestone (IGM)	0.60	15.15	1.206	150	37.439	38.645	12.882
9	10	Limestone (IGM)	0.60	15.05	1.721	150	43.166	44.887	14.962
10	11	Limestone (IGM)	0.60	14.95	2.311	150	48.732	51.043	17.014
11	12	Limestone (IGM)	0.60	14.85	2.976	150	54.137	57.113	19.038
12	13	Limestone (IGM)	0.60	14.75	3.715	150	59.383	63.098	21.033
13	14	Limestone (IGM)	0.60	14.65	4.527	150	64.472	69.000	23.000
14	15	Limestone (IGM)	0.60	14.55	5.411	150	69.406	74.817	24.939
15	16	Limestone (IGM)	0.60	14.45	6.365	150	74.186	80.551	26.850
16	17	Limestone (IGM)	0.60	14.35	7.389	150	78.814	86.203	28.734
17	18	Limestone (IGM)	0.60	14.25	8.481	150	83.292	91.773	30.591
18	19	Limestone (IGM)	0.60	14.15	9.641	150	87.620	97.261	32.420
19	20	Limestone (IGM)	0.60	14.05	10.867	150	91.802	102.669	34.223
20	21	Limestone (IGM)	0.60	13.95	12.159	150	95.838	107.996	35.999
21	22	Limestone (IGM)	0.60	13.85	13.514	150	99.730	113.244	37.748
22	23	LS/ sand	0.30	13.75	14.217	28	18.958	33.175	11.058
23	24	LS/ sand	0.30	13.65	14.938	28	19.284	34.222	11.407
24	25	LS/ sand	0.30	13.55	15.676	28	19.594	35.270	11.757
25	26	LS/ sand	0.30	13.45	16.430	28	19.889	36.319	12.106
26	27	LS/ sand	0.30	13.35	17.202	28	20.169	37.371	12.457
27	28	LS/ sand	0.30	13.25	17.990	28	20.433	38.423	12.808
28	29	Dense sand	0.50	13.15	19.335	55	40.885	60.219	20.073
29	30	Dense sand	0.50	13.05	20.714	55	41.596	62.310	20.770
30	31	Dense sand	0.50	12.95	22.127	55	42.272	64.399	21.466
31	32	Dense sand	0.50	12.85	23.573	55	42.912	66.485	22.162
32	33	Dense sand	0.50	12.75	25.053	55	43.516	68.569	22.856
33	34	Dense sand	0.50	12.65	26.564	55	44.086	70.650	23.550
34	35	Dense sand	0.50	12.55	28.106	55	44.622	72.728	24.243
35	36	Dense sand	0.50	12.45	29.679	55	45.124	74.803	24.934
36	37	Dense sand	0.50	12.35	31.282	55	45.593	76.874	25.625
37	38	Dense sand	0.50	12.25	32.914	55	46.028	78.942	26.314
38	39	Dense sand	0.50	12.15	34.574	55	46.432	81.006	27.002
39	40	Dense sand	0.50	12.05	36.262	55	46.804	83.066	27.689
40	41	Dense sand	0.50	11.95	37.978	55	47.144	85.122	28.374
41	42	Dense sand	0.50	11.85	39.720	55	47.454	87.174	29.058
42	43	Limestone (IGM)	0.60	11.75	41.848	150	131.020	172.868	57.623
43	44	Limestone (IGM)	0.60	11.65	44.020	150	132.511	176.531	58.844
44	45	Limestone (IGM)	0.60	11.55	46.234	150	133.894	180.128	60.043
45	46	Limestone (IGM)	0.60	11.45	48.490	150	135.169	183.659	61.220
46	47	Limestone (IGM)	0.60	11.35	50.787	150	136.339	187.126	62.375
47	48	Limestone (IGM)	0.60	11.25	53.123	150	137.405	190.528	63.509
48	49	Limestone (IGM)	0.60	11.15	55.498	150	138.369	193.867	64.622
49	50	Limestone (IGM)	0.60	11.05	57.910	150	139.234	197.143	65.714

Table E-1.13: Capacity calculation for 18" circular, tapered pile for B-1 profile

(Refer Table-1 for stratification and material properties)

Layer From (ft)	depth To (ft)	Soil type	Coefficient of friction β	Av. Dia. of tapering pile **d** (inch)	Total ultimate Skin friction (ton)	N_t,Toe resistance Coefficient	Ultimate toe resistance $q_t * A_t$ (ton)	Ultimate pile capacity (ton)	Safe pile load for FS=3 (ton)
0	1	Silt	0.00	17.95	0.000	0	0.000	0.000	0.000
1	2	Loose sand	0.30	17.85	0.041	25	1.711	1.752	0.584
2	3	Loose sand	0.30	17.75	0.111	25	2.580	2.691	0.897
3	4	Loose sand	0.30	17.65	0.209	25	3.430	3.638	1.213
4	5	Very loose sand	0.23	17.55	0.305	20	3.374	3.679	1.226
5	6	Very loose sand	0.23	17.45	0.422	20	3.990	4.411	1.470
6	7	Very loose sand	0.23	17.35	0.558	20	4.590	5.148	1.716
7	8	Very loose sand	0.23	17.25	0.714	20	5.176	5.891	1.964
8	9	Very loose sand	0.23	17.15	0.890	20	5.748	6.638	2.213
9	10	Very loose sand	0.23	17.05	1.085	20	6.305	7.390	2.463
10	11	Very loose sand	0.23	16.95	1.300	20	6.848	8.148	2.716
11	12	Very loose sand	0.23	16.85	1.533	20	7.377	8.909	2.970
12	13	Very loose sand	0.23	16.75	1.784	20	7.892	9.676	3.225
13	14	Very loose sand	0.23	16.65	2.054	20	8.392	10.447	3.482
14	15	Very loose sand	0.23	16.55	2.342	20	8.880	11.222	3.741
15	16	Very loose sand	0.23	16.45	2.648	20	9.353	12.002	4.001
16	17	Very loose sand	0.23	16.35	2.972	20	9.813	12.785	4.262
17	18	LS/ Grav. Sand	0.55	16.25	3.798	60	31.554	35.352	11.784
18	19	LS/ Grav. Sand	0.55	16.15	4.686	60	33.608	38.294	12.765
19	20	LS/ Grav. Sand	0.55	16.05	5.635	60	35.605	41.240	13.747
20	21	LS/ Grav. Sand	0.55	15.95	6.644	60	37.544	44.188	14.729
21	22	LS/ Grav. Sand	0.55	15.85	7.712	60	39.426	47.138	15.713
22	23	LS/ Grav. Sand	0.45	15.75	8.630	50	34.040	42.670	14.223
23	24	LS/ Grav. Sand	0.45	15.65	9.586	50	35.187	44.773	14.924
24	25	LS/ Grav. Sand	0.45	15.55	10.579	50	36.297	46.876	15.625
25	26	LS/ Sand	0.45	15.45	11.609	50	37.369	48.978	16.326
26	27	LS/ Sand	0.30	15.35	12.318	28	21.417	33.736	11.245
27	28	LS/ Sand	0.30	15.25	13.048	28	21.890	34.938	11.646
28	29	LS/ Sand	0.30	15.15	13.799	28	22.345	36.144	12.048
29	30	LS/ Sand	0.30	15.05	14.570	28	22.781	37.352	12.451
30	31	LS/ Sand	0.30	14.95	15.361	28	23.201	38.562	12.854
31	32	LS/ Sand	0.30	14.85	16.172	28	23.603	39.775	13.258
32	33	Dense Sand	0.55	14.75	17.701	60	51.933	69.634	23.211
33	34	Dense Sand	0.55	14.65	19.281	60	53.238	72.519	24.173
34	35	Dense Sand	0.55	14.55	20.910	60	54.493	75.403	25.134
35	36	Dense Sand	0.55	14.45	22.588	60	55.698	78.286	26.095
36	37	Dense Sand	0.55	14.35	24.313	60	56.855	81.168	27.056
37	38	Dense Sand	0.55	14.25	26.086	60	57.963	84.049	28.016
38	39	Dense Sand	0.55	14.15	27.905	60	59.023	86.928	28.976
39	40	Dense Sand	0.55	14.05	29.770	60	60.036	89.805	29.935
40	41	Dense Sand	0.55	13.95	31.679	60	61.002	92.681	30.894
41	42	Dense Sand	0.55	13.85	33.631	60	61.922	95.554	31.851
42	43	Dense Sand	0.55	13.75	35.627	60	62.797	98.424	32.808
43	44	Dense Sand	0.55	13.65	37.665	60	63.627	101.292	33.764
44	45	Dense Sand	0.55	13.55	39.744	60	64.412	104.156	34.719
45	46	Dense Sand	0.55	13.45	41.863	60	65.154	107.018	35.673
46	47	Limestone (IGM)	0.60	13.35	44.224	150	165.355	209.579	69.860
47	48	Limestone (IGM)	0.60	13.25	46.637	150	167.696	214.333	71.444
48	49	Limestone (IGM)	0.60	13.15	49.102	150	169.910	219.012	73.004
49	50	Limestone (IGM)	0.60	13.05	51.618	150	171.999	223.617	74.539

Table E-1.14: Capacity calculation for 18" circular, tapered pile for B-2 profile

(Refer Table-1 for stratification and material properties)

Layer From (ft)	depth To (ft)	Soil type	Coefficient of friction β	Av. Dia. of tapering pile **d** (inch)	Total ultimate Skin friction (ton)	N_t,Toe resistance Coefficient	Ultimate toe resistance $q_t * A_t$ (ton)	Ultimate pile capacity (ton)	Safe pile load for FS=3 (ton)
0	1	silt	0.00	17.95	0.000	0	0.000	0.000	0.000
1	2	LS/ Loose Sand	0.28	17.85	0.039	25	1.732	1.771	0.590
2	3	LS/ Loose Sand	0.28	17.75	0.105	25	2.623	2.727	0.909
3	4	LS/ Loose Sand	0.28	17.65	0.198	25	3.493	3.691	1.230
4	5	Loose sand	0.30	17.55	0.326	25	4.322	4.648	1.549
5	6	Loose sand	0.30	17.45	0.482	25	5.131	5.614	1.871
6	7	Loose sand	0.30	17.35	0.666	25	5.921	6.587	2.196
7	8	Loose sand	0.30	17.25	0.876	25	6.692	7.569	2.523
8	9	Loose sand	0.30	17.15	1.114	25	7.444	8.558	2.853
9	10	Loose sand	0.30	17.05	1.378	25	8.177	9.555	3.185
10	11	Loose sand	0.30	16.95	1.668	25	8.891	10.559	3.520
11	12	Loose sand	0.30	16.85	1.984	25	9.586	11.570	3.857
12	13	LS/Med d. sand	0.30	16.75	2.326	25	10.283	12.608	4.203
13	14	LS/Med d. sand	0.30	16.65	2.693	28	12.275	14.969	4.990
14	15	LS/Med d. sand	0.30	16.55	3.086	28	13.014	16.100	5.367
15	16	LS/Med d. sand	0.30	16.45	3.504	28	13.731	17.235	5.745
16	17	LS/Med d. sand	0.30	16.35	3.947	28	14.429	18.376	6.125
17	18	LS/Med d. sand	0.30	16.25	4.415	28	15.106	19.520	6.507
18	19	LS/Med d. sand	0.30	16.15	4.906	28	15.763	20.669	6.890
19	20	LS/Med d. sand	0.30	16.05	5.422	28	16.401	21.822	7.274
20	21	LS/Med d. sand	0.30	15.95	5.960	28	17.018	22.979	7.660
21	22	LS/Med d. sand	0.30	15.85	6.522	28	17.617	24.140	8.047
22	23	LS/Med d. sand	0.30	15.75	7.107	28	18.197	25.304	8.435
23	24	LS/Med d. sand	0.30	15.65	7.714	28	18.757	26.472	8.824
24	25	LS/Med d. sand	0.30	15.55	8.344	28	19.299	27.643	9.214
25	26	LS/Med d. sand	0.30	15.45	8.995	28	19.822	28.817	9.606
26	27	LS/Med d. sand	0.30	15.35	9.668	28	20.327	29.995	9.998
27	28	LS/Med d. sand	0.30	15.25	10.361	28	20.814	31.175	10.392
28	29	LS/Med d. sand	0.30	15.15	11.076	28	21.283	32.359	10.786
29	30	LS/Med d. sand	0.30	15.05	11.811	28	21.733	33.545	11.182
30	31	LS/Med d. sand	0.30	14.95	12.566	28	22.167	34.733	11.578
31	32	LS/Med d. sand	0.30	14.85	13.341	28	22.583	35.924	11.975
32	33	Very dense sand	0.55	14.75	14.808	65	54.116	68.924	22.975
33	34	Very dense sand	0.55	14.65	16.331	65	55.748	72.079	24.026
34	35	Very dense sand	0.55	14.55	17.910	65	57.320	75.229	25.076
35	36	Very dense sand	0.55	14.45	19.542	65	58.833	78.375	26.125
36	37	Very dense sand	0.55	14.35	21.228	65	60.288	81.516	27.172
37	38	Very dense sand	0.55	14.25	22.967	65	61.685	84.651	28.217
38	39	Very dense sand	0.55	14.15	24.757	65	63.025	87.782	29.261
39	40	Very dense sand	0.55	14.05	26.597	65	64.309	90.907	30.302
40	41	Very dense sand	0.55	13.95	28.488	65	65.538	94.026	31.342
41	42	Very dense sand	0.55	13.85	30.427	65	66.711	97.138	32.379
42	43	Limestone (IGM)	0.60	13.75	32.598	150	156.916	189.514	63.171
43	44	Limestone (IGM)	0.60	13.65	34.825	150	159.749	194.574	64.858
44	45	Limestone (IGM)	0.60	13.55	37.108	150	162.448	199.556	66.519
45	46	Limestone (IGM)	0.60	13.45	39.446	150	165.015	204.461	68.154
46	47	Limestone (IGM)	0.60	13.35	41.837	150	167.453	209.290	69.763
47	48	Limestone (IGM)	0.60	13.25	44.280	150	169.763	214.043	71.348
48	49	Limestone (IGM)	0.60	13.15	46.775	150	171.946	218.720	72.907
49	50	Limestone (IGM)	0.60	13.05	49.320	150	174.004	223.324	74.441

Table E-1.15: Capacity calculation for 18" circular, tapered pile for B-3 profile

(Refer Table-1 for stratification and material properties)

Layer From (ft)	depth To (ft)	Soil type	Coefficient of friction β	Av. Dia. of tapering pile **d** (inch)	Total ultimate Skin friction (ton)	N_t,Toe resistance Coefficient	Ultimate toe resistance $q_t * A_t$ (ton)	Ultimate pile capacity (ton)	Safe pile load for FS=3 (ton)
0	1	silt	0.00	17.95	0.000	0	0.000	0.000	0.000
1	2	Loose sand	0.30	17.85	0.041	25	1.711	1.752	0.584
2	3	Loose sand	0.30	17.75	0.111	25	2.580	2.691	0.897
3	4	Loose sand	0.30	17.65	0.209	25	3.430	3.638	1.213
4	5	Loose sand	0.30	17.55	0.335	25	4.259	4.594	1.531
5	6	Loose sand	0.30	17.45	0.489	25	5.069	5.559	1.853
6	7	Loose sand	0.30	17.35	0.671	25	5.860	6.531	2.177
7	8	Loose sand	0.30	17.25	0.879	25	6.632	7.511	2.504
8	9	Loose sand	0.30	17.15	1.115	25	7.384	8.499	2.833
9	10	Med. dense sand	0.40	17.05	1.468	45	14.931	16.399	5.466
10	11	Med. dense sand	0.40	16.95	1.864	45	16.529	18.393	6.131
11	12	Med. dense sand	0.40	16.85	2.302	45	18.087	20.389	6.796
12	13	Med. dense sand	0.40	16.75	2.783	45	19.604	22.387	7.462
13	14	Med. dense sand	0.40	16.65	3.304	45	21.081	24.385	8.128
14	15	Med. dense sand	0.40	16.55	3.866	45	22.518	26.385	8.795
15	16	Med. dense sand	0.40	16.45	4.468	45	23.916	28.385	9.462
16	17	Med. dense sand	0.40	16.35	5.110	45	25.275	30.386	10.129
17	18	Med. dense sand	0.40	16.25	5.792	45	26.596	32.387	10.796
18	19	Med. dense sand	0.40	16.15	6.511	45	27.878	34.389	11.463
19	20	Med. dense sand	0.40	16.05	7.269	45	29.123	36.392	12.131
20	21	Med. dense sand	0.40	15.95	8.064	45	30.330	38.394	12.798
21	22	LS/Grav sand	0.60	15.85	9.311	50	34.897	44.208	14.736
22	23	LS/Grav sand	0.60	15.75	10.609	50	36.057	46.665	15.555
23	24	LS/Grav sand	0.60	15.65	11.956	50	37.178	49.135	16.378
24	25	LS/Grav sand	0.60	15.55	13.354	50	38.263	51.616	17.205
25	26	LS/Grav sand	0.60	15.45	14.800	50	39.310	54.110	18.037
26	27	LS/Grav sand	0.60	15.35	16.294	50	40.320	56.614	18.871
27	28	LS/Grav sand	0.60	15.25	17.836	50	41.294	59.130	19.710
28	29	LS/Grav sand	0.60	15.15	19.424	50	42.233	61.656	20.552
29	30	LS/Grav sand	0.60	15.05	21.058	50	43.136	64.193	21.398
30	31	LS/Grav sand	0.60	14.95	22.736	50	44.003	66.740	22.247
31	32	LS/Grav sand	0.60	14.85	24.459	50	44.836	69.296	23.099
32	33	Very dense sand	0.55	14.75	26.087	65	59.900	85.987	28.662
33	34	Very dense sand	0.55	14.65	27.769	65	61.453	89.222	29.741
34	35	Very dense sand	0.55	14.55	29.506	65	62.947	92.453	30.818
35	36	Very dense sand	0.55	14.45	31.295	65	64.383	95.678	31.893
36	37	Very dense sand	0.55	14.35	33.137	65	65.761	98.898	32.966
37	38	Very dense sand	0.55	14.25	35.031	65	67.082	102.113	34.038
38	39	Very dense sand	0.55	14.15	36.975	65	68.347	105.321	35.107
39	40	Very dense sand	0.55	14.05	38.968	65	69.555	108.523	36.174
40	41	Very dense sand	0.55	13.95	41.010	65	70.709	111.719	37.240
41	42	Very dense sand	0.55	13.85	43.100	65	71.809	114.909	38.303
42	43	Limestone (IGM)	0.60	13.75	45.434	150	168.510	213.943	71.314
43	44	Limestone (IGM)	0.60	13.65	47.823	150	171.173	218.996	72.999
44	45	Limestone (IGM)	0.60	13.55	50.267	150	173.705	223.971	74.657
45	46	Limestone (IGM)	0.60	13.45	52.764	150	176.106	228.870	76.290
46	47	Limestone (IGM)	0.60	13.35	55.313	150	178.379	233.692	77.897
47	48	Limestone (IGM)	0.60	13.25	57.913	150	180.525	238.438	79.479
48	49	Limestone (IGM)	0.60	13.15	60.564	150	182.546	243.110	81.037
49	50	Limestone (IGM)	0.60	13.05	63.264	150	184.443	247.707	82.569

Table E-1.16: Capacity calculation for 18" circular, tapered pile for B-4 profile

(Refer Table-1 for stratification and material properties)

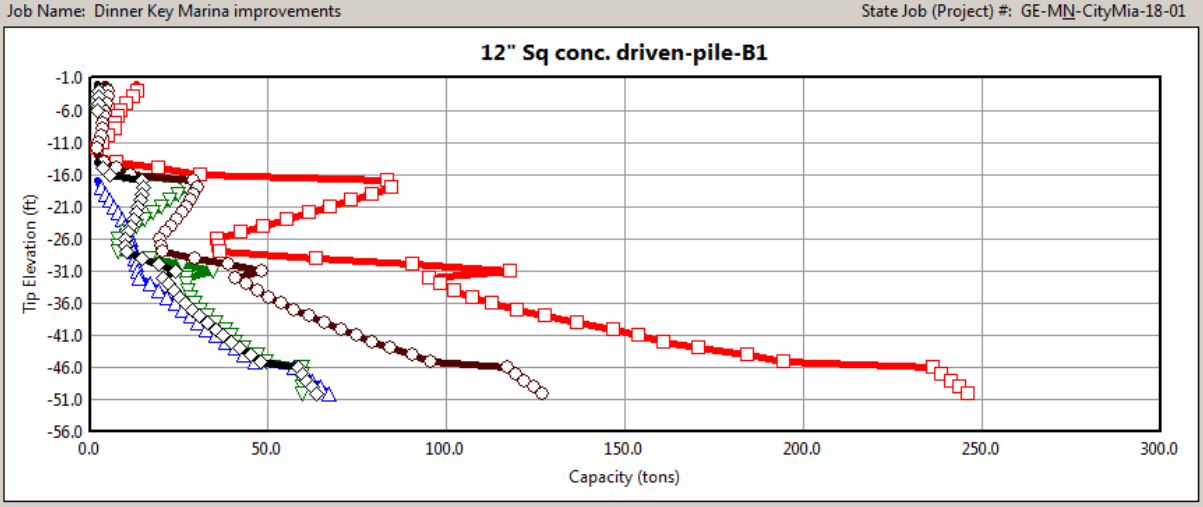
Layer From (ft)	depth To (ft)	Soil type	Coefficient of friction β	Av. Dia. of tapering pile **d** (inch)	Total ultimate Skin friction (ton)	N_t,Toe resistance Coefficient	Ultimate toe resistance $q_t * A_t$ (ton)	Ultimate pile capacity (ton)	Safe pile load for FS=3 (ton)
0	1	silt	0.00	17.95	0.000	0	0.000	0.000	0.000
1	2	LS/sand	0.30	17.85	0.041	28	1.940	1.982	0.661
2	3	LS/sand	0.30	17.75	0.112	28	2.938	3.050	1.017
3	4	LS/sand	0.30	17.65	0.212	28	3.912	4.124	1.375
4	5	LS/sand	0.30	17.55	0.341	28	4.864	5.205	1.735
5	6	LS/sand	0.30	17.45	0.498	28	5.793	6.291	2.097
6	7	Loose Sand	0.28	17.35	0.670	25	5.962	6.633	2.211
7	8	Loose Sand	0.28	17.25	0.868	25	6.733	7.601	2.534
8	9	Limestone (IGM)	0.60	17.15	1.363	150	48.013	49.376	16.459
9	10	Limestone (IGM)	0.60	17.05	1.946	150	55.445	57.391	19.130
10	11	Limestone (IGM)	0.60	16.95	2.615	150	62.692	65.308	21.769
11	12	Limestone (IGM)	0.60	16.85	3.370	150	69.757	73.127	24.376
12	13	Limestone (IGM)	0.60	16.75	4.210	150	76.641	80.851	26.950
13	14	Limestone (IGM)	0.60	16.65	5.132	150	83.346	88.478	29.493
14	15	Limestone (IGM)	0.60	16.55	6.137	150	89.873	96.011	32.004
15	16	Limestone (IGM)	0.60	16.45	7.224	150	96.225	103.448	34.483
16	17	Limestone (IGM)	0.60	16.35	8.390	150	102.402	110.792	36.931
17	18	Limestone (IGM)	0.60	16.25	9.636	150	108.406	118.042	39.347
18	19	Limestone (IGM)	0.60	16.15	10.960	150	114.240	125.199	41.733
19	20	Limestone (IGM)	0.60	16.05	12.360	150	119.904	132.264	44.088
20	21	Limestone (IGM)	0.60	15.95	13.837	150	125.401	139.238	46.413
21	22	Limestone (IGM)	0.60	15.85	15.389	150	130.732	146.120	48.707
22	23	LS/ sand	0.30	15.75	16.194	28	24.897	41.091	13.697
23	24	LS/ sand	0.30	15.65	17.020	28	25.373	42.392	14.131
24	25	LS/ sand	0.30	15.55	17.866	28	25.830	43.696	14.565
25	26	LS/ sand	0.30	15.45	18.734	28	26.269	45.003	15.001
26	27	LS/ sand	0.30	15.35	19.621	28	26.690	46.311	15.437
27	28	LS/ sand	0.30	15.25	20.528	28	27.094	47.622	15.874
28	29	Dense sand	0.50	15.15	22.077	55	54.322	76.398	25.466
29	30	Dense sand	0.50	15.05	23.667	55	55.380	79.047	26.349
30	31	Dense sand	0.50	14.95	25.299	55	56.395	81.694	27.231
31	32	Dense sand	0.50	14.85	26.970	55	57.369	84.339	28.113
32	33	Dense sand	0.50	14.75	28.681	55	58.301	86.983	28.994
33	34	Dense sand	0.50	14.65	30.431	55	59.192	89.624	29.875
34	35	Dense sand	0.50	14.55	32.220	55	60.043	92.263	30.754
35	36	Dense sand	0.50	14.45	34.045	55	60.854	94.899	31.633
36	37	Dense sand	0.50	14.35	35.907	55	61.625	97.532	32.511
37	38	Dense sand	0.50	14.25	37.806	55	62.357	100.163	33.388
38	39	Dense sand	0.50	14.15	39.740	55	63.050	102.790	34.263
39	40	Dense sand	0.50	14.05	41.708	55	63.705	105.413	35.138
40	41	Dense sand	0.50	13.95	43.711	55	64.323	108.033	36.011
41	42	Dense sand	0.50	13.85	45.747	55	64.903	110.650	36.883
42	43	Limestone (IGM)	0.60	13.75	48.237	150	179.642	227.879	75.960
43	44	Limestone (IGM)	0.60	13.65	50.782	150	182.144	232.926	77.642
44	45	Limestone (IGM)	0.60	13.55	53.380	150	184.515	237.894	79.298
45	46	Limestone (IGM)	0.60	13.45	56.030	150	186.757	242.786	80.929
46	47	Limestone (IGM)	0.60	13.35	58.731	150	188.871	247.602	82.534
47	48	Limestone (IGM)	0.60	13.25	61.483	150	190.860	252.342	84.114
48	49	Limestone (IGM)	0.60	13.15	64.283	150	192.724	257.008	85.669
49	50	Limestone (IGM)	0.60	13.05	67.132	150	194.467	261.598	87.199

Appendix E-2: Concrete piles- FB-Deep program output

Plot Window

Job Name: Dinner Key Marina improvements

State Job (Project) #: GE-MN-CityMia-18-01



Curves

- Ultimate Side Friction
- Mobilized End Bearing
- Ultimate Pile Capacity
- Estimated Davisson Capacity
- Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-1	
Ground Surface Elevation	0.00	(ft)
Section:	Square	
Width	12.00	(in)

Project Data

File:	inner-key-b1driven-sq
Date:	Jan 21, 2019
Engineer:	AK

Analysis Data

Analysis Type:	SPT

Plot Options

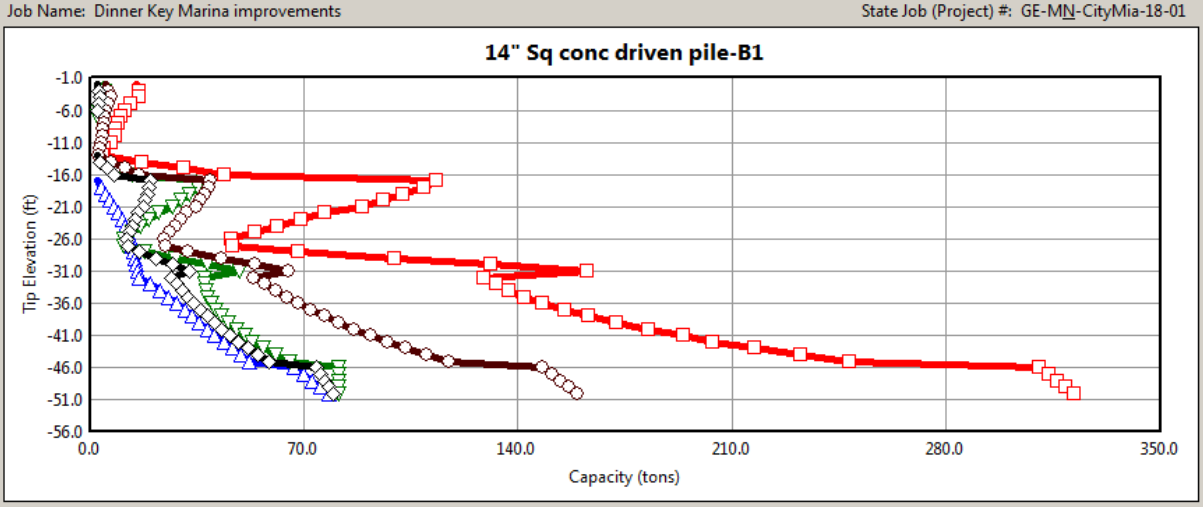
Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Plot Window

Job Name: Dinner Key Marina improvements

State Job (Project) #: GE-MN-CityMia-18-01



Curves

- [x] Ultimate Side Friction
- [x] Mobilized End Bearing
- [x] Ultimate Pile Capacity
- [x] Estimated Davisson Capacity
- [x] Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-1	
Ground Surface Elevation	0.00	(ft)
Section:	Square	
Width	14.00	(in)

Project Data

File:	inner-key-b1driven-sq
Date:	Jan 21, 2019
Engineer:	AK

Analysis Data

Analysis Type:	SPT

Plot Options

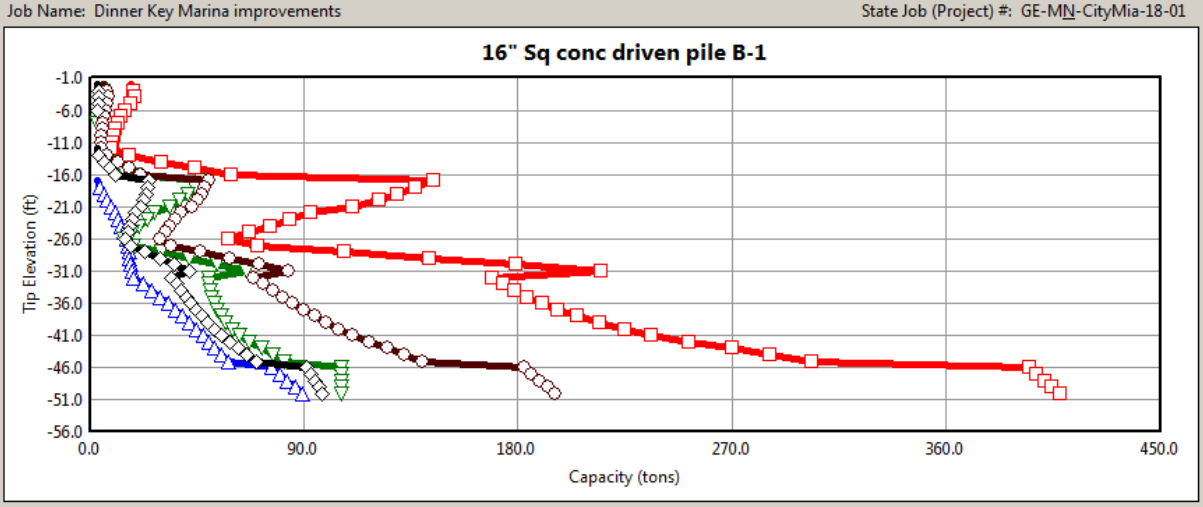
Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Plot Window

Job Name: Dinner Key Marina improvements

State Job (Project) #: GE-MN-CityMia-18-01



Curves

- [x] Ultimate Side Friction
- [x] Mobilized End Bearing
- [x] Ultimate Pile Capacity
- [x] Estimated Davisson Capacity
- [x] Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-1	
Ground Surface Elevation	0.00	(ft)
Section:	Square	
Width	16.00	(in)

Project Data

File:	inner-key-b1driven-sq
Date:	Jan 21, 2019
Engineer:	AK

Analysis Data

Analysis Type:	SPT

Plot Options

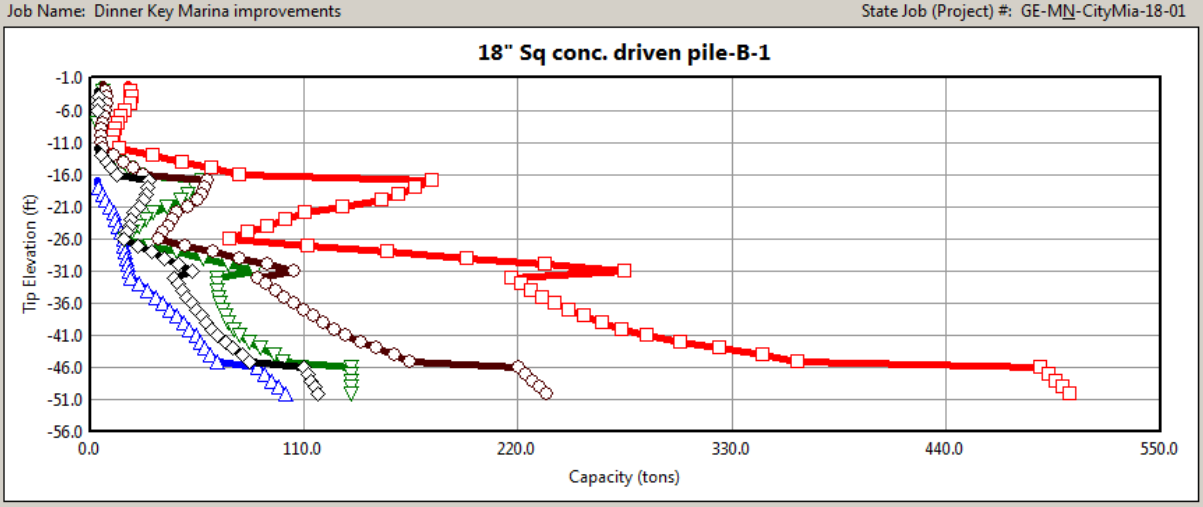
Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Plot Window

Job Name: Dinner Key Marina improvements

State Job (Project) #: GE-MN-CityMia-18-01



Curves

- Ultimate Side Friction
- Mobilized End Bearing
- Ultimate Pile Capacity
- Estimated Davisson Capacity
- Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-1	
Ground Surface Elevation	0.00	(ft)
Section:	Square	
Width	18.00	(in)

Project Data

File:	inner-key-b1driven-sq
Date:	Jan 21, 2019
Engineer:	AK

Analysis Data

Analysis Type:	SPT

Plot Options

Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Date: January 21, 2019
Time: 09:52:54

General Information:
==========
Input file: .....n\driven-square\dinner-driven-sq-b1\dinner-key-b1driven-sq.spc
Project number: GE-M&N-CityMia-18-01
Job name: Dinner Key Marina improvements
Engineer: AK
Units: English

Analysis Information:
==========
Analysis Type: SPT

Soil Information:
==========
Boring date: 11/26/2018, Boring Number: B-1
Station number: Offset:

Ground Elevation: 0.000(ft)

Hammer type: Automatic Hammer, Correction factor = 1.24

ID	Depth (ft)	No. of Blows (Blows/ft)	Soil Type
1	0.00	2.00	2- Clay and silty sand
2	1.00	2.00	2- Clay and silty sand
3	1.00	7.00	3- Clean sand
4	4.00	7.00	3- Clean sand
5	4.00	2.00	3- Clean sand
6	17.00	2.00	3- Clean sand
7	17.00	25.00	4- Lime Stone/Very shelly sand
8	22.00	25.00	4- Lime Stone/Very shelly sand
9	22.00	17.00	4- Lime Stone/Very shelly sand
10	26.00	17.00	4- Lime Stone/Very shelly sand
11	26.00	8.00	4- Lime Stone/Very shelly sand
12	32.00	8.00	4- Lime Stone/Very shelly sand
13	32.00	33.00	3- Clean sand
14	46.00	33.00	3- Clean sand
15	46.00	49.00	4- Lime Stone/Very shelly sand
16	50.00	49.00	4- Lime Stone/Very shelly sand
17	60.00	49.00	4- Lime Stone/Very shelly sand

Blowcount Average Per Soil Layer

Layer Num.	Starting Elevation (ft)	Bottom Elevation (ft)	Thickness (ft)	Average Blowcount (Blows/ft)	Soil Type
1	0.00	-1.00	1.00	2.00	2-Clay and Silty Sand
2	-1.00	-17.00	16.00	2.94	3-Clean Sand
3	-17.00	-32.00	15.00	16.07	4-Limestone, Very Shelly Sand
4	-32.00	-46.00	14.00	33.00	3-Clean Sand
5	-46.00	-60.00	14.00	49.00	4-Limestone, Very Shelly Sand

Driven Pile Data:
==========
Pile unit weight = 145.00(pcf), Section Type: Square

Pile Geometry:

Width (in)	Length (ft)	Tip Elev. (ft)
12.00	1.00	-1.00
12.00	2.00	-2.00
12.00	3.00	-3.00
12.00	4.00	-4.00
12.00	5.00	-5.00
12.00	6.00	-6.00
12.00	7.00	-7.00
12.00	8.00	-8.00
12.00	9.00	-9.00
12.00	10.00	-10.00
12.00	11.00	-11.00
12.00	12.00	-12.00
12.00	13.00	-13.00
12.00	14.00	-14.00
12.00	15.00	-15.00
12.00	16.00	-16.00
12.00	17.00	-17.00
12.00	18.00	-18.00
12.00	19.00	-19.00
12.00	20.00	-20.00
12.00	21.00	-21.00
12.00	22.00	-22.00
12.00	23.00	-23.00
12.00	24.00	-24.00
12.00	25.00	-25.00
12.00	26.00	-26.00
12.00	27.00	-27.00
12.00	28.00	-28.00
12.00	29.00	-29.00
12.00	30.00	-30.00
12.00	31.00	-31.00
12.00	32.00	-32.00
12.00	33.00	-33.00
12.00	34.00	-34.00
12.00	35.00	-35.00
12.00	36.00	-36.00
12.00	37.00	-37.00
12.00	38.00	-38.00
12.00	39.00	-39.00
12.00	40.00	-40.00
12.00	41.00	-41.00
12.00	42.00	-42.00
12.00	43.00	-43.00
12.00	44.00	-44.00
12.00	45.00	-45.00
12.00	46.00	-46.00
12.00	47.00	-47.00
12.00	48.00	-48.00
12.00	49.00	-49.00
12.00	50.00	-50.00
14.00	1.00	-1.00
14.00	2.00	-2.00
14.00	3.00	-3.00
14.00	4.00	-4.00

14.00	5.00	-5.00
14.00	6.00	-6.00
14.00	7.00	-7.00
14.00	8.00	-8.00
14.00	9.00	-9.00
14.00	10.00	-10.00
14.00	11.00	-11.00
14.00	12.00	-12.00
14.00	13.00	-13.00
14.00	14.00	-14.00
14.00	15.00	-15.00
14.00	16.00	-16.00
14.00	17.00	-17.00
14.00	18.00	-18.00
14.00	19.00	-19.00
14.00	20.00	-20.00
14.00	21.00	-21.00
14.00	22.00	-22.00
14.00	23.00	-23.00
14.00	24.00	-24.00
14.00	25.00	-25.00
14.00	26.00	-26.00
14.00	27.00	-27.00
14.00	28.00	-28.00
14.00	29.00	-29.00
14.00	30.00	-30.00
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14.00	45.00	-45.00
14.00	46.00	-46.00
14.00	47.00	-47.00
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16.00	5.00	-5.00
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16.00	7.00	-7.00
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16.00	19.00	-19.00
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16.00	21.00	-21.00
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16.00	23.00	-23.00
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16.00	25.00	-25.00
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16.00	35.00	-35.00
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16.00	38.00	-38.00
16.00	39.00	-39.00
16.00	40.00	-40.00
16.00	41.00	-41.00
16.00	42.00	-42.00
16.00	43.00	-43.00
16.00	44.00	-44.00
16.00	45.00	-45.00
16.00	46.00	-46.00
16.00	47.00	-47.00
16.00	48.00	-48.00
16.00	49.00	-49.00
16.00	50.00	-50.00
18.00	1.00	-1.00
18.00	2.00	-2.00
18.00	3.00	-3.00
18.00	4.00	-4.00
18.00	5.00	-5.00
18.00	6.00	-6.00
18.00	7.00	-7.00
18.00	8.00	-8.00
18.00	9.00	-9.00
18.00	10.00	-10.00
18.00	11.00	-11.00
18.00	12.00	-12.00
18.00	13.00	-13.00
18.00	14.00	-14.00
18.00	15.00	-15.00
18.00	16.00	-16.00
18.00	17.00	-17.00
18.00	18.00	-18.00
18.00	19.00	-19.00
18.00	20.00	-20.00
18.00	21.00	-21.00
18.00	22.00	-22.00
18.00	23.00	-23.00
18.00	24.00	-24.00
18.00	25.00	-25.00
18.00	26.00	-26.00
18.00	27.00	-27.00
18.00	28.00	-28.00
18.00	29.00	-29.00
18.00	30.00	-30.00
18.00	31.00	-31.00
18.00	32.00	-32.00

18.00	33.00	-33.00
18.00	34.00	-34.00
18.00	35.00	-35.00
18.00	36.00	-36.00
18.00	37.00	-37.00
18.00	38.00	-38.00
18.00	39.00	-39.00
18.00	40.00	-40.00
18.00	41.00	-41.00
18.00	42.00	-42.00
18.00	43.00	-43.00
18.00	44.00	-44.00
18.00	45.00	-45.00
18.00	46.00	-46.00
18.00	47.00	-47.00
18.00	48.00	-48.00
18.00	49.00	-49.00
18.00	50.00	-50.00

Driven Pile Capacity:
==========

Section Type: Square
Pile Width: 12.00 (in)

Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
1.00	12.0	0.00	3.97	3.97	1.98	11.90
2.00	12.0	0.54	4.13	4.67	2.34	12.94
3.00	12.0	1.21	4.11	5.32	2.66	13.55
4.00	12.0	1.98	3.47	5.45	2.73	12.40
5.00	12.0	1.98	2.78	4.76	2.38	10.31
6.00	12.0	1.98	2.31	4.29	2.15	8.92
7.00	12.0	1.98	1.98	3.96	1.98	7.93
8.00	12.0	1.98	1.74	3.72	1.86	7.19
9.00	12.0	1.98	1.74	3.72	1.86	7.19
10.00	12.0	1.98	1.16	3.14	1.57	5.45
11.00	12.0	1.98	0.58	2.56	1.28	3.72
12.00	12.0	1.98	0.00	1.98	0.99	1.98
13.00	12.0	1.98	0.00	1.98	0.99	1.98
14.00	12.0	1.98	1.94	3.92	1.96	7.81
15.00	12.0	1.98	5.83	7.81	3.90	19.47
16.00	12.0	1.98	9.72	11.69	5.85	31.12
17.00	12.0	1.98	27.20	29.18	14.59	83.59
18.00	12.0	3.22	27.20	30.42	15.21	84.83
19.00	12.0	4.46	24.86	29.32	14.66	79.05
20.00	12.0	5.70	22.52	28.22	14.11	73.27
21.00	12.0	6.94	20.18	27.12	13.56	67.49
22.00	12.0	8.18	17.85	26.02	13.01	61.71
23.00	12.0	9.02	15.40	24.43	12.21	55.23
24.00	12.0	9.87	12.96	22.83	11.41	48.75
25.00	12.0	10.71	10.52	21.23	10.61	42.26
26.00	12.0	11.55	8.08	19.63	9.81	35.78
27.00	12.0	11.95	8.08	20.02	10.01	36.18
28.00	12.0	12.35	8.08	20.42	10.21	36.57

29.00	12.0	12.74	16.97	29.71	14.86	63.65
30.00	12.0	13.14	25.86	39.00	19.50	90.72
31.00	12.0	13.54	34.75	48.29	24.15	117.80
32.00	12.0	13.93	27.08	41.02	20.51	95.18
33.00	12.0	16.88	27.22	44.09	22.05	98.53
34.00	12.0	19.55	27.62	47.17	23.58	102.41
35.00	12.0	21.90	28.45	50.34	25.17	107.23
36.00	12.0	24.08	29.64	53.72	26.86	113.00
37.00	12.0	26.19	31.21	57.39	28.70	119.81
38.00	12.0	28.27	33.14	61.41	30.70	127.69
39.00	12.0	30.36	35.45	65.81	32.91	136.71
40.00	12.0	32.52	38.13	70.64	35.32	146.90
41.00	12.0	35.28	39.51	74.79	37.39	153.80
42.00	12.0	38.15	40.89	79.03	39.52	160.81
43.00	12.0	40.82	43.32	84.13	42.07	170.77
44.00	12.0	43.33	47.08	90.41	45.20	184.57
45.00	12.0	46.44	49.37	95.81	47.90	194.55
46.00	12.0	57.47	59.68	117.15	58.57	236.51
47.00	12.0	59.90	59.68	119.58	59.79	238.94
48.00	12.0	62.33	59.68	122.01	61.01	241.37
49.00	12.0	64.76	59.68	124.44	62.22	243.80
50.00	12.0	67.19	59.68	126.87	63.44	246.23

Section Type: Square
Pile Width: 14.00 (in)

Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
1.00	14.0	0.00	4.63	4.63	2.31	13.89
2.00	14.0	0.59	4.86	5.44	2.72	15.16
3.00	14.0	1.28	4.95	6.23	3.12	16.13
4.00	14.0	2.27	4.67	6.94	3.47	16.28
5.00	14.0	2.31	3.78	6.09	3.04	13.65
6.00	14.0	2.31	3.15	5.46	2.73	11.76
7.00	14.0	2.31	2.70	5.01	2.50	10.41
8.00	14.0	2.31	2.36	4.67	2.34	9.40
9.00	14.0	2.31	2.10	4.41	2.20	8.61
10.00	14.0	2.31	2.03	4.33	2.17	8.38
11.00	14.0	2.31	1.58	3.88	1.94	7.03
12.00	14.0	2.31	0.90	3.21	1.60	5.01
13.00	14.0	2.31	0.60	2.91	1.46	4.12
14.00	14.0	2.31	4.91	7.22	3.61	17.04
15.00	14.0	2.31	9.45	11.75	5.88	30.65
16.00	14.0	2.31	13.98	16.29	8.14	44.25
17.00	14.0	2.31	37.03	39.33	19.67	113.39
18.00	14.0	3.76	35.21	38.96	19.48	109.38
19.00	14.0	5.20	32.48	37.68	18.84	102.63
20.00	14.0	6.65	29.75	36.40	18.20	95.89
21.00	14.0	8.10	27.02	35.11	17.56	89.15
22.00	14.0	9.54	22.39	31.93	15.97	76.71
23.00	14.0	10.53	19.54	30.07	15.03	69.15
24.00	14.0	11.51	16.69	28.20	14.10	61.58
25.00	14.0	12.49	13.84	26.33	13.17	54.02
26.00	14.0	13.48	10.99	24.47	12.23	46.45
27.00	14.0	13.94	10.99	24.93	12.47	46.92
28.00	14.0	14.40	17.91	32.31	16.16	68.13
29.00	14.0	14.87	28.28	43.15	21.57	99.72
30.00	14.0	15.33	38.66	53.99	26.99	131.31

31.00	14.0	15.79	49.03	64.83	32.41	162.90
32.00	14.0	16.25	37.58	53.83	26.92	128.98
33.00	14.0	19.72	37.71	57.43	28.71	132.85
34.00	14.0	22.90	38.11	61.01	30.51	137.24
35.00	14.0	25.87	38.78	64.66	32.33	142.22
36.00	14.0	28.58	39.86	68.45	34.22	148.17
37.00	14.0	31.12	41.36	72.48	36.24	155.20
38.00	14.0	33.58	43.23	76.81	38.40	163.26
39.00	14.0	36.02	45.47	81.48	40.74	172.42
40.00	14.0	38.47	48.08	86.55	43.27	182.70
41.00	14.0	40.97	51.06	92.03	46.01	194.14
42.00	14.0	43.91	53.33	97.24	48.62	203.90
43.00	14.0	46.55	57.01	103.55	51.78	217.56
44.00	14.0	49.30	61.06	110.36	55.18	232.49
45.00	14.0	52.19	65.50	117.69	58.84	248.69
46.00	14.0	67.05	81.23	148.28	74.14	310.74
47.00	14.0	69.89	81.23	151.11	75.56	313.57
48.00	14.0	72.72	81.23	153.95	76.97	316.41
49.00	14.0	75.56	81.23	156.79	78.39	319.24
50.00	14.0	78.39	81.23	159.62	79.81	322.08

Section Type: Square
Pile Width: 16.00 (in)

Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
1.00	16.0	0.00	5.29	5.29	2.65	15.87
2.00	16.0	0.63	5.58	6.21	3.11	17.38
3.00	16.0	1.34	5.78	7.12	3.56	18.68
4.00	16.0	2.33	5.62	7.95	3.98	19.20
5.00	16.0	2.64	4.94	7.58	3.79	17.45
6.00	16.0	2.64	4.11	6.75	3.38	14.98
7.00	16.0	2.64	3.53	6.17	3.08	13.22
8.00	16.0	2.64	3.09	5.72	2.86	11.90
9.00	16.0	2.64	2.74	5.38	2.69	10.87
10.00	16.0	2.64	2.47	5.11	2.55	10.05
11.00	16.0	2.64	2.31	4.95	2.48	9.58
12.00	16.0	2.64	2.06	4.70	2.35	8.81
13.00	16.0	2.64	4.74	7.38	3.69	16.86
14.00	16.0	2.64	9.15	11.79	5.89	30.09
15.00	16.0	2.64	13.82	16.46	8.23	44.09
16.00	16.0	2.64	19.00	21.64	10.82	59.64
17.00	16.0	2.64	47.32	49.96	24.98	144.60
18.00	16.0	4.29	44.20	48.49	24.25	136.90
19.00	16.0	5.95	41.08	47.03	23.51	129.19
20.00	16.0	7.60	37.96	45.56	22.78	121.49
21.00	16.0	9.25	33.76	43.01	21.51	110.53
22.00	16.0	10.91	27.38	38.29	19.14	93.05
23.00	16.0	12.03	24.13	36.16	18.08	84.41
24.00	16.0	13.15	20.87	34.02	17.01	75.76
25.00	16.0	14.28	17.61	31.89	15.95	67.12
26.00	16.0	15.40	14.36	29.76	14.88	58.47
27.00	16.0	15.93	18.31	34.24	17.12	70.86
28.00	16.0	16.46	30.17	46.63	23.31	106.96
29.00	16.0	16.99	42.02	59.01	29.51	143.06
30.00	16.0	17.52	53.88	71.40	35.70	179.16
31.00	16.0	18.05	65.74	83.79	41.89	215.26
32.00	16.0	18.58	50.30	68.87	34.44	169.46

33.00	16.0	22.60	50.40	72.99	36.50	173.79
34.00	16.0	26.33	50.77	77.09	38.55	178.63
35.00	16.0	29.83	51.41	81.24	40.62	184.05
36.00	16.0	33.15	52.32	85.47	42.74	190.10
37.00	16.0	36.29	53.58	89.87	44.93	197.02
38.00	16.0	39.19	55.35	94.53	47.27	205.22
39.00	16.0	42.02	57.48	99.50	49.75	214.47
40.00	16.0	44.83	59.99	104.82	52.41	224.81
41.00	16.0	47.64	62.87	110.51	55.26	236.26
42.00	16.0	50.00	67.40	117.39	58.70	252.19
43.00	16.0	52.46	72.56	125.03	62.51	270.15
44.00	16.0	55.48	76.88	132.36	66.18	286.11
45.00	16.0	58.61	81.57	140.18	70.09	303.33
46.00	16.0	76.63	106.09	182.72	91.36	394.91
47.00	16.0	79.87	106.09	185.96	92.98	398.15
48.00	16.0	83.11	106.09	189.20	94.60	401.39
49.00	16.0	86.35	106.09	192.44	96.22	404.63
50.00	16.0	89.59	106.09	195.69	97.84	407.87

Section Type: Square
Pile Width: 18.00 (in)

Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
1.00	18.0	0.00	5.95	5.95	2.98	17.86
2.00	18.0	0.66	6.31	6.97	3.49	19.59
3.00	18.0	1.39	6.61	8.01	4.00	21.23
4.00	18.0	2.38	6.57	8.95	4.48	22.10
5.00	18.0	2.86	6.08	8.94	4.47	21.11
6.00	18.0	2.97	5.21	8.18	4.09	18.59
7.00	18.0	2.97	4.46	7.43	3.72	16.36
8.00	18.0	2.97	3.91	6.87	3.44	14.69
9.00	18.0	2.97	3.47	6.44	3.22	13.38
10.00	18.0	2.97	3.12	6.09	3.05	12.34
11.00	18.0	2.97	2.84	5.81	2.90	11.49
12.00	18.0	2.97	4.06	7.03	3.51	15.15
13.00	18.0	2.97	9.89	12.86	6.43	32.64
14.00	18.0	2.97	14.85	17.82	8.91	47.52
15.00	18.0	2.97	19.81	22.78	11.39	62.41
16.00	18.0	2.97	24.77	27.74	13.87	77.29
17.00	18.0	2.97	57.70	60.67	30.33	176.06
18.00	18.0	4.83	54.19	59.02	29.51	167.39
19.00	18.0	6.69	50.68	57.37	28.68	158.73
20.00	18.0	8.55	47.17	55.72	27.86	150.06
21.00	18.0	10.41	40.00	50.41	25.20	130.40
22.00	18.0	12.27	32.82	45.09	22.55	110.74
23.00	18.0	13.53	29.16	42.69	21.35	101.02
24.00	18.0	14.80	25.50	40.30	20.15	91.29
25.00	18.0	16.06	21.83	37.90	18.95	81.56
26.00	18.0	17.33	18.17	35.50	17.75	71.84
27.00	18.0	17.92	31.51	49.43	24.72	112.45
28.00	18.0	18.52	44.85	63.37	31.68	153.07
29.00	18.0	19.11	58.19	77.30	38.65	193.68
30.00	18.0	19.71	71.53	91.24	45.62	234.29
31.00	18.0	20.30	84.87	105.17	52.59	274.91
32.00	18.0	20.90	65.44	86.34	43.17	217.22
33.00	18.0	25.46	65.52	90.98	45.49	222.03
34.00	18.0	29.83	65.78	95.61	47.81	227.18

35.00	18.0	33.90	66.36	100.25	50.13	232.97
36.00	18.0	37.77	67.20	104.97	52.48	239.37
37.00	18.0	41.48	68.31	109.79	54.90	246.42
38.00	18.0	45.08	69.69	114.77	57.39	254.16
39.00	18.0	48.36	71.70	120.06	60.03	263.45
40.00	18.0	51.57	74.07	125.65	62.82	273.80
41.00	18.0	54.53	77.25	131.78	65.89	286.28
42.00	18.0	56.86	82.32	139.19	69.59	303.83
43.00	18.0	59.31	88.15	147.46	73.73	323.75
44.00	18.0	61.89	94.73	156.61	78.31	346.07
45.00	18.0	65.27	99.65	164.92	82.46	364.22
46.00	18.0	86.21	134.28	220.48	110.24	489.03
47.00	18.0	89.85	134.28	224.13	112.06	492.68
48.00	18.0	93.50	134.28	227.77	113.89	496.33
49.00	18.0	97.14	134.28	231.42	115.71	499.97
50.00	18.0	100.79	134.28	235.07	117.53	503.62

NOTES
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1. MOBILIZED END BEARING IS 1/3 OF THE ORIGINAL RB-121 VALUES.

2. DAVISSON PILE CAPACITY IS AN ESTIMATE BASED ON FAILURE CRITERIA, AND EQUALS ULTIMATE SIDE FRICTION PLUS MOBILIZED END BEARING.

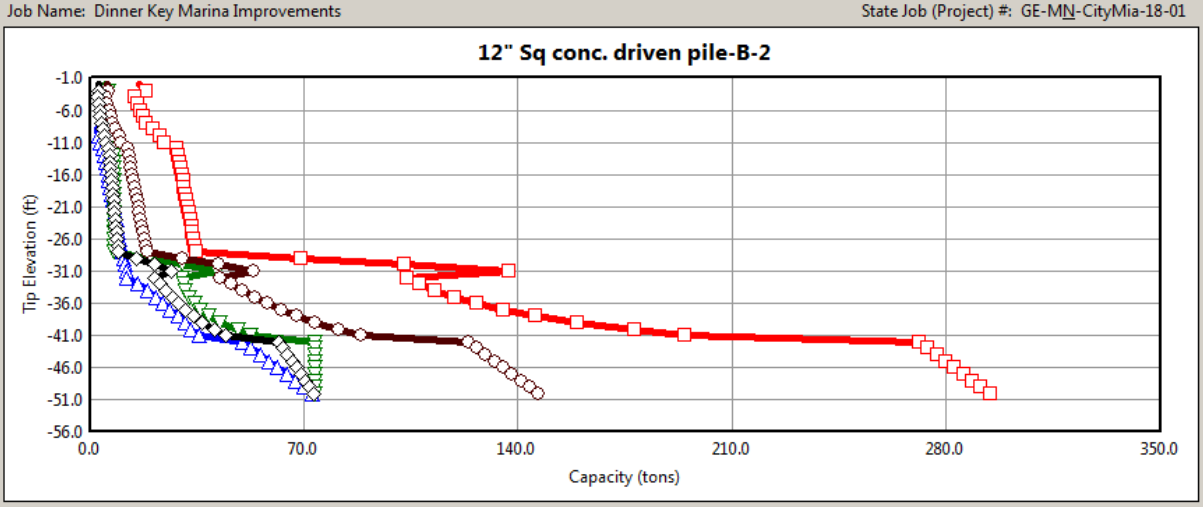
3. ALLOWABLE PILE CAPACITY IS 1/2 THE DAVISSON PILE CAPACITY.

4. ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS 3 x THE MOBILIZED END BEARING.
   EXCEPTION: FOR H-PILES TIPPED IN SAND OR LIMESTONE, THE ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS 2 x THE MOBILIZED END BEARING.

Plot Window

Job Name: Dinner Key Marina Improvements

State Job (Project) #: GE-MN-CityMia-18-01



Curves

- Ultimate Side Friction
- Mobilized End Bearing
- Ultimate Pile Capacity
- Estimated Davisson Capacity
- Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-2	
Ground Surface Elevation	0.00	(ft)
Section:	Square	
Width	12.00	(in)

Project Data

File:	ıner-key-b2-driven-sq
Date:	Jan 21, 2019
Engineer:	AK

Analysis Data

Analysis Type:	SPT

Plot Options

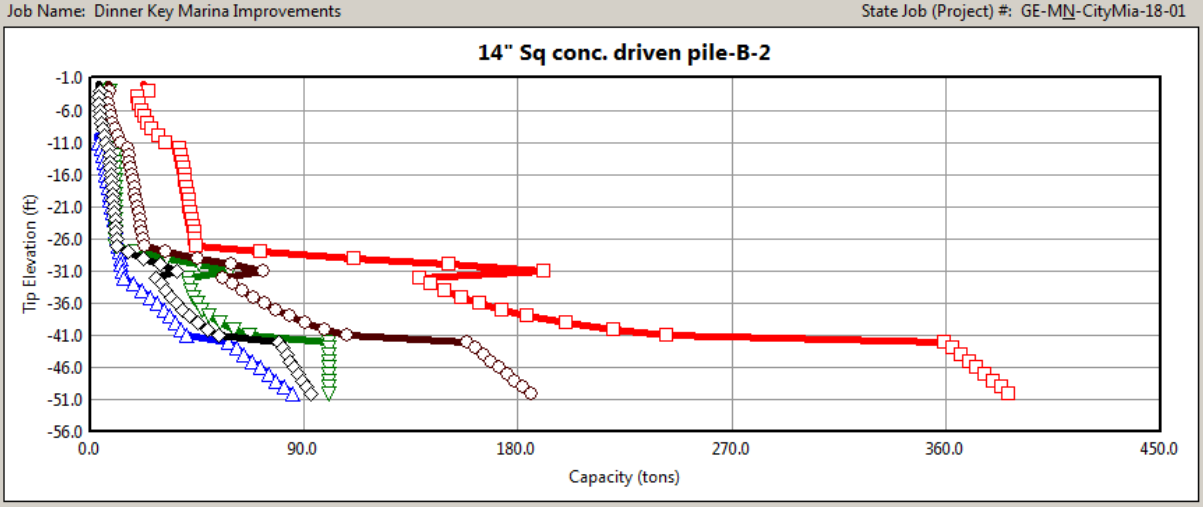
Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Plot Window

Job Name: Dinner Key Marina Improvements

State Job (Project) #: GE-MN-CityMia-18-01



Curves

- Ultimate Side Friction
- Mobilized End Bearing
- Ultimate Pile Capacity
- Estimated Davisson Capacity
- Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-2	
Ground Surface Elevation	0.00	(ft)
Section:	Square	
Width	14.00	(in)

Project Data

File:	ıner-key-b2-driven-sq
Date:	Jan 21, 2019
Engineer:	AK

Analysis Data

Analysis Type:	SPT

Plot Options

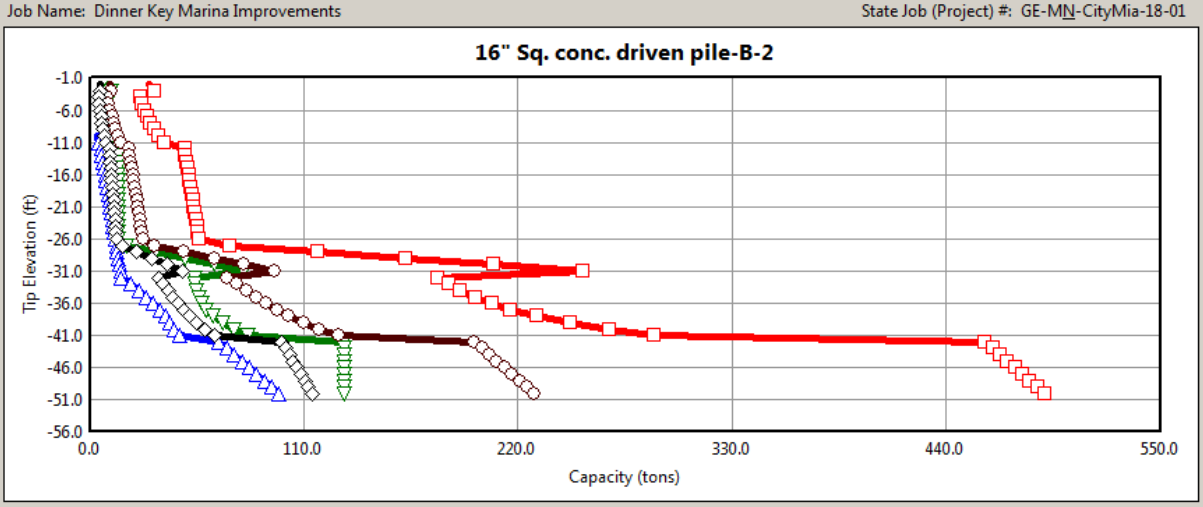
Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Plot Window

Job Name: Dinner Key Marina Improvements

State Job (Project) #: GE-MN-CityMia-18-01



Curves

- [x] Ultimate Side Friction
- [x] Mobilized End Bearing
- [x] Ultimate Pile Capacity
- [x] Estimated Davisson Capacity
- [x] Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-2	
Ground Surface Elevation	0.00	(ft)
Section:	Square	
Width	16.00	(in)

Project Data

File:	ıner-key-b2-driven-sq
Date:	Jan 21, 2019
Engineer:	AK

Analysis Data

Analysis Type:	SPT

Plot Options

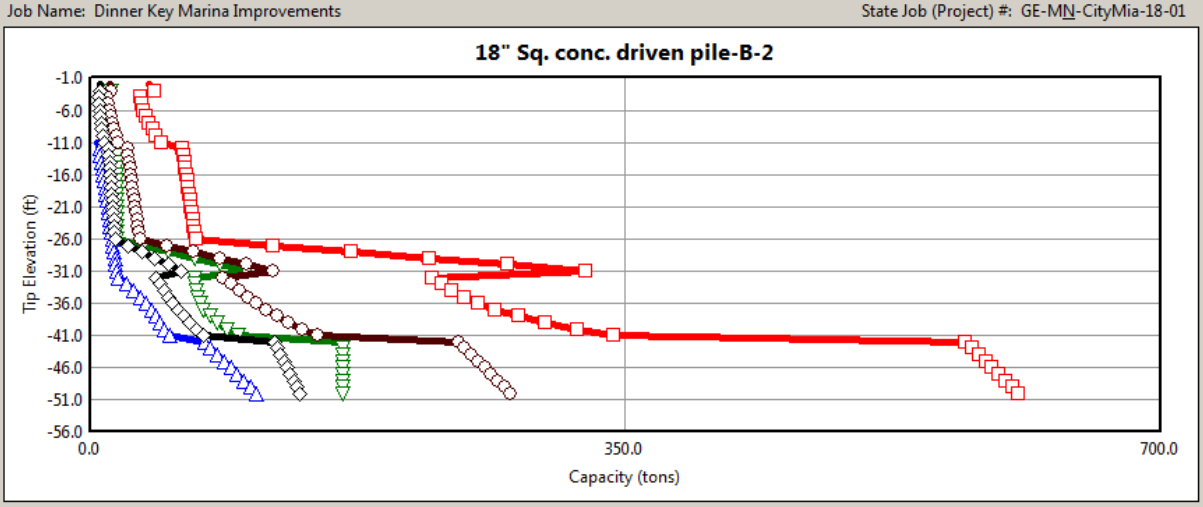
Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Plot Window

Job Name: Dinner Key Marina Improvements

State Job (Project) #: GE-MN-CityMia-18-01



Curves

- [x] Ultimate Side Friction
- [x] Mobilized End Bearing
- [x] Ultimate Pile Capacity
- [x] Estimated Davisson Capacity
- [x] Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-2	
Ground Surface Elevation	0.00	(ft)
Section:	Square	
Width	18.00	(in)

Project Data

File:	ıner-key-b2-driven-sq
Date:	Jan 21, 2019
Engineer:	AK

Analysis Data

Analysis Type:	SPT

Plot Options

Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Date: January 21, 2019
Time: 10:39:22

General Information:
==========
Input file: .....\driven-square\dinner-driven-sq-b2\dinner-key-b2-driven-sq.spc
Project number: GE-M&N-CityMia-18-01
Job name: Dinner Key Marina Improvements
Engineer: AK
Units: English

Analysis Information:
==========
Analysis Type: SPT

Soil Information:
==========
Boring date: 11/26/2018, Boring Number: B-2
Station number: Offset:

Ground Elevation: 0.000(ft)

Hammer type: Automatic Hammer, Correction factor = 1.24

ID	Depth (ft)	No. of Blows (Blows/ft)	Soil Type
1	0.00	2.00	2- Clay and silty sand
2	1.00	2.00	2- Clay and silty sand
3	1.00	4.00	4- Lime Stone/Very shelly sand
4	4.00	4.00	4- Lime Stone/Very shelly sand
5	4.00	5.00	3- Clean sand
6	12.00	5.00	3- Clean sand
7	12.00	8.00	4- Lime Stone/Very shelly sand
8	32.00	8.00	4- Lime Stone/Very shelly sand
9	32.00	40.00	3- Clean sand
10	42.00	40.00	3- Clean sand
11	42.00	58.00	4- Lime Stone/Very shelly sand
12	50.00	58.00	4- Lime Stone/Very shelly sand
13	60.00	58.00	4- Lime Stone/Very shelly sand

Blowcount Average Per Soil Layer

Layer Num.	Starting Elevation (ft)	Bottom Elevation (ft)	Thickness (ft)	Average Blowcount (Blows/ft)	Soil Type
1	0.00	-1.00	1.00	2.00	2-Clay and Silty Sand
2	-1.00	-4.00	3.00	4.00	4-Limestone, Very Shelly Sand
3	-4.00	-12.00	8.00	5.00	3-Clean Sand
4	-12.00	-32.00	20.00	8.00	4-Limestone, Very Shelly Sand
5	-32.00	-42.00	10.00	40.00	3-Clean Sand
6	-42.00	-60.00	18.00	58.00	4-Limestone, Very Shelly Sand

Driven Pile Data:
==========
Pile unit weight = 145.00(pcf), Section Type: Square

Pile Geometry:

Width (in)	Length (ft)	Tip Elev. (ft)
12.00	1.00	-1.00
12.00	2.00	-2.00
12.00	3.00	-3.00
12.00	4.00	-4.00
12.00	5.00	-5.00
12.00	6.00	-6.00
12.00	7.00	-7.00
12.00	8.00	-8.00
12.00	9.00	-9.00
12.00	10.00	-10.00
12.00	11.00	-11.00
12.00	12.00	-12.00
12.00	13.00	-13.00
12.00	14.00	-14.00
12.00	15.00	-15.00
12.00	16.00	-16.00
12.00	17.00	-17.00
12.00	18.00	-18.00
12.00	19.00	-19.00
12.00	20.00	-20.00
12.00	21.00	-21.00
12.00	22.00	-22.00
12.00	23.00	-23.00
12.00	24.00	-24.00
12.00	25.00	-25.00
12.00	26.00	-26.00
12.00	27.00	-27.00
12.00	28.00	-28.00
12.00	29.00	-29.00
12.00	30.00	-30.00
12.00	31.00	-31.00
12.00	32.00	-32.00
12.00	33.00	-33.00
12.00	34.00	-34.00
12.00	35.00	-35.00
12.00	36.00	-36.00
12.00	37.00	-37.00
12.00	38.00	-38.00
12.00	39.00	-39.00
12.00	40.00	-40.00
12.00	41.00	-41.00
12.00	42.00	-42.00
12.00	43.00	-43.00
12.00	44.00	-44.00
12.00	45.00	-45.00
12.00	46.00	-46.00
12.00	47.00	-47.00
12.00	48.00	-48.00
12.00	49.00	-49.00
12.00	50.00	-50.00
14.00	1.00	-1.00
14.00	2.00	-2.00
14.00	3.00	-3.00
14.00	4.00	-4.00
14.00	5.00	-5.00

14.00	6.00	-6.00
14.00	7.00	-7.00
14.00	8.00	-8.00
14.00	9.00	-9.00
14.00	10.00	-10.00
14.00	11.00	-11.00
14.00	12.00	-12.00
14.00	13.00	-13.00
14.00	14.00	-14.00
14.00	15.00	-15.00
14.00	16.00	-16.00
14.00	17.00	-17.00
14.00	18.00	-18.00
14.00	19.00	-19.00
14.00	20.00	-20.00
14.00	21.00	-21.00
14.00	22.00	-22.00
14.00	23.00	-23.00
14.00	24.00	-24.00
14.00	25.00	-25.00
14.00	26.00	-26.00
14.00	27.00	-27.00
14.00	28.00	-28.00
14.00	29.00	-29.00
14.00	30.00	-30.00
14.00	31.00	-31.00
14.00	32.00	-32.00
14.00	33.00	-33.00
14.00	34.00	-34.00
14.00	35.00	-35.00
14.00	36.00	-36.00
14.00	37.00	-37.00
14.00	38.00	-38.00
14.00	39.00	-39.00
14.00	40.00	-40.00
14.00	41.00	-41.00
14.00	42.00	-42.00
14.00	43.00	-43.00
14.00	44.00	-44.00
14.00	45.00	-45.00
14.00	46.00	-46.00
14.00	47.00	-47.00
14.00	48.00	-48.00
14.00	49.00	-49.00
14.00	50.00	-50.00
16.00	1.00	-1.00
16.00	2.00	-2.00
16.00	3.00	-3.00
16.00	4.00	-4.00
16.00	5.00	-5.00
16.00	6.00	-6.00
16.00	7.00	-7.00
16.00	8.00	-8.00
16.00	9.00	-9.00
16.00	10.00	-10.00
16.00	11.00	-11.00
16.00	12.00	-12.00
16.00	13.00	-13.00
16.00	14.00	-14.00
16.00	15.00	-15.00
16.00	16.00	-16.00
16.00	17.00	-17.00
16.00	18.00	-18.00
16.00	19.00	-19.00

16.00	20.00	-20.00
16.00	21.00	-21.00
16.00	22.00	-22.00
16.00	23.00	-23.00
16.00	24.00	-24.00
16.00	25.00	-25.00
16.00	26.00	-26.00
16.00	27.00	-27.00
16.00	28.00	-28.00
16.00	29.00	-29.00
16.00	30.00	-30.00
16.00	31.00	-31.00
16.00	32.00	-32.00
16.00	33.00	-33.00
16.00	34.00	-34.00
16.00	35.00	-35.00
16.00	36.00	-36.00
16.00	37.00	-37.00
16.00	38.00	-38.00
16.00	39.00	-39.00
16.00	40.00	-40.00
16.00	41.00	-41.00
16.00	42.00	-42.00
16.00	43.00	-43.00
16.00	44.00	-44.00
16.00	45.00	-45.00
16.00	46.00	-46.00
16.00	47.00	-47.00
16.00	48.00	-48.00
16.00	49.00	-49.00
16.00	50.00	-50.00
18.00	1.00	-1.00
18.00	2.00	-2.00
18.00	3.00	-3.00
18.00	4.00	-4.00
18.00	5.00	-5.00
18.00	6.00	-6.00
18.00	7.00	-7.00
18.00	8.00	-8.00
18.00	9.00	-9.00
18.00	10.00	-10.00
18.00	11.00	-11.00
18.00	12.00	-12.00
18.00	13.00	-13.00
18.00	14.00	-14.00
18.00	15.00	-15.00
18.00	16.00	-16.00
18.00	17.00	-17.00
18.00	18.00	-18.00
18.00	19.00	-19.00
18.00	20.00	-20.00
18.00	21.00	-21.00
18.00	22.00	-22.00
18.00	23.00	-23.00
18.00	24.00	-24.00
18.00	25.00	-25.00
18.00	26.00	-26.00
18.00	27.00	-27.00
18.00	28.00	-28.00
18.00	29.00	-29.00
18.00	30.00	-30.00
18.00	31.00	-31.00
18.00	32.00	-32.00
18.00	33.00	-33.00

18.00	34.00	-34.00
18.00	35.00	-35.00
18.00	36.00	-36.00
18.00	37.00	-37.00
18.00	38.00	-38.00
18.00	39.00	-39.00
18.00	40.00	-40.00
18.00	41.00	-41.00
18.00	42.00	-42.00
18.00	43.00	-43.00
18.00	44.00	-44.00
18.00	45.00	-45.00
18.00	46.00	-46.00
18.00	47.00	-47.00
18.00	48.00	-48.00
18.00	49.00	-49.00
18.00	50.00	-50.00

Driven Pile Capacity:
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Section Type: Square
Pile Width: 12.00 (in)

Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
1.00	12.0	0.00	4.63	4.63	2.32	13.89
2.00	12.0	0.20	5.29	5.49	2.75	16.07
3.00	12.0	0.40	5.95	6.35	3.17	18.25
4.00	12.0	0.60	4.80	5.39	2.70	14.98
5.00	12.0	1.04	4.86	5.89	2.95	15.60
6.00	12.0	1.45	5.00	6.45	3.22	16.44
7.00	12.0	1.86	5.19	7.05	3.52	17.42
8.00	12.0	2.28	5.40	7.68	3.84	18.48
9.00	12.0	2.64	5.98	8.62	4.31	20.59
10.00	12.0	3.04	6.60	9.63	4.82	22.83
11.00	12.0	3.51	6.97	10.48	5.24	24.42
12.00	12.0	4.36	8.08	12.44	6.22	28.59
13.00	12.0	4.76	8.08	12.84	6.42	28.99
14.00	12.0	5.16	8.08	13.23	6.62	29.39
15.00	12.0	5.56	8.08	13.63	6.82	29.78
16.00	12.0	5.95	8.08	14.03	7.01	30.18
17.00	12.0	6.35	8.08	14.42	7.21	30.58
18.00	12.0	6.75	8.08	14.82	7.41	30.97
19.00	12.0	7.14	8.08	15.22	7.61	31.37
20.00	12.0	7.54	8.08	15.61	7.81	31.77
21.00	12.0	7.94	8.08	16.01	8.01	32.16
22.00	12.0	8.33	8.08	16.41	8.20	32.56
23.00	12.0	8.73	8.08	16.81	8.40	32.96
24.00	12.0	9.13	8.08	17.20	8.60	33.35
25.00	12.0	9.52	8.08	17.60	8.80	33.75
26.00	12.0	9.92	8.08	18.00	9.00	34.15
27.00	12.0	10.32	8.08	18.39	9.20	34.54
28.00	12.0	10.71	8.08	18.79	9.39	34.94
29.00	12.0	11.11	19.28	30.39	15.20	68.96

30.00	12.0	11.51	30.49	42.00	21.00	102.98
31.00	12.0	11.90	41.70	53.60	26.80	137.00
32.00	12.0	12.30	30.49	42.79	21.40	103.77
33.00	12.0	15.77	30.72	46.49	23.25	107.94
34.00	12.0	18.77	31.43	50.19	25.10	113.04
35.00	12.0	21.47	32.59	54.06	27.03	119.25
36.00	12.0	24.00	34.23	58.23	29.11	126.68
37.00	12.0	26.45	36.33	62.78	31.39	135.44
38.00	12.0	28.89	38.90	67.79	33.89	145.58
39.00	12.0	31.04	42.80	73.85	36.92	159.45
40.00	12.0	33.04	48.42	81.45	40.73	178.29
41.00	12.0	35.73	52.90	88.63	44.32	194.42
42.00	12.0	50.00	73.79	123.79	61.89	271.37
43.00	12.0	52.87	73.79	126.66	63.33	274.25
44.00	12.0	55.75	73.79	129.54	64.77	277.12
45.00	12.0	58.63	73.79	132.42	66.21	280.00
46.00	12.0	61.50	73.79	135.30	67.65	282.88
47.00	12.0	64.38	73.79	138.17	69.09	285.75
48.00	12.0	67.26	73.79	141.05	70.52	288.63
49.00	12.0	70.13	73.79	143.93	71.96	291.51
50.00	12.0	73.01	73.79	146.80	73.40	294.38

Section Type: Square
Pile Width: 14.00 (in)

Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
1.00	14.0	0.00	6.69	6.69	3.34	20.07
2.00	14.0	0.23	7.46	7.69	3.85	22.61
3.00	14.0	0.46	8.23	8.69	4.35	25.15
4.00	14.0	0.69	6.53	7.22	3.61	20.28
5.00	14.0	1.21	6.60	7.81	3.90	21.00
6.00	14.0	1.69	6.76	8.45	4.23	21.98
7.00	14.0	2.16	6.98	9.14	4.57	23.11
8.00	14.0	2.64	7.25	9.89	4.94	24.38
9.00	14.0	3.09	7.70	10.79	5.39	26.18
10.00	14.0	3.51	8.45	11.96	5.98	28.86
11.00	14.0	3.97	9.30	13.27	6.64	31.88
12.00	14.0	5.09	10.99	16.08	8.04	38.07
13.00	14.0	5.56	10.99	16.55	8.27	38.53
14.00	14.0	6.02	10.99	17.01	8.50	38.99
15.00	14.0	6.48	10.99	17.47	8.74	39.46
16.00	14.0	6.94	10.99	17.94	8.97	39.92
17.00	14.0	7.41	10.99	18.40	9.20	40.38
18.00	14.0	7.87	10.99	18.86	9.43	40.85
19.00	14.0	8.33	10.99	19.32	9.66	41.31
20.00	14.0	8.80	10.99	19.79	9.89	41.77
21.00	14.0	9.26	10.99	20.25	10.13	42.23
22.00	14.0	9.72	10.99	20.71	10.36	42.70
23.00	14.0	10.18	10.99	21.18	10.59	43.16
24.00	14.0	10.65	10.99	21.64	10.82	43.62
25.00	14.0	11.11	10.99	22.10	11.05	44.09
26.00	14.0	11.57	10.99	22.57	11.28	44.55
27.00	14.0	12.04	10.99	23.03	11.51	45.01
28.00	14.0	12.50	19.71	32.21	16.10	71.63
29.00	14.0	12.96	32.78	45.75	22.87	111.32
30.00	14.0	13.43	45.86	59.29	29.64	151.01
31.00	14.0	13.89	58.94	72.82	36.41	190.70

32.00	14.0	14.35	41.50	55.85	27.93	138.86
33.00	14.0	18.44	41.74	60.17	30.09	143.65
34.00	14.0	22.04	42.44	64.47	32.24	149.34
35.00	14.0	25.29	43.60	68.90	34.45	156.10
36.00	14.0	28.33	45.24	73.57	36.78	164.04
37.00	14.0	31.24	47.34	78.58	39.29	173.25
38.00	14.0	34.02	50.03	84.05	42.02	184.11
39.00	14.0	36.11	54.83	90.94	45.47	200.59
40.00	14.0	38.33	60.59	98.92	49.46	220.09
41.00	14.0	40.72	67.31	108.04	54.02	242.67
42.00	14.0	58.33	100.44	158.77	79.38	359.64
43.00	14.0	61.69	100.44	162.12	81.06	363.00
44.00	14.0	65.04	100.44	165.48	82.74	366.36
45.00	14.0	68.40	100.44	168.84	84.42	369.71
46.00	14.0	71.75	100.44	172.19	86.10	373.07
47.00	14.0	75.11	100.44	175.55	87.77	376.42
48.00	14.0	78.47	100.44	178.91	89.45	379.78
49.00	14.0	81.82	100.44	182.26	91.13	383.14
50.00	14.0	85.18	100.44	185.62	92.81	386.49

Section Type: Square
Pile Width: 16.00 (in)

Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
1.00	16.0	0.00	9.11	9.11	4.56	27.34
2.00	16.0	0.26	9.99	10.26	5.13	30.25
3.00	16.0	0.53	10.88	11.41	5.70	33.16
4.00	16.0	0.79	8.53	9.32	4.66	26.37
5.00	16.0	1.38	8.61	9.99	4.99	27.20
6.00	16.0	1.93	8.79	10.72	5.36	28.31
7.00	16.0	2.46	9.04	11.51	5.75	29.60
8.00	16.0	2.98	9.43	12.40	6.20	31.26
9.00	16.0	3.48	9.94	13.42	6.71	33.30
10.00	16.0	4.00	10.54	14.54	7.27	35.61
11.00	16.0	4.51	11.35	15.86	7.93	38.55
12.00	16.0	5.82	14.36	20.18	10.09	48.89
13.00	16.0	6.35	14.36	20.71	10.35	49.42
14.00	16.0	6.88	14.36	21.23	10.62	49.95
15.00	16.0	7.41	14.36	21.76	10.88	50.48
16.00	16.0	7.94	14.36	22.29	11.15	51.01
17.00	16.0	8.47	14.36	22.82	11.41	51.54
18.00	16.0	8.99	14.36	23.35	11.68	52.06
19.00	16.0	9.52	14.36	23.88	11.94	52.59
20.00	16.0	10.05	14.36	24.41	12.20	53.12
21.00	16.0	10.58	14.36	24.94	12.47	53.65
22.00	16.0	11.11	14.36	25.47	12.73	54.18
23.00	16.0	11.64	14.36	26.00	13.00	54.71
24.00	16.0	12.17	14.36	26.53	13.26	55.24
25.00	16.0	12.70	14.36	27.05	13.53	55.77
26.00	16.0	13.23	14.36	27.58	13.79	56.30
27.00	16.0	13.76	19.34	33.09	16.55	71.77
28.00	16.0	14.28	34.28	48.57	24.28	117.13
29.00	16.0	14.81	49.23	64.04	32.02	162.49
30.00	16.0	15.34	64.17	79.51	39.76	207.85
31.00	16.0	15.87	79.11	94.98	47.49	253.21
32.00	16.0	16.40	54.21	70.61	35.30	179.02
33.00	16.0	21.11	54.44	75.55	37.78	184.43

34.00	16.0	25.31	55.14	80.45	40.23	190.73
35.00	16.0	29.14	56.31	85.45	42.72	198.06
36.00	16.0	32.70	57.94	90.65	45.32	206.53
37.00	16.0	36.10	60.04	96.14	48.07	216.23
38.00	16.0	38.81	63.61	102.42	51.21	229.63
39.00	16.0	41.23	68.55	109.77	54.89	246.87
40.00	16.0	43.71	74.45	118.17	59.08	267.08
41.00	16.0	46.33	81.32	127.66	63.83	290.30
42.00	16.0	66.66	131.18	197.85	98.92	460.22
43.00	16.0	70.50	131.18	201.68	100.84	464.05
44.00	16.0	74.33	131.18	205.52	102.76	467.89
45.00	16.0	78.17	131.18	209.35	104.68	471.72
46.00	16.0	82.01	131.18	213.19	106.59	475.56
47.00	16.0	85.84	131.18	217.03	108.51	479.39
48.00	16.0	89.68	131.18	220.86	110.43	483.23
49.00	16.0	93.51	131.18	224.70	112.35	487.07
50.00	16.0	97.35	131.18	228.53	114.27	490.90

Section Type: Square
Pile Width: 18.00 (in)

Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
1.00	18.0	0.00	11.91	11.91	5.95	35.72
2.00	18.0	0.30	12.90	13.20	6.60	38.99
3.00	18.0	0.60	13.89	14.48	7.24	42.26
4.00	18.0	0.89	10.79	11.68	5.84	33.26
5.00	18.0	1.55	10.88	12.43	6.22	34.19
6.00	18.0	2.17	11.09	13.26	6.63	35.44
7.00	18.0	2.76	11.40	14.16	7.08	36.96
8.00	18.0	3.31	11.87	15.19	7.59	38.93
9.00	18.0	3.87	12.44	16.32	8.16	41.21
10.00	18.0	4.45	13.10	17.55	8.78	43.76
11.00	18.0	5.03	13.85	18.88	9.44	46.58
12.00	18.0	6.55	18.17	24.72	12.36	61.06
13.00	18.0	7.14	18.17	25.31	12.66	61.65
14.00	18.0	7.74	18.17	25.91	12.95	62.25
15.00	18.0	8.33	18.17	26.50	13.25	62.84
16.00	18.0	8.93	18.17	27.10	13.55	63.44
17.00	18.0	9.52	18.17	27.69	13.85	64.03
18.00	18.0	10.12	18.17	28.29	14.14	64.63
19.00	18.0	10.71	18.17	28.88	14.44	65.22
20.00	18.0	11.31	18.17	29.48	14.74	65.82
21.00	18.0	11.90	18.17	30.07	15.04	66.41
22.00	18.0	12.50	18.17	30.67	15.33	67.01
23.00	18.0	13.09	18.17	31.26	15.63	67.60
24.00	18.0	13.69	18.17	31.86	15.93	68.20
25.00	18.0	14.28	18.17	32.45	16.23	68.80
26.00	18.0	14.88	18.17	33.05	16.53	69.39
27.00	18.0	15.48	34.98	50.46	25.23	120.42
28.00	18.0	16.07	51.79	67.86	33.93	171.45
29.00	18.0	16.67	68.61	85.27	42.64	222.48
30.00	18.0	17.26	85.42	102.68	51.34	273.51
31.00	18.0	17.86	102.23	120.08	60.04	324.54
32.00	18.0	18.45	68.61	87.06	43.53	224.27
33.00	18.0	23.79	68.84	92.63	46.31	230.30
34.00	18.0	28.59	69.54	98.13	49.07	237.21
35.00	18.0	33.00	70.71	103.71	51.85	245.12

36.00	18.0	37.11	72.34	109.45	54.73	254.13
37.00	18.0	40.78	74.75	115.54	57.77	265.04
38.00	18.0	43.62	78.88	122.49	61.25	280.24
39.00	18.0	46.38	83.96	130.35	65.17	298.27
40.00	18.0	49.17	90.01	139.19	69.59	319.21
41.00	18.0	52.05	97.03	149.07	74.54	343.13
42.00	18.0	75.00	166.03	241.03	120.51	573.09
43.00	18.0	79.31	166.03	245.34	122.67	577.40
44.00	18.0	83.63	166.03	249.66	124.83	581.72
45.00	18.0	87.94	166.03	253.97	126.99	586.03
46.00	18.0	92.26	166.03	258.29	129.14	590.35
47.00	18.0	96.57	166.03	262.60	131.30	594.66
48.00	18.0	100.89	166.03	266.92	133.46	598.98
49.00	18.0	105.20	166.03	271.23	135.62	603.29
50.00	18.0	109.52	166.03	275.55	137.77	607.61

NOTES
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1. MOBILIZED END BEARING IS 1/3 OF THE ORIGINAL RB-121 VALUES.

2. DAVISSON PILE CAPACITY IS AN ESTIMATE BASED ON FAILURE CRITERIA, AND EQUALS ULTIMATE SIDE FRICTION PLUS MOBILIZED END BEARING.

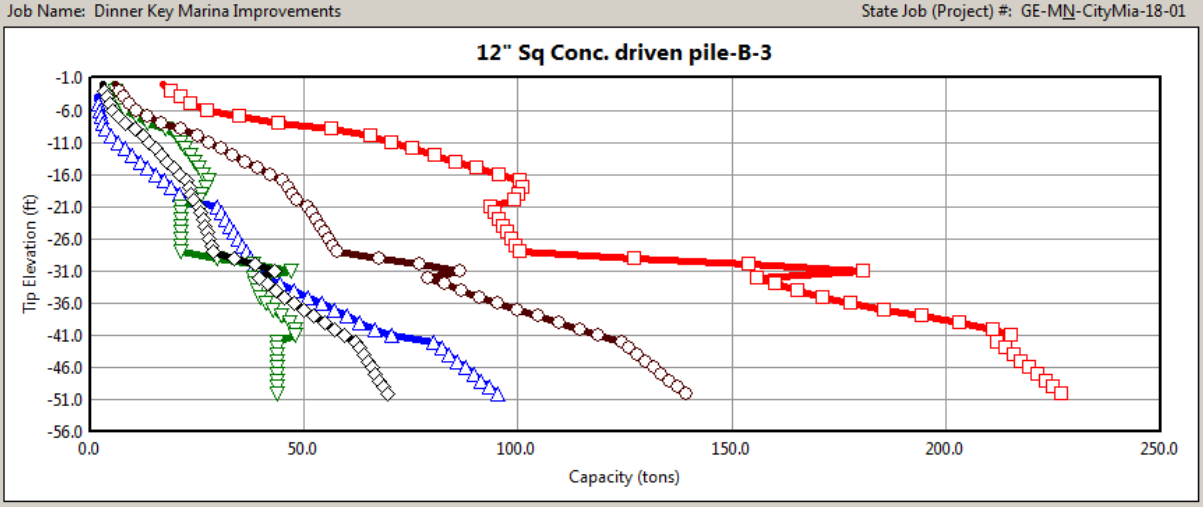
3. ALLOWABLE PILE CAPACITY IS 1/2 THE DAVISSON PILE CAPACITY.

4. ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS 3 x THE MOBILIZED END BEARING.
   EXCEPTION: FOR H-PILES TIPPED IN SAND OR LIMESTONE, THE ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS 2 x THE MOBILIZED END BEARING.

Plot Window

Job Name: Dinner Key Marina Improvements

State Job (Project) #: GE-MN-CityMia-18-01



Curves

- Ultimate Side Friction
- Mobilized End Bearing
- Ultimate Pile Capacity
- Estimated Davisson Capacity
- Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-3	
Ground Surface Elevation	0.00	(ft)
Section:	Square	
Width	12.00	(in)

Project Data

File:	ıner-key-b3-driven-sq
Date:	Jan 21, 2019
Engineer:	AK

Analysis Data

Analysis Type:	SPT

Plot Options

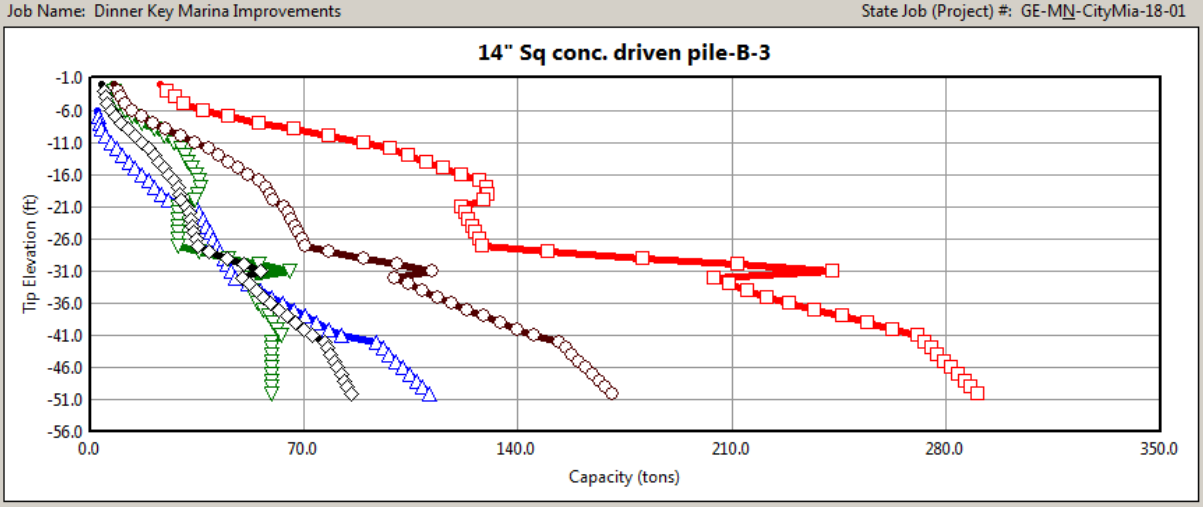
Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Plot Window

Job Name: Dinner Key Marina Improvements

State Job (Project) #: GE-MN-CityMia-18-01



Curves

- Ultimate Side Friction
- Mobilized End Bearing
- Ultimate Pile Capacity
- Estimated Davisson Capacity
- Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-3	
Ground Surface Elevation	0.00	(ft)
Section:	Square	
Width	14.00	(in)

Project Data

File:	ıner-key-b3-driven-sq
Date:	Jan 21, 2019
Engineer:	AK

Analysis Data

Analysis Type:	SPT

Plot Options

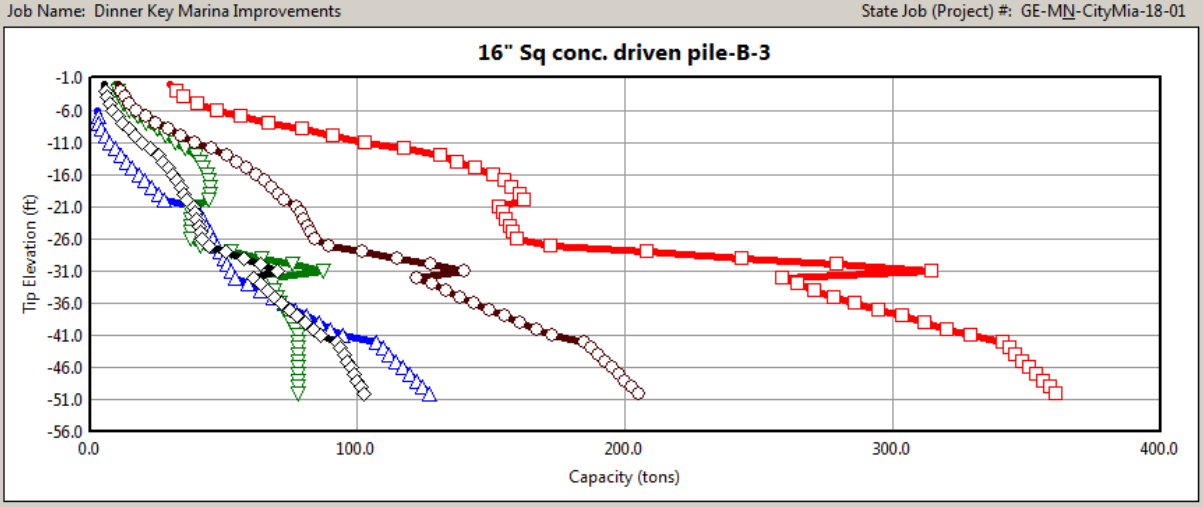
Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Plot Window

Job Name: Dinner Key Marina Improvements

State Job (Project) #: GE-MN-CityMia-18-01



Curves

- Ultimate Side Friction
- Mobilized End Bearing
- Ultimate Pile Capacity
- Estimated Davisson Capacity
- Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-3	
Ground Surface Elevation	0.00	(ft)
Section:	Square	
Width	16.00	(in)

Project Data

File:	ıner-key-b3-driven-sq
Date:	Jan 21, 2019
Engineer:	AK

Analysis Data

Analysis Type:	SPT

Plot Options

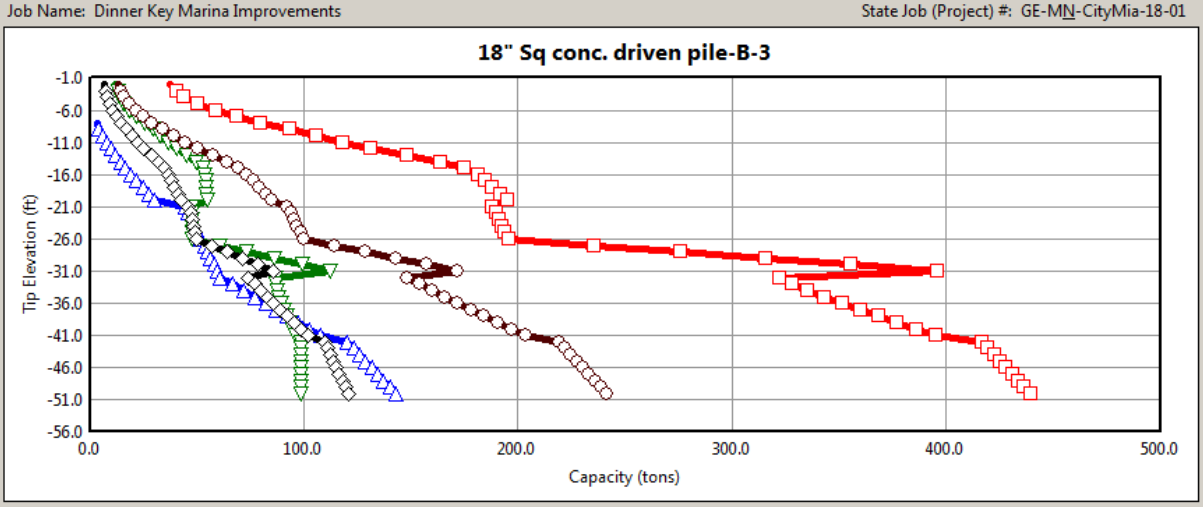
Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Plot Window

Job Name: Dinner Key Marina Improvements

State Job (Project) #: GE-MN-CityMia-18-01



Curves

- Ultimate Side Friction
- Mobilized End Bearing
- Ultimate Pile Capacity
- Estimated Davisson Capacity
- Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-3	
Ground Surface Elevation	0.00	(ft)
Section:	Square	
Width	18.00	(in)

Project Data

File:	ıner-key-b3-driven-sq
Date:	Jan 21, 2019
Engineer:	AK

Analysis Data

Analysis Type:	SPT

Plot Options

Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Date: January 21, 2019
Time: 10:51:31

General Information:
==========
Input file: .....\driven-square\dinner-driven-sq-b3\dinner-key-b3-driven-sq.spc
Project number: GE-M&N-CityMia-18-01
Job name: Dinner Key Marina Improvements
Engineer: AK
Units: English

Analysis Information:
==========
Analysis Type: SPT

Soil Information:
==========
Boring date: 11/26/2018, Boring Number: B-3
Station number: Offset:

Ground Elevation: 0.000(ft)

Hammer type: Automatic Hammer, Correction factor = 1.24

ID	Depth (ft)	No. of Blows (Blows/ft)	Soil Type
1	0.00	2.00	2- Clay and silty sand
2	1.00	2.00	2- Clay and silty sand
3	1.00	8.00	3- Clean sand
4	9.00	8.00	3- Clean sand
5	9.00	21.00	3- Clean sand
6	21.00	21.00	3- Clean sand
7	21.00	20.00	4- Lime Stone/Very shelly sand
8	32.00	20.00	4- Lime Stone/Very shelly sand
9	32.00	42.00	3- Clean sand
10	42.00	42.00	3- Clean sand
11	42.00	38.00	4- Lime Stone/Very shelly sand
12	50.00	38.00	4- Lime Stone/Very shelly sand
13	60.00	38.00	4- Lime Stone/Very shelly sand

Blowcount Average Per Soil Layer

Layer Num.	Starting Elevation (ft)	Bottom Elevation (ft)	Thickness (ft)	Average Blowcount (Blows/ft)	Soil Type
1	0.00	-1.00	1.00	2.00	2-Clay and Silty Sand
2	-1.00	-21.00	20.00	15.80	3-Clean Sand
3	-21.00	-32.00	11.00	20.00	4-Limestone, Very Shelly Sand
4	-32.00	-42.00	10.00	42.00	3-Clean Sand
5	-42.00	-60.00	18.00	38.00	4-Limestone, Very Shelly Sand

Driven Pile Data:
==========
Pile unit weight = 145.00(pcf), Section Type: Square

Pile Geometry:

Width (in)	Length (ft)	Tip Elev. (ft)
12.00	1.00	-1.00
12.00	2.00	-2.00
12.00	3.00	-3.00
12.00	4.00	-4.00
12.00	5.00	-5.00
12.00	6.00	-6.00
12.00	7.00	-7.00
12.00	8.00	-8.00
12.00	9.00	-9.00
12.00	10.00	-10.00
12.00	11.00	-11.00
12.00	12.00	-12.00
12.00	13.00	-13.00
12.00	14.00	-14.00
12.00	15.00	-15.00
12.00	16.00	-16.00
12.00	17.00	-17.00
12.00	18.00	-18.00
12.00	19.00	-19.00
12.00	20.00	-20.00
12.00	21.00	-21.00
12.00	22.00	-22.00
12.00	23.00	-23.00
12.00	24.00	-24.00
12.00	25.00	-25.00
12.00	26.00	-26.00
12.00	27.00	-27.00
12.00	28.00	-28.00
12.00	29.00	-29.00
12.00	30.00	-30.00
12.00	31.00	-31.00
12.00	32.00	-32.00
12.00	33.00	-33.00
12.00	34.00	-34.00
12.00	35.00	-35.00
12.00	36.00	-36.00
12.00	37.00	-37.00
12.00	38.00	-38.00
12.00	39.00	-39.00
12.00	40.00	-40.00
12.00	41.00	-41.00
12.00	42.00	-42.00
12.00	43.00	-43.00
12.00	44.00	-44.00
12.00	45.00	-45.00
12.00	46.00	-46.00
12.00	47.00	-47.00
12.00	48.00	-48.00
12.00	49.00	-49.00
12.00	50.00	-50.00
14.00	1.00	-1.00
14.00	2.00	-2.00
14.00	3.00	-3.00
14.00	4.00	-4.00
14.00	5.00	-5.00
14.00	6.00	-6.00
14.00	7.00	-7.00
14.00	8.00	-8.00

14.00	9.00	-9.00
14.00	10.00	-10.00
14.00	11.00	-11.00
14.00	12.00	-12.00
14.00	13.00	-13.00
14.00	14.00	-14.00
14.00	15.00	-15.00
14.00	16.00	-16.00
14.00	17.00	-17.00
14.00	18.00	-18.00
14.00	19.00	-19.00
14.00	20.00	-20.00
14.00	21.00	-21.00
14.00	22.00	-22.00
14.00	23.00	-23.00
14.00	24.00	-24.00
14.00	25.00	-25.00
14.00	26.00	-26.00
14.00	27.00	-27.00
14.00	28.00	-28.00
14.00	29.00	-29.00
14.00	30.00	-30.00
14.00	31.00	-31.00
14.00	32.00	-32.00
14.00	33.00	-33.00
14.00	34.00	-34.00
14.00	35.00	-35.00
14.00	36.00	-36.00
14.00	37.00	-37.00
14.00	38.00	-38.00
14.00	39.00	-39.00
14.00	40.00	-40.00
14.00	41.00	-41.00
14.00	42.00	-42.00
14.00	43.00	-43.00
14.00	44.00	-44.00
14.00	45.00	-45.00
14.00	46.00	-46.00
14.00	47.00	-47.00
14.00	48.00	-48.00
14.00	49.00	-49.00
14.00	50.00	-50.00
16.00	1.00	-1.00
16.00	2.00	-2.00
16.00	3.00	-3.00
16.00	4.00	-4.00
16.00	5.00	-5.00
16.00	6.00	-6.00
16.00	7.00	-7.00
16.00	8.00	-8.00
16.00	9.00	-9.00
16.00	10.00	-10.00
16.00	11.00	-11.00
16.00	12.00	-12.00
16.00	13.00	-13.00
16.00	14.00	-14.00
16.00	15.00	-15.00
16.00	16.00	-16.00
16.00	17.00	-17.00
16.00	18.00	-18.00
16.00	19.00	-19.00
16.00	20.00	-20.00
16.00	21.00	-21.00
16.00	22.00	-22.00

16.00	23.00	-23.00
16.00	24.00	-24.00
16.00	25.00	-25.00
16.00	26.00	-26.00
16.00	27.00	-27.00
16.00	28.00	-28.00
16.00	29.00	-29.00
16.00	30.00	-30.00
16.00	31.00	-31.00
16.00	32.00	-32.00
16.00	33.00	-33.00
16.00	34.00	-34.00
16.00	35.00	-35.00
16.00	36.00	-36.00
16.00	37.00	-37.00
16.00	38.00	-38.00
16.00	39.00	-39.00
16.00	40.00	-40.00
16.00	41.00	-41.00
16.00	42.00	-42.00
16.00	43.00	-43.00
16.00	44.00	-44.00
16.00	45.00	-45.00
16.00	46.00	-46.00
16.00	47.00	-47.00
16.00	48.00	-48.00
16.00	49.00	-49.00
16.00	50.00	-50.00
18.00	1.00	-1.00
18.00	2.00	-2.00
18.00	3.00	-3.00
18.00	4.00	-4.00
18.00	5.00	-5.00
18.00	6.00	-6.00
18.00	7.00	-7.00
18.00	8.00	-8.00
18.00	9.00	-9.00
18.00	10.00	-10.00
18.00	11.00	-11.00
18.00	12.00	-12.00
18.00	13.00	-13.00
18.00	14.00	-14.00
18.00	15.00	-15.00
18.00	16.00	-16.00
18.00	17.00	-17.00
18.00	18.00	-18.00
18.00	19.00	-19.00
18.00	20.00	-20.00
18.00	21.00	-21.00
18.00	22.00	-22.00
18.00	23.00	-23.00
18.00	24.00	-24.00
18.00	25.00	-25.00
18.00	26.00	-26.00
18.00	27.00	-27.00
18.00	28.00	-28.00
18.00	29.00	-29.00
18.00	30.00	-30.00
18.00	31.00	-31.00
18.00	32.00	-32.00
18.00	33.00	-33.00
18.00	34.00	-34.00
18.00	35.00	-35.00
18.00	36.00	-36.00

18.00	37.00	-37.00
18.00	38.00	-38.00
18.00	39.00	-39.00
18.00	40.00	-40.00
18.00	41.00	-41.00
18.00	42.00	-42.00
18.00	43.00	-43.00
18.00	44.00	-44.00
18.00	45.00	-45.00
18.00	46.00	-46.00
18.00	47.00	-47.00
18.00	48.00	-48.00
18.00	49.00	-49.00
18.00	50.00	-50.00

Driven Pile Capacity:
==========

Section Type: Square
Pile Width: 12.00 (in)

Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
1.00	12.0	0.00	5.29	5.29	2.65	15.87
2.00	12.0	0.52	5.58	6.10	3.05	17.27
3.00	12.0	0.97	6.07	7.05	3.52	19.20
4.00	12.0	1.45	6.61	8.07	4.03	21.29
5.00	12.0	1.97	7.17	9.15	4.57	23.49
6.00	12.0	2.37	8.42	10.79	5.39	27.63
7.00	12.0	2.69	10.77	13.46	6.73	35.00
8.00	12.0	3.11	13.67	16.78	8.39	44.12
9.00	12.0	3.60	17.64	21.24	10.62	56.51
10.00	12.0	5.05	20.25	25.30	12.65	65.81
11.00	12.0	6.67	21.33	28.00	14.00	70.65
12.00	12.0	8.35	22.40	30.75	15.38	75.56
13.00	12.0	10.08	23.48	33.56	16.78	80.52
14.00	12.0	11.85	24.55	36.41	18.20	85.51
15.00	12.0	13.65	25.63	39.28	19.64	90.53
16.00	12.0	15.48	26.70	42.18	21.09	95.58
17.00	12.0	17.32	27.78	45.10	22.55	100.65
18.00	12.0	19.18	27.31	46.49	23.25	101.12
19.00	12.0	21.05	26.38	47.44	23.72	100.20
20.00	12.0	22.94	25.45	48.39	24.20	99.30
21.00	12.0	29.78	21.28	51.06	25.53	93.61
22.00	12.0	30.77	21.28	52.05	26.02	94.60
23.00	12.0	31.76	21.28	53.04	26.52	95.59
24.00	12.0	32.76	21.28	54.03	27.02	96.59
25.00	12.0	33.75	21.28	55.02	27.51	97.58
26.00	12.0	34.74	21.28	56.02	28.01	98.57
27.00	12.0	35.73	21.28	57.01	28.50	99.56
28.00	12.0	36.72	21.28	58.00	29.00	100.55
29.00	12.0	37.72	29.85	67.56	33.78	127.25
30.00	12.0	38.71	38.41	77.12	38.56	153.95
31.00	12.0	39.70	46.98	86.68	43.34	180.65
32.00	12.0	40.69	38.41	79.11	39.55	155.93

33.00	12.0	44.45	38.59	83.04	41.52	160.23
34.00	12.0	47.88	39.13	87.01	43.50	165.27
35.00	12.0	51.08	40.02	91.10	45.55	171.14
36.00	12.0	54.12	41.27	95.39	47.69	177.93
37.00	12.0	57.07	42.88	99.94	49.97	185.70
38.00	12.0	59.97	44.84	104.82	52.41	194.50
39.00	12.0	63.11	46.68	109.79	54.89	203.14
40.00	12.0	66.53	48.18	114.71	57.35	211.06
41.00	12.0	70.69	48.15	118.84	59.42	215.14
42.00	12.0	80.27	43.92	124.19	62.09	212.02
43.00	12.0	82.16	43.92	126.07	63.04	213.91
44.00	12.0	84.04	43.92	127.96	63.98	215.79
45.00	12.0	85.93	43.92	129.84	64.92	217.68
46.00	12.0	87.81	43.92	131.73	65.86	219.56
47.00	12.0	89.70	43.92	133.61	66.81	221.45
48.00	12.0	91.58	43.92	135.50	67.75	223.33
49.00	12.0	93.47	43.92	137.38	68.69	225.22
50.00	12.0	95.35	43.92	139.27	69.63	227.10

Section Type: Square
Pile Width: 14.00 (in)

Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
1.00	14.0	0.00	7.20	7.20	3.60	21.60
2.00	14.0	0.60	7.54	8.14	4.07	23.23
3.00	14.0	1.12	8.12	9.24	4.62	25.47
4.00	14.0	1.67	8.74	10.41	5.21	27.90
5.00	14.0	2.22	9.49	11.71	5.86	30.68
6.00	14.0	2.53	11.54	14.06	7.03	37.14
7.00	14.0	2.91	14.14	17.05	8.53	45.33
8.00	14.0	3.38	17.29	20.67	10.33	55.25
9.00	14.0	3.92	20.99	24.91	12.46	66.90
10.00	14.0	5.42	24.26	29.68	14.84	78.20
11.00	14.0	7.09	27.59	34.68	17.34	89.86
12.00	14.0	8.94	29.87	38.81	19.40	98.54
13.00	14.0	10.91	31.12	42.03	21.01	104.26
14.00	14.0	12.93	32.37	45.30	22.65	110.04
15.00	14.0	14.99	33.63	48.61	24.31	115.87
16.00	14.0	17.08	34.88	51.96	25.98	121.72
17.00	14.0	19.20	36.04	55.24	27.62	127.33
18.00	14.0	21.34	36.21	57.56	28.78	129.99
19.00	14.0	23.50	35.55	59.05	29.53	130.15
20.00	14.0	25.68	34.47	60.15	30.07	129.08
21.00	14.0	34.74	28.96	63.70	31.85	121.62
22.00	14.0	35.90	28.96	64.86	32.43	122.78
23.00	14.0	37.06	28.96	66.02	33.01	123.94
24.00	14.0	38.22	28.96	67.18	33.59	125.09
25.00	14.0	39.37	28.96	68.33	34.17	126.25
26.00	14.0	40.53	28.96	69.49	34.74	127.41
27.00	14.0	41.69	28.96	70.65	35.32	128.57
28.00	14.0	42.84	35.62	78.47	39.23	149.72
29.00	14.0	44.00	45.62	89.62	44.81	180.87
30.00	14.0	45.16	55.62	100.78	50.39	212.01
31.00	14.0	46.32	65.62	111.93	55.97	243.16
32.00	14.0	47.47	52.29	99.76	49.88	204.33
33.00	14.0	51.89	52.46	104.35	52.18	209.28
34.00	14.0	55.96	53.00	108.96	54.48	214.96

35.00	14.0	59.78	53.89	113.67	56.83	221.45
36.00	14.0	63.40	55.14	118.55	59.27	228.83
37.00	14.0	66.90	56.75	123.65	61.83	237.15
38.00	14.0	70.37	58.64	129.01	64.51	246.30
39.00	14.0	74.28	59.98	134.27	67.13	254.23
40.00	14.0	78.25	61.40	139.65	69.82	262.45
41.00	14.0	82.26	62.90	145.17	72.58	270.97
42.00	14.0	93.65	59.78	153.43	76.71	272.98
43.00	14.0	95.85	59.78	155.63	77.81	275.18
44.00	14.0	98.05	59.78	157.82	78.91	277.38
45.00	14.0	100.25	59.78	160.02	80.01	279.57
46.00	14.0	102.45	59.78	162.22	81.11	281.77
47.00	14.0	104.65	59.78	164.42	82.21	283.97
48.00	14.0	106.85	59.78	166.62	83.31	286.17
49.00	14.0	109.04	59.78	168.82	84.41	288.37
50.00	14.0	111.24	59.78	171.02	85.51	290.57

Section Type: Square
Pile Width: 16.00 (in)

Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
1.00	16.0	0.00	9.41	9.41	4.70	28.22
2.00	16.0	0.68	9.80	10.48	5.24	30.08
3.00	16.0	1.27	10.45	11.72	5.86	32.63
4.00	16.0	1.88	11.17	13.05	6.53	35.39
5.00	16.0	2.32	12.64	14.96	7.48	40.24
6.00	16.0	2.70	14.95	17.64	8.82	47.53
7.00	16.0	3.13	17.80	20.94	10.47	56.54
8.00	16.0	3.63	21.21	24.85	12.42	67.27
9.00	16.0	4.21	25.17	29.38	14.69	79.71
10.00	16.0	5.82	28.36	34.18	17.09	90.91
11.00	16.0	7.56	31.88	39.44	19.72	103.19
12.00	16.0	9.43	35.98	45.41	22.70	117.37
13.00	16.0	11.49	39.83	51.32	25.66	130.98
14.00	16.0	13.75	41.26	55.01	27.50	137.53
15.00	16.0	16.06	42.69	58.75	29.38	144.14
16.00	16.0	18.41	44.13	62.54	31.27	150.79
17.00	16.0	20.80	44.73	65.53	32.77	155.00
18.00	16.0	23.22	44.93	68.15	34.07	158.00
19.00	16.0	25.66	45.12	70.79	35.39	161.03
20.00	16.0	28.13	44.84	72.97	36.48	162.65
21.00	16.0	39.71	37.83	77.53	38.77	153.18
22.00	16.0	41.03	37.83	78.85	39.43	154.50
23.00	16.0	42.35	37.83	80.18	40.09	155.83
24.00	16.0	43.67	37.83	81.50	40.75	157.15
25.00	16.0	45.00	37.83	82.82	41.41	158.47
26.00	16.0	46.32	37.83	84.14	42.07	159.80
27.00	16.0	47.64	41.63	89.28	44.64	172.54
28.00	16.0	48.97	53.06	102.02	51.01	208.14
29.00	16.0	50.29	64.48	114.77	57.39	243.74
30.00	16.0	51.61	75.91	127.52	63.76	279.34
31.00	16.0	52.93	87.33	140.27	70.13	314.94
32.00	16.0	54.26	68.29	122.55	61.27	259.13
33.00	16.0	59.33	68.47	127.80	63.90	264.74
34.00	16.0	64.05	69.01	133.05	66.53	271.07
35.00	16.0	68.49	69.90	138.39	69.19	278.18
36.00	16.0	72.72	71.15	143.87	71.93	286.16

37.00	16.0	76.79	72.76	149.55	74.77	295.06
38.00	16.0	81.12	74.16	155.29	77.64	303.62
39.00	16.0	85.64	75.42	161.06	80.53	311.91
40.00	16.0	90.18	76.76	166.94	83.47	320.47
41.00	16.0	94.76	78.18	172.94	86.47	329.31
42.00	16.0	107.03	78.07	185.10	92.55	341.25
43.00	16.0	109.54	78.07	187.62	93.81	343.76
44.00	16.0	112.06	78.07	190.13	95.07	346.28
45.00	16.0	114.57	78.07	192.64	96.32	348.79
46.00	16.0	117.08	78.07	195.16	97.58	351.30
47.00	16.0	119.60	78.07	197.67	98.83	353.82
48.00	16.0	122.11	78.07	200.18	100.09	356.33
49.00	16.0	124.62	78.07	202.70	101.35	358.84
50.00	16.0	127.13	78.07	205.21	102.60	361.36

Section Type: Square
Pile Width: 18.00 (in)

Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
1.00	18.0	0.00	11.90	11.90	5.95	35.71
2.00	18.0	0.77	12.34	13.11	6.56	37.80
3.00	18.0	1.42	13.08	14.50	7.25	40.66
4.00	18.0	2.03	14.09	16.12	8.06	44.31
5.00	18.0	2.43	16.09	18.52	9.26	50.70
6.00	18.0	2.87	18.65	21.52	10.76	58.81
7.00	18.0	3.35	21.76	25.11	12.56	68.63
8.00	18.0	3.89	25.42	29.31	14.66	80.16
9.00	18.0	4.49	29.64	34.13	17.06	93.40
10.00	18.0	6.18	33.23	39.41	19.70	105.87
11.00	18.0	8.01	36.85	44.87	22.43	118.58
12.00	18.0	10.01	40.50	50.51	25.25	131.50
13.00	18.0	12.09	45.41	57.50	28.75	148.32
14.00	18.0	14.38	49.76	64.14	32.07	163.65
15.00	18.0	16.87	52.82	69.70	34.85	175.34
16.00	18.0	19.48	54.09	73.56	36.78	181.74
17.00	18.0	22.13	54.31	76.43	38.22	185.05
18.00	18.0	24.81	54.53	79.34	39.67	188.39
19.00	18.0	27.53	54.75	82.28	41.14	191.77
20.00	18.0	30.28	54.96	85.24	42.62	195.17
21.00	18.0	44.67	47.87	92.54	46.27	188.29
22.00	18.0	46.16	47.87	94.03	47.02	189.78
23.00	18.0	47.65	47.87	95.52	47.76	191.26
24.00	18.0	49.13	47.87	97.01	48.50	192.75
25.00	18.0	50.62	47.87	98.49	49.25	194.24
26.00	18.0	52.11	47.87	99.98	49.99	195.73
27.00	18.0	53.60	60.73	114.32	57.16	235.78
28.00	18.0	55.09	73.58	128.66	64.33	275.82
29.00	18.0	56.57	86.43	143.01	71.50	315.87
30.00	18.0	58.06	99.29	157.35	78.67	355.92
31.00	18.0	59.55	112.14	171.69	85.84	395.97
32.00	18.0	61.04	87.04	148.08	74.04	322.16
33.00	18.0	66.81	87.19	153.99	77.00	328.37
34.00	18.0	72.21	87.69	159.90	79.95	335.27
35.00	18.0	77.31	88.55	165.86	82.93	342.95
36.00	18.0	82.18	89.76	171.95	85.97	351.47
37.00	18.0	87.00	91.16	178.16	89.08	360.49
38.00	18.0	92.16	92.23	184.39	92.19	368.84

39.00	18.0	97.32	93.37	190.69	95.35	377.44
40.00	18.0	102.50	94.59	197.09	98.55	386.28
41.00	18.0	107.70	95.90	203.59	101.80	395.39
42.00	18.0	120.41	98.81	219.22	109.61	416.85
43.00	18.0	123.24	98.81	222.05	111.02	419.67
44.00	18.0	126.06	98.81	224.88	112.44	422.50
45.00	18.0	128.89	98.81	227.70	113.85	425.33
46.00	18.0	131.72	98.81	230.53	115.26	428.15
47.00	18.0	134.54	98.81	233.36	116.68	430.98
48.00	18.0	137.37	98.81	236.18	118.09	433.81
49.00	18.0	140.20	98.81	239.01	119.51	436.64
50.00	18.0	143.03	98.81	241.84	120.92	439.46

NOTES
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1. MOBILIZED END BEARING IS 1/3 OF THE ORIGINAL RB-121 VALUES.

2. DAVISSON PILE CAPACITY IS AN ESTIMATE BASED ON FAILURE CRITERIA, AND EQUALS ULTIMATE SIDE FRICTION PLUS MOBILIZED END BEARING.

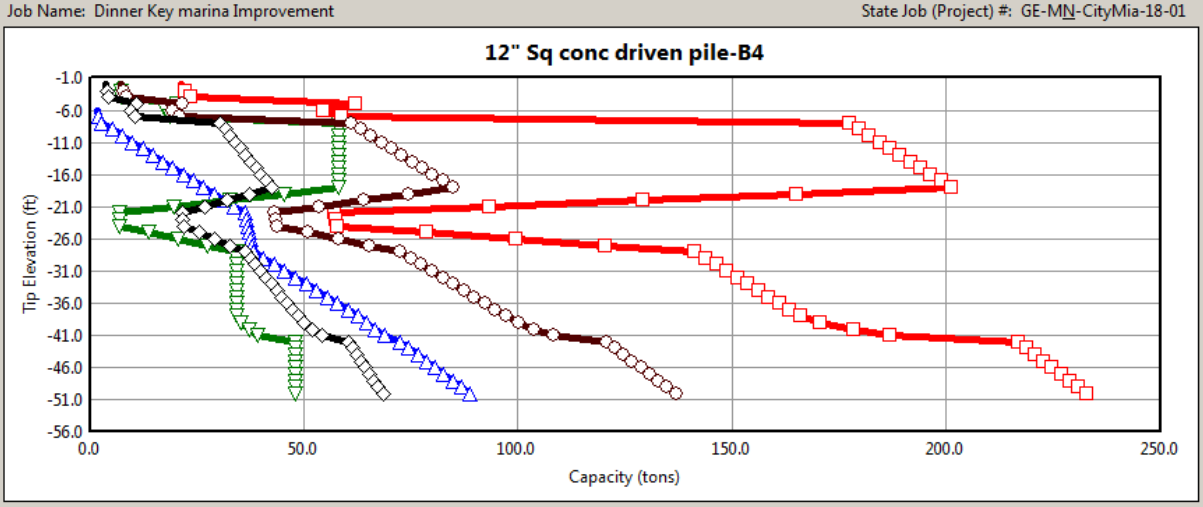
3. ALLOWABLE PILE CAPACITY IS 1/2 THE DAVISSON PILE CAPACITY.

4. ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS 3 x THE MOBILIZED END BEARING.
   EXCEPTION: FOR H-PILES TIPPED IN SAND OR LIMESTONE, THE ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS 2 x THE MOBILIZED END BEARING.

Plot Window

Job Name: Dinner Key marina Improvement

State Job (Project) #: GE-MN-CityMia-18-01



Curves

- [x] Ultimate Side Friction
- [x] Mobilized End Bearing
- [x] Ultimate Pile Capacity
- [x] Estimated Davisson Capacity
- [x] Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-4	
Ground Surface Elevation	0.00	(ft)
Section:	Square	
Width	12.00	(in)

Project Data

File:	ıner-key-b4-driven-sq
Date:	Jan 21, 2019
Engineer:	AK

Analysis Data

Analysis Type:	SPT

Plot Options

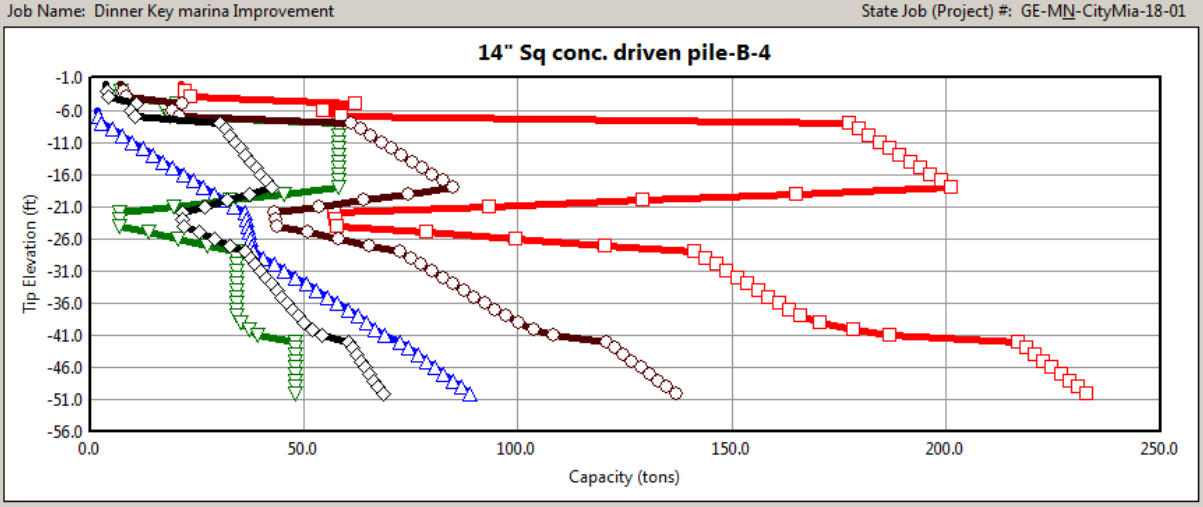
Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Plot Window

Job Name: Dinner Key marina Improvement

State Job (Project) #: GE-MN-CityMia-18-01



Curves

- ☑ Ultimate Side Friction
- ☑ Mobilized End Bearing
- ☑ Ultimate Pile Capacity
- ☑ Estimated Davisson Capacity
- ☑ Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-4	
Ground Surface Elevation	0.00	(ft)
Section:	Square	
Width	12.00	(in)

Project Data

File:	ıner-key-b4-driven-sq
Date:	Jan 21, 2019
Engineer:	AK

Analysis Data

Analysis Type:	SPT

Plot Options

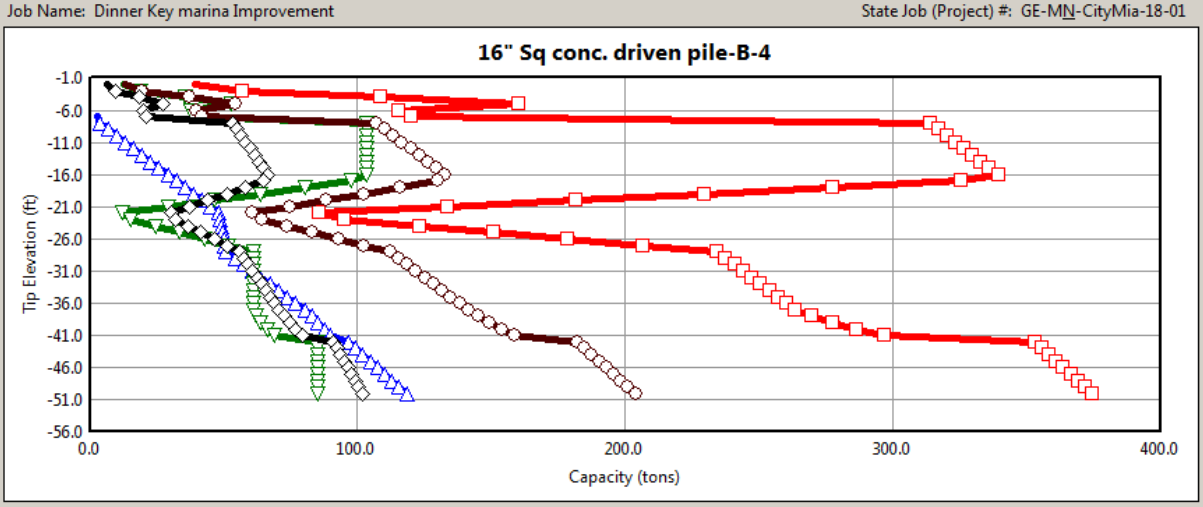
Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Plot Window

Job Name: Dinner Key marina Improvement

State Job (Project) #: GE-MN-CityMia-18-01



Curves

- Ultimate Side Friction
- Mobilized End Bearing
- Ultimate Pile Capacity
- Estimated Davisson Capacity
- Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-4	
Ground Surface Elevation	0.00	(ft)
Section:	Square	
Width	16.00	(in)

Project Data

File:	ıner-key-b4-driven-sq
Date:	Jan 21, 2019
Engineer:	AK

Analysis Data

Analysis Type:	SPT

Plot Options

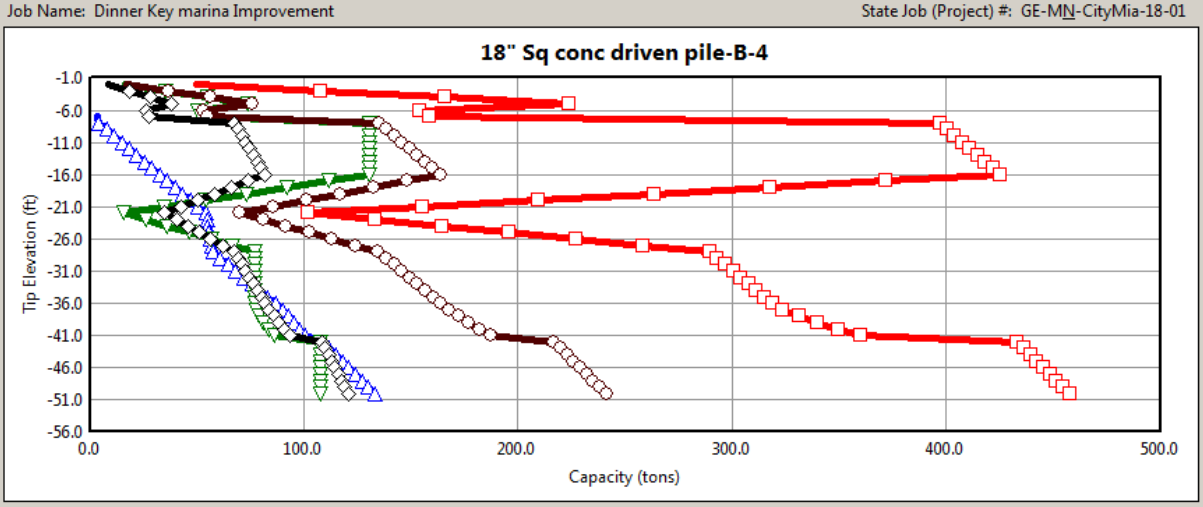
Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Plot Window

Job Name: Dinner Key marina Improvement

State Job (Project) #: GE-MN-CityMia-18-01



Curves

- ☑ Ultimate Side Friction
- ☑ Mobilized End Bearing
- ☑ Ultimate Pile Capacity
- ☑ Estimated Davisson Capacity
- ☑ Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-4	
Ground Surface Elevation	0.00	(ft)
Section:	Square	
Width	18.00	(in)

Project Data

File:	ıner-key-b4-driven-sq
Date:	Jan 21, 2019
Engineer:	AK

Analysis Data

Analysis Type:	SPT

Plot Options

Customize | Update Plot | Print Plot | Print Window | Save To File

Close

General Information:
====================
Input file: .....n\driven-square\dinner-drivensq-b4\dinner-key-b4-driven-sq.spc
Project number: GE-M&N-CityMia-18-01
Job name: Dinner Key marina Improvement
Engineer: AK
Units: English

Analysis Information:
=====================
Analysis Type: SPT

Soil Information:
=================
Boring date: 11/27/2018, Boring Number: B-4
Station number: Offset:

Ground Elevation: 0.000(ft)

Hammer type: Automatic Hammer, Correction factor = 1.24

ID	Depth (ft)	No. of Blows (Blows/ft)	Soil Type
1	0.00	2.00	2- Clay and silty sand
2	1.00	2.00	2- Clay and silty sand
3	1.00	7.00	4- Lime Stone/Very shelly sand
4	6.00	7.00	4- Lime Stone/Very shelly sand
5	6.00	6.00	3- Clean sand
6	8.00	6.00	3- Clean sand
7	8.00	48.00	4- Lime Stone/Very shelly sand
8	22.00	48.00	4- Lime Stone/Very shelly sand
9	22.00	7.00	4- Lime Stone/Very shelly sand
10	28.00	7.00	4- Lime Stone/Very shelly sand
11	28.00	26.00	3- Clean sand
12	42.00	26.00	3- Clean sand
13	42.00	41.00	4- Lime Stone/Very shelly sand
14	50.00	41.00	4- Lime Stone/Very shelly sand
15	60.00	41.00	4- Lime Stone/Very shelly sand

Blowcount Average Per Soil Layer

Layer Num.	Starting Elevation (ft)	Bottom Elevation (ft)	Thickness (ft)	Average Blowcount (Blows/ft)	Soil Type
1	0.00	-1.00	1.00	2.00	2-Clay and Silty Sand
2	-1.00	-6.00	5.00	7.00	4-Limestone, Very Shelly Sand
3	-6.00	-8.00	2.00	6.00	3-Clean Sand
4	-8.00	-28.00	20.00	35.70	4-Limestone, Very Shelly Sand
5	-28.00	-42.00	14.00	26.00	3-Clean Sand
6	-42.00	-60.00	18.00	41.00	4-Limestone, Very Shelly Sand

Driven Pile Data:
==========
Pile unit weight = 145.00(pcf), Section Type: Square

Pile Geometry:

Width (in)	Length (ft)	Tip Elev. (ft)
12.00	1.00	-1.00
12.00	2.00	-2.00
12.00	3.00	-3.00
12.00	4.00	-4.00
12.00	5.00	-5.00
12.00	6.00	-6.00
12.00	7.00	-7.00
12.00	8.00	-8.00
12.00	9.00	-9.00
12.00	10.00	-10.00
12.00	11.00	-11.00
12.00	12.00	-12.00
12.00	13.00	-13.00
12.00	14.00	-14.00
12.00	15.00	-15.00
12.00	16.00	-16.00
12.00	17.00	-17.00
12.00	18.00	-18.00
12.00	19.00	-19.00
12.00	20.00	-20.00
12.00	21.00	-21.00
12.00	22.00	-22.00
12.00	23.00	-23.00
12.00	24.00	-24.00
12.00	25.00	-25.00
12.00	26.00	-26.00
12.00	27.00	-27.00
12.00	28.00	-28.00
12.00	29.00	-29.00
12.00	30.00	-30.00
12.00	31.00	-31.00
12.00	32.00	-32.00
12.00	33.00	-33.00
12.00	34.00	-34.00
12.00	35.00	-35.00
12.00	36.00	-36.00
12.00	37.00	-37.00
12.00	38.00	-38.00
12.00	39.00	-39.00
12.00	40.00	-40.00
12.00	41.00	-41.00
12.00	42.00	-42.00
12.00	43.00	-43.00
12.00	44.00	-44.00
12.00	45.00	-45.00
12.00	46.00	-46.00
12.00	47.00	-47.00
12.00	48.00	-48.00
12.00	49.00	-49.00
12.00	50.00	-50.00
14.00	1.00	-1.00
14.00	2.00	-2.00
14.00	3.00	-3.00
14.00	4.00	-4.00
14.00	5.00	-5.00

14.00	6.00	-6.00
14.00	7.00	-7.00
14.00	8.00	-8.00
14.00	9.00	-9.00
14.00	10.00	-10.00
14.00	11.00	-11.00
14.00	12.00	-12.00
14.00	13.00	-13.00
14.00	14.00	-14.00
14.00	15.00	-15.00
14.00	16.00	-16.00
14.00	17.00	-17.00
14.00	18.00	-18.00
14.00	19.00	-19.00
14.00	20.00	-20.00
14.00	21.00	-21.00
14.00	22.00	-22.00
14.00	23.00	-23.00
14.00	24.00	-24.00
14.00	25.00	-25.00
14.00	26.00	-26.00
14.00	27.00	-27.00
14.00	28.00	-28.00
14.00	29.00	-29.00
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14.00	33.00	-33.00
14.00	34.00	-34.00
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14.00	36.00	-36.00
14.00	37.00	-37.00
14.00	38.00	-38.00
14.00	39.00	-39.00
14.00	40.00	-40.00
14.00	41.00	-41.00
14.00	42.00	-42.00
14.00	43.00	-43.00
14.00	44.00	-44.00
14.00	45.00	-45.00
14.00	46.00	-46.00
14.00	47.00	-47.00
14.00	48.00	-48.00
14.00	49.00	-49.00
14.00	50.00	-50.00
16.00	1.00	-1.00
16.00	2.00	-2.00
16.00	3.00	-3.00
16.00	4.00	-4.00
16.00	5.00	-5.00
16.00	6.00	-6.00
16.00	7.00	-7.00
16.00	8.00	-8.00
16.00	9.00	-9.00
16.00	10.00	-10.00
16.00	11.00	-11.00
16.00	12.00	-12.00
16.00	13.00	-13.00
16.00	14.00	-14.00
16.00	15.00	-15.00
16.00	16.00	-16.00
16.00	17.00	-17.00
16.00	18.00	-18.00
16.00	19.00	-19.00

16.00	20.00	-20.00
16.00	21.00	-21.00
16.00	22.00	-22.00
16.00	23.00	-23.00
16.00	24.00	-24.00
16.00	25.00	-25.00
16.00	26.00	-26.00
16.00	27.00	-27.00
16.00	28.00	-28.00
16.00	29.00	-29.00
16.00	30.00	-30.00
16.00	31.00	-31.00
16.00	32.00	-32.00
16.00	33.00	-33.00
16.00	34.00	-34.00
16.00	35.00	-35.00
16.00	36.00	-36.00
16.00	37.00	-37.00
16.00	38.00	-38.00
16.00	39.00	-39.00
16.00	40.00	-40.00
16.00	41.00	-41.00
16.00	42.00	-42.00
16.00	43.00	-43.00
16.00	44.00	-44.00
16.00	45.00	-45.00
16.00	46.00	-46.00
16.00	47.00	-47.00
16.00	48.00	-48.00
16.00	49.00	-49.00
16.00	50.00	-50.00
18.00	1.00	-1.00
18.00	2.00	-2.00
18.00	3.00	-3.00
18.00	4.00	-4.00
18.00	5.00	-5.00
18.00	6.00	-6.00
18.00	7.00	-7.00
18.00	8.00	-8.00
18.00	9.00	-9.00
18.00	10.00	-10.00
18.00	11.00	-11.00
18.00	12.00	-12.00
18.00	13.00	-13.00
18.00	14.00	-14.00
18.00	15.00	-15.00
18.00	16.00	-16.00
18.00	17.00	-17.00
18.00	18.00	-18.00
18.00	19.00	-19.00
18.00	20.00	-20.00
18.00	21.00	-21.00
18.00	22.00	-22.00
18.00	23.00	-23.00
18.00	24.00	-24.00
18.00	25.00	-25.00
18.00	26.00	-26.00
18.00	27.00	-27.00
18.00	28.00	-28.00
18.00	29.00	-29.00
18.00	30.00	-30.00
18.00	31.00	-31.00
18.00	32.00	-32.00
18.00	33.00	-33.00

18.00	34.00	-34.00
18.00	35.00	-35.00
18.00	36.00	-36.00
18.00	37.00	-37.00
18.00	38.00	-38.00
18.00	39.00	-39.00
18.00	40.00	-40.00
18.00	41.00	-41.00
18.00	42.00	-42.00
18.00	43.00	-43.00
18.00	44.00	-44.00
18.00	45.00	-45.00
18.00	46.00	-46.00
18.00	47.00	-47.00
18.00	48.00	-48.00
18.00	49.00	-49.00
18.00	50.00	-50.00

Driven Pile Capacity:
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Section Type: Square
Pile Width: 12.00 (in)

Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
1.00	12.0	0.00	7.04	7.04	3.52	21.11
2.00	12.0	0.35	7.04	7.38	3.69	21.46
3.00	12.0	0.69	7.26	7.96	3.98	22.48
4.00	12.0	1.04	7.49	8.53	4.26	23.50
5.00	12.0	1.39	20.27	21.66	10.83	62.20
6.00	12.0	1.74	17.67	19.40	9.70	54.73
7.00	12.0	2.15	18.89	21.04	10.52	58.81
8.00	12.0	2.87	58.18	61.05	30.52	177.41
9.00	12.0	5.25	58.18	63.43	31.71	179.79
10.00	12.0	7.63	58.18	65.81	32.90	182.17
11.00	12.0	10.01	58.18	68.19	34.09	184.55
12.00	12.0	12.39	58.18	70.57	35.28	186.93
13.00	12.0	14.77	58.18	72.95	36.48	189.31
14.00	12.0	17.15	58.18	75.33	37.67	191.69
15.00	12.0	19.53	58.18	77.71	38.86	194.07
16.00	12.0	21.91	58.18	80.09	40.05	196.45
17.00	12.0	24.29	58.18	82.47	41.24	198.83
18.00	12.0	26.67	58.18	84.85	42.43	201.21
19.00	12.0	29.06	45.39	74.45	37.22	165.24
20.00	12.0	31.44	32.61	64.04	32.02	129.26
21.00	12.0	33.82	19.82	53.64	26.82	93.28
22.00	12.0	36.20	7.04	43.23	21.62	57.31
23.00	12.0	36.55	7.04	43.58	21.79	57.65
24.00	12.0	36.89	7.04	43.93	21.96	58.00
25.00	12.0	37.24	13.87	51.11	25.56	78.86
26.00	12.0	37.59	20.71	58.30	29.15	99.73
27.00	12.0	37.93	27.55	65.49	32.74	120.59
28.00	12.0	38.28	34.39	72.67	36.34	141.45
29.00	12.0	40.73	34.39	75.12	37.56	143.90

30.00	12.0	43.18	34.39	77.57	38.79	146.35
31.00	12.0	45.63	34.39	80.02	40.01	148.80
32.00	12.0	48.08	34.39	82.47	41.24	151.25
33.00	12.0	50.53	34.39	84.92	42.46	153.70
34.00	12.0	52.98	34.39	87.37	43.69	156.15
35.00	12.0	55.43	34.39	89.82	44.91	158.60
36.00	12.0	57.88	34.39	92.27	46.14	161.05
37.00	12.0	60.33	34.39	94.72	47.36	163.50
38.00	12.0	62.78	34.39	97.17	48.59	165.95
39.00	12.0	64.83	35.28	100.12	50.06	170.68
40.00	12.0	66.53	37.32	103.85	51.92	178.49
41.00	12.0	68.98	39.27	108.25	54.13	186.80
42.00	12.0	72.58	48.06	120.65	60.32	216.77
43.00	12.0	74.62	48.06	122.68	61.34	218.80
44.00	12.0	76.65	48.06	124.71	62.36	220.83
45.00	12.0	78.69	48.06	126.75	63.37	222.87
46.00	12.0	80.72	48.06	128.78	64.39	224.90
47.00	12.0	82.75	48.06	130.81	65.41	226.93
48.00	12.0	84.79	48.06	132.85	66.42	228.97
49.00	12.0	86.82	48.06	134.88	67.44	231.00
50.00	12.0	88.85	48.06	136.91	68.46	233.04

Section Type: Square
Pile Width: 14.00 (in)

Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
1.00	14.0	0.00	9.58	9.58	4.79	28.73
2.00	14.0	0.41	9.75	10.16	5.08	29.66
3.00	14.0	0.81	10.01	10.82	5.41	30.85
4.00	14.0	1.22	20.05	21.26	10.63	61.35
5.00	14.0	1.62	34.96	36.58	18.29	106.51
6.00	14.0	2.03	26.84	28.86	14.43	82.54
7.00	14.0	2.54	28.06	30.60	15.30	86.72
8.00	14.0	3.34	79.19	82.53	41.27	240.91
9.00	14.0	6.12	79.19	85.31	42.66	243.69
10.00	14.0	8.90	79.19	88.09	44.04	246.47
11.00	14.0	11.68	79.19	90.87	45.43	249.24
12.00	14.0	14.46	79.19	93.64	46.82	252.02
13.00	14.0	17.23	79.19	96.42	48.21	254.80
14.00	14.0	20.01	79.19	99.20	49.60	257.58
15.00	14.0	22.79	79.19	101.98	50.99	260.35
16.00	14.0	25.57	79.19	104.75	52.38	263.13
17.00	14.0	28.34	79.19	107.53	53.77	265.91
18.00	14.0	31.12	69.24	100.36	50.18	238.85
19.00	14.0	33.90	54.33	88.23	44.11	196.88
20.00	14.0	36.68	39.41	76.09	38.04	154.91
21.00	14.0	39.45	24.49	63.95	31.97	112.94
22.00	14.0	42.23	9.58	51.81	25.90	70.96
23.00	14.0	42.64	9.58	52.21	26.11	71.37
24.00	14.0	43.04	14.90	57.94	28.97	87.73
25.00	14.0	43.45	22.87	66.32	33.16	112.07
26.00	14.0	43.85	30.85	74.70	37.35	136.41
27.00	14.0	44.26	38.83	83.09	41.54	160.75
28.00	14.0	44.66	46.81	91.47	45.73	185.08
29.00	14.0	47.52	46.81	94.33	47.16	187.94
30.00	14.0	50.38	46.81	97.19	48.59	190.80
31.00	14.0	53.24	46.81	100.05	50.02	193.66

32.00	14.0	56.10	46.81	102.90	51.45	196.52
33.00	14.0	58.95	46.81	105.76	52.88	199.38
34.00	14.0	61.81	46.81	108.62	54.31	202.24
35.00	14.0	64.67	46.81	111.48	55.74	205.09
36.00	14.0	67.53	46.81	114.34	57.17	207.95
37.00	14.0	70.39	46.81	117.20	58.60	210.81
38.00	14.0	73.17	46.94	120.12	60.06	214.00
39.00	14.0	75.15	48.75	123.90	61.95	221.39
40.00	14.0	77.16	50.88	128.04	64.02	229.79
41.00	14.0	79.23	53.33	132.56	66.28	239.22
42.00	14.0	84.68	65.42	150.10	75.05	280.93
43.00	14.0	87.05	65.42	152.47	76.24	283.30
44.00	14.0	89.43	65.42	154.84	77.42	285.67
45.00	14.0	91.80	65.42	157.22	78.61	288.05
46.00	14.0	94.17	65.42	159.59	79.79	290.42
47.00	14.0	96.54	65.42	161.96	80.98	292.79
48.00	14.0	98.92	65.42	164.33	82.17	295.16
49.00	14.0	101.29	65.42	166.71	83.35	297.54
50.00	14.0	103.66	65.42	169.08	84.54	299.91

Section Type: Square
Pile Width: 16.00 (in)

Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
1.00	16.0	0.00	12.61	12.61	6.30	37.83
2.00	16.0	0.46	12.91	13.37	6.69	39.19
3.00	16.0	0.93	18.79	19.72	9.86	57.30
4.00	16.0	1.39	35.84	37.23	18.61	108.91
5.00	16.0	1.85	52.89	54.74	27.37	160.51
6.00	16.0	2.31	37.79	40.10	20.05	115.67
7.00	16.0	2.92	39.02	41.94	20.97	119.97
8.00	16.0	3.82	103.43	107.25	53.63	314.11
9.00	16.0	7.00	103.43	110.43	55.21	317.29
10.00	16.0	10.17	103.43	113.60	56.80	320.46
11.00	16.0	13.35	103.43	116.78	58.39	323.64
12.00	16.0	16.52	103.43	119.95	59.98	326.81
13.00	16.0	19.69	103.43	123.12	61.56	329.99
14.00	16.0	22.87	103.43	126.30	63.15	333.16
15.00	16.0	26.04	103.43	129.47	64.74	336.33
16.00	16.0	29.22	103.43	132.65	66.32	339.51
17.00	16.0	32.39	97.75	130.14	65.07	325.64
18.00	16.0	35.57	80.70	116.27	58.13	277.67
19.00	16.0	38.74	63.65	102.39	51.20	229.70
20.00	16.0	41.92	46.60	88.52	44.26	181.73
21.00	16.0	45.09	29.56	74.65	37.32	133.76
22.00	16.0	48.26	12.51	60.77	30.39	85.79
23.00	16.0	48.73	15.55	64.28	32.14	95.37
24.00	16.0	49.19	24.67	73.86	36.93	123.19
25.00	16.0	49.65	33.78	83.44	41.72	151.00
26.00	16.0	50.12	42.90	93.02	46.51	178.82
27.00	16.0	50.58	52.02	102.60	51.30	206.64
28.00	16.0	51.04	61.14	112.18	56.09	234.45
29.00	16.0	54.31	61.14	115.45	57.72	237.72
30.00	16.0	57.58	61.14	118.71	59.36	240.99
31.00	16.0	60.84	61.14	121.98	60.99	244.25
32.00	16.0	64.11	61.14	125.25	62.62	247.52
33.00	16.0	67.38	61.14	128.51	64.26	250.79

34.00	16.0	70.64	61.14	131.78	65.89	254.05
35.00	16.0	73.91	61.14	135.05	67.52	257.32
36.00	16.0	77.18	61.14	138.31	69.16	260.59
37.00	16.0	80.44	61.14	141.58	70.79	263.85
38.00	16.0	83.09	62.22	145.31	72.66	269.76
39.00	16.0	85.42	64.12	149.54	74.77	277.78
40.00	16.0	87.75	66.34	154.09	77.05	286.78
41.00	16.0	90.11	68.89	159.00	79.50	296.79
42.00	16.0	96.78	85.44	182.22	91.11	353.10
43.00	16.0	99.49	85.44	184.93	92.47	355.81
44.00	16.0	102.20	85.44	187.64	93.82	358.53
45.00	16.0	104.91	85.44	190.36	95.18	361.24
46.00	16.0	107.63	85.44	193.07	96.53	363.95
47.00	16.0	110.34	85.44	195.78	97.89	366.66
48.00	16.0	113.05	85.44	198.49	99.24	369.37
49.00	16.0	115.76	85.44	201.20	100.60	372.08
50.00	16.0	118.47	85.44	203.91	101.96	374.79

Section Type: Square
Pile Width: 18.00 (in)

Test Pile Length (ft)	Pile Width (in)	Ultimate Side Friction (tons)	Mobilized End Bearing (tons)	Estimated Davisson Capacity (tons)	Allowable Pile Capacity (tons)	Ultimate Pile Capacity (tons)
1.00	18.0	0.00	16.17	16.17	8.08	48.51
2.00	18.0	0.52	16.51	17.03	8.51	50.04
3.00	18.0	1.04	35.69	36.73	18.36	108.10
4.00	18.0	1.56	54.86	56.43	28.21	166.15
5.00	18.0	2.08	74.04	76.13	38.06	224.21
6.00	18.0	2.60	50.52	53.12	26.56	154.15
7.00	18.0	3.31	51.75	55.06	27.53	158.55
8.00	18.0	4.30	130.90	135.20	67.60	397.01
9.00	18.0	7.87	130.90	138.78	69.39	400.58
10.00	18.0	11.44	130.90	142.35	71.17	404.15
11.00	18.0	15.01	130.90	145.92	72.96	407.73
12.00	18.0	18.59	130.90	149.49	74.74	411.30
13.00	18.0	22.16	130.90	153.06	76.53	414.87
14.00	18.0	25.73	130.90	156.63	78.32	418.44
15.00	18.0	29.30	130.90	160.20	80.10	422.01
16.00	18.0	32.87	130.90	163.77	81.89	425.58
17.00	18.0	36.44	111.73	148.17	74.08	371.62
18.00	18.0	40.01	92.55	132.56	66.28	317.65
19.00	18.0	43.58	73.37	116.95	58.48	263.69
20.00	18.0	47.15	54.19	101.34	50.67	209.72
21.00	18.0	50.73	35.01	85.74	42.87	155.76
22.00	18.0	54.30	15.83	70.13	35.06	101.79
23.00	18.0	54.82	26.09	80.91	40.45	133.08
24.00	18.0	55.34	36.35	91.69	45.84	164.38
25.00	18.0	55.86	46.60	102.46	51.23	195.67
26.00	18.0	56.38	56.86	113.24	56.62	226.96
27.00	18.0	56.90	67.12	124.02	62.01	258.26
28.00	18.0	57.42	77.38	134.80	67.40	289.55
29.00	18.0	61.10	77.38	138.47	69.24	293.23
30.00	18.0	64.77	77.38	142.15	71.07	296.90
31.00	18.0	68.45	77.38	145.82	72.91	300.58
32.00	18.0	72.12	77.38	149.50	74.75	304.25
33.00	18.0	75.80	77.38	153.17	76.59	307.93
34.00	18.0	79.47	77.38	156.85	78.43	311.60
35.00	18.0	83.15	77.38	160.53	80.26	315.28

36.00	18.0	86.82	77.38	164.20	82.10	318.95
37.00	18.0	90.27	77.74	168.01	84.00	323.49
38.00	18.0	92.98	79.41	172.39	86.19	331.21
39.00	18.0	95.65	81.40	177.05	88.53	339.86
40.00	18.0	98.30	83.72	182.03	91.01	349.47
41.00	18.0	100.97	86.37	187.34	93.67	360.07
42.00	18.0	108.88	108.14	217.01	108.51	433.29
43.00	18.0	111.93	108.14	220.06	110.03	436.34
44.00	18.0	114.98	108.14	223.11	111.56	439.39
45.00	18.0	118.03	108.14	226.16	113.08	442.44
46.00	18.0	121.08	108.14	229.21	114.61	445.49
47.00	18.0	124.13	108.14	232.27	116.13	448.54
48.00	18.0	127.18	108.14	235.32	117.66	451.59
49.00	18.0	130.23	108.14	238.37	119.18	454.64
50.00	18.0	133.28	108.14	241.42	120.71	457.69

NOTES
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1. MOBILIZED END BEARING IS 1/3 OF THE ORIGINAL RB-121 VALUES.

2. DAVISSON PILE CAPACITY IS AN ESTIMATE BASED ON FAILURE CRITERIA, AND EQUALS ULTIMATE SIDE FRICTION PLUS MOBILIZED END BEARING.

3. ALLOWABLE PILE CAPACITY IS 1/2 THE DAVISSON PILE CAPACITY.

4. ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS 3 x THE MOBILIZED END BEARING.
   EXCEPTION: FOR H-PILES TIPPED IN SAND OR LIMESTONE, THE ULTIMATE PILE CAPACITY IS ULTIMATE SIDE FRICTION PLUS 2 x THE MOBILIZED END BEARING.