SECTION 024660 - DRILLED PIERS (AUGER CAST PILES)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Auger cast piles. (A type of drilled pier.)

1.3 BASIS OF PAYMENT

A. Base bid shall be a lump sum amount.

1. Base the lump sum amount on total footage based on the pile tip elevation indicated on drawings
2. Include test piles and reaction piles for the number and types indicated on the drawings.
3. Include exploration augering.
4. Include as-built pile location survey.

B. Payment adjustment.

1. Adjustments shall be based on total aggregate length of all piling and not individual piles.
2. No payment will be made for piles that are abandoned or replaced because they do not comply with the contract documents.
   a. The Contractor shall be responsible for engineering costs incurred if redesign is required due to nonconforming piles.
   b. Contractor shall install additional piles or add grade-beams as required by the engineer due to non-conforming piles at his own expense.
   c. Measurements will be based on effective length of piles in place, with fractional lengths measured to nearest foot. Payment for linear footage in excess of that indicated on drawings and credit for linear footage less than that indicated on drawings, shall be made at unit prices stated in the contract, based on net addition or deduction.
3. Unit prices include labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete fill, testing and inspecting, and other items for complete drilled-pier installation.

C. Unit prices:

1. Provide the following unit prices (including set-up charges):
a. Price per foot adding footage to the base vertical pile footage.

2. Unit prices include labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, casings, dewatering, reinforcement, concrete fill, testing and inspecting, and other items for complete augercast pile installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each grout mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings: For concrete reinforcement detailing fabricating, bending, supporting, and placing.

D. Test pile and reaction pile locations, testing assembly and equipment

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer, land surveyor, and testing agency.

B. Welding certificates.

C. Material Certificates: For the following, from manufacturer:
   1. Cementitious materials.
   2. Admixtures.
   3. Steel reinforcement and accessories.

D. Material Test Reports:

E. Field quality-control reports.

F. Other Informational Submittals:
   1. Record drawings.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that has specialized in augercast pile work.

B. Testing Agency Qualifications: Qualified according to ASTM C 1077, ASTM D 3740, and ASTM E 329 for testing indicated.

C. Augercast pile Standard: Comply with ACI 336.1 unless modified in this Section.

D. Pre-installation Conference: Conduct conference at Project site.
1. Review methods and procedures related to augercast piles including, but not limited to, the following:
   a. Review geotechnical report.
   b. Discuss existing utilities and subsurface conditions.
   c. Review coordination with temporary controls and protections.

1.7 PROJECT CONDITIONS

A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.

1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.

B. Interruption of Existing Utilities: Do not interrupt any utility to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Owner's written permission.

C. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.

1. The geotechnical report is included elsewhere in the Project Manual.

D. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record actual measurements of each drilled pier’s location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.

1. Record and maintain information pertinent to each augercast pile and cooperate with Owner's testing and inspecting agency to provide data for required reports.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Bar Centralizer: Bar centralizing device made of minimum four bend steel bars with clamps, such as UNISPACER by Foundation Technologies, Inc. or approved equal.
C. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice.

2.2 GROUT MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source, throughout Project:
   1. Portland Cement: ASTM C 150, Type I/II.

B. Fine Aggregate: ASTM C 33, with a fineness modulus between 1.40 and 3.40.
   1. Free of materials with deleterious reactivity to alkali in cement.

C. Fly Ash: ASTM C618, Class C or F


E. Water reducing admixture: ASTM C494, Type A or D

F. Mineral filler: Finely powdered siliceous material capable of combining with the lime liberated during the process of hydration of Portland Cement.

G. Fluidifier: Compound that increases flowability, assists in cement grain dispersal, reduces bleeding, and neutralizes setting shrinkage. ASTM C937

2.3 GROUT MIXTURES AND MIXING

A. Prepare mix designs for each type of grout required.

B. Proportion and mix components to provide grout which maintains the solids in suspension without appreciable water gain, is pumped easily, and penetrates laterally to fill subsurface voids.

C. Standard Flow Cone Rate: Maximum 15 seconds.

D. Proportion normal-weight concrete mixture as follows:
   1. Compressive Strength (28 Days): as shown on drawings.
   2. Limit use of fly ash to not exceed 25% of Portland Cement by weight.

E. Maximum Allowable Design Stress: 0.25 \( f'c \)

2.4 EQUIPMENT

A. Augering Equipment:
   1. Use a continuous flight auger from head to the top of the auger. No gaps or breaks.
2. Grout outlet shall be at the bottom of the auger head below the bar containing the cutting teeth.
5. Do not use teeth which worn more than 50%.
6. Auger hollow shaft shall allow placement of #11 reinforcing bar.
7. Provide an auger guide for augers over 40 feet long.
8. Prevent piling leads from twisting with a stabilizer arm

B. Pumping Equipment:
   1. Pump: Positive displacement, piston type.
      a. Minimum head capacity: 350 psi
      b. Provide pressure gauges at pump discharge to ensure proper grout pressures.
      c. Equip pump with a digital counter for counting pump strokes to determine volume of grout pumped.

C. Agitating Storage Tank
   1. Provide agitating tank when ready-mix mortar is used
   2. Size to maintain homogeneous mix and continuity of mortar between ready-mix and mortar pump.

PART 3 - EXECUTION

3.1 PREPARATION
   A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by augercast pile operations.
   B. Provide written report on mobilization and methods to protect existing structures.

3.2 INSTALLATION
   A. General.
      1. Verify (by excavation if necessary) that piles clear all existing underground utilities or other existing construction.
      3. Contractor shall repair, at no cost to the Owner, any damage to existing utilities or other existing construction.
      4. Install piles by rotating a continuous flight, hollow shaft auger into the ground to the required depth as determined by the owner’s Geotechnical Engineer.
      5. Remove all oils and rust inhibitors from mixing drums and mortar pumps.
      6. Pump mortar under pressure through the hollow shaft as the auger is withdrawn. Pressure must be sufficient to prevent collapse and causing lateral penetration of grout into soil and porous zones on surrounding soil and rock.
      7. Fill the hole completely.
8. Provide a 10-feet head of grout above the injection point or above the water level, whichever is higher, during the raising of the auger.
9. Raise auger with a continuous steady pull with a maximum auger withdrawal rate: 10 feet per minute.
10. Install only materials that produce a homogeneous mortar of the desired consistency. A single addition of water made upon arrival at the job site to adjust fluidity is permissible. Subsequent additions of water will not be allowed.
11. The minimum volume of grout placed in the pile shall be equal to 125% of the theoretical volume of the augered hole.
12. Re-circulate grout through pump during any lapse in operation.
   a. Do not use grout that is more than 2-1/2 hours old from the time of batching.
   b. Do not use grout whose temperature exceeds 90 F.
13. Provide metal sleeves (of the proper diameter and length) for piles with cutoffs near or above the bottom of excavation.
14. Inform Architect immediately if any obstruction prevents placement of piles as indicated on the drawings.
15. For closely set piles (within 5 pile diameters center to center), allow 24 hours to pass before installing adjacent piles.

B. Tolerances:
   1. Install piles in locations indicated on the drawings.
   2. Piles in group of 2 or more shall be within 3 inches from the design location. Centroid of pile group shall be within 1.5” from the design location.
   3. Single piles shall be located within 1.5” from the design location.
   4. If location tolerances are exceeded, provide corrective construction. Submit design and construction proposals to Architect for review before proceeding.

3.3 STEEL REINFORCEMENT

A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.
C. Place singular bar, full-length reinforcement throughout the hollow shaft auger prior to pumping or auger removal.
D. Multiple bar vertical cages and single bars shall have approved centering devices.
E. Protect exposed ends of extended reinforcement from damage and exposure to weather.
3.4 FIELD QUALITY CONTROL

A. Inspections: Owner will engage a qualified Geotechnical Engineer to inspect the installation of piles. As a minimum, the inspection report shall consist the following:

1. Date, time & weather.
2. Top of grade elevation.
3. Pile Diameter.
4. Pile length (or estimated bottom of pile elevation).
5. Rock socket length.
7. Grout factor (actual to theoretical grout volume ratio)
8. Reinforcement provided.
9. Rebar cover provided.
10. Grout delivery ticket no.
11. Other miscellaneous observations.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Survey: The contractor shall engage a licensed surveyor to prepare as-built survey of all piles and report to the architect. The survey shall indicate the design location and actual location of pile at cut-off elevation. The report shall indicate deviation from design location in east-west and north-south directions.

1. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
2. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Grout Test Cubes: Minimum of five 2-inch cubes required for each day piles are installed.

1. Test one cube at 7 days.
2. Test one cube at 14 days.
3. Test two cubes at 28 days.
4. Additional reserve cylinder to be tested under the direction of the Engineer, if required.
5. Produce test cubes in accordance with ASTM C109.
6. Test the test cubes in accordance with ASTM C109, except restrain grout with a top plate.

E. An auger cast pile will be considered defective if it does not pass tests and inspections or if it is located more than the tolerance from the design location.

1. Replace all abandoned or rejected piles with additional piles as directed by the Architect.
2. Cut off rejected or abandoned piles a minimum of one foot below the bottom elevation of the pile cap.

3.5 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.
3.6 REPORTS & RECORDS

A. At conclusion of work, the Geotechnical Engineer shall forward five (5) copies of his grouting records, together with five (5) copies, signed and sealed, of the following certificate:

“"I have observed all auger-cast piling work on this project. This work has been performed in accordance with the requirement of these specifications, The 2010 Florida Building Code and Good Standard of Practice.""

END OF SECTION 02466
SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
B. Design Mixtures: For each concrete mixture.
C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement.
D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.
B. Material certificates.
C. Material test reports.
D. Floor surface flatness and levelness measurements.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

C. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

D. Galvanized-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from galvanized-steel wire into flat sheets.

E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:
   a. Fly Ash: ASTM C 618, Class F or C.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C 33, graded.
1. Maximum Coarse-Aggregate Size: 1 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.


2.4 ADMIXTURES


B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2.6 RELATED MATERIALS


2.7 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

C. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing or high-range water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

D. Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: As specified on structural drawings at 28 days.
3. Slump Limit: 5 inches, plus or minus 1 inch.
4. Air Content: No entrained air for foundations.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
6. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.8 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Chamfer exterior corners and edges of permanently exposed concrete.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

3.4 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

3.5 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

C. Cold-Weather Placement: Comply with ACI 306.1.

D. Hot-Weather Placement: Comply with ACI 301.
3.6 FINISHING FORMED SURFACES

A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view.

B. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.7 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than
seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.8 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

3.9 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION 033000
SECTION 0514000 - PRE-ENGINEERED ALUMINUM PEDESTRIAN BRIDGE

PART 1 - GENERAL

A. Scope: Furnish labor, materials, equipment and supervision necessary to provide and install the prefabricated aluminum pedestrian bridge in accordance with the plans and specified herein.

B. Bridge to be fully engineered. This specification provides minimum requirements.

C. Size: 111'-0" clear span between abutments with clear deck width of 8'-0". Total width shall not exceed 10'-0'.

D. Bridge construction shall be a closed bow truss type with a flat (horizontal) bottom chord and arched top chord profile. Arched profile shall have a maximum depth of 12'-0" at midspan and a minimum depth of 4'-6" at abutments.

E. Design:


2. Structural design in accordance with the latest edition of Specifications for Aluminum Structures by the Aluminum Association, Inc.

3. Loads:

   a) Bridge Structure: Design for a minimum uniform pedestrian load of 90 psf or 10 kips vehicle load (H-5 truck).

   b) Railings: Design to resist a uniform load of not less than 50 pounds per lineal foot or a concentrated load of not less than 200 pounds applied in any direction at the top of railing, at any location, whichever condition(s) produces maximum stress(es). The reactions and stresses due to the above referenced uniform and concentrated loads shall be considered not to be acting simultaneously.

   c) Wind loads in accordance with the Florida Building Code, latest edition.

   d) Vertical deflection shall be less than L/360 for entire bridge under live load.

   e) Lateral deflection shall be less than L/400 for entire bridge under wind load.

4. Bridge shall be cambered such that walkway is flat (horizontal) under self-weight loading.

5. Decking: Aluminum deck shall be 1-5/8" x 11-5/8" triple I-beam slip resistant knurled surface extruded aluminum slats with a maximum 1/8" gap between decking slats.
6. Railings: 42” height from top of decking with vertical aluminum pickets spaced to reject a 4” diameter object. Railing sections shall be positioned inside of the main side truss. Provide a 2-1/2” diameter top rail.

7. Main Side Truss: 12’-0” maximum depth with horizontal bottom chord and arched top chord. Minimum height at truss ends is 4’-0” from top of decking. Side truss may extend below top of deck level.

8. Lowest cross member between the top chords of the main side trusses shall not be lower than 8’-0” from top of decking.

9. All members of the bridge truss (top and bottom chords, verticals, diagonals, and top and bottom transverse and diagonal members) shall be square or rectangular in cross section.

F. Submittals:

1. Submit fully detailed drawings showing bridge size and configuration, component details, system layout, loading and bearing criteria, member sizes, bracing, anchorage, connections, and erection procedures/requirements.

2. Drawings must be signed and sealed by a Florida Registered Professional Engineer and comply with the requirements of the local municipal building permit authority and the Florida Building Code.

3. Submit calculations signed and sealed by a Florida registered professional engineer.

II. PRODUCTS

A. Materials:

1. Aluminum bridges shall be constructed using aluminum alloy 6061-T6 and 6063-T5 in accordance with requirements of the latest edition of Specifications for Aluminum Structures by the Aluminum Association, Inc.

2. Hardware: All connectors shall be stainless steel.

3. Bridge shall include neoprene bearing pads to allow for expansion and contraction.

III. FABRICATION

A. All welding shall be performed in accordance with the American Welding Society D1.2 Structural Welding Code Aluminum.

B. All connections shall be either welded or connected with tamper resistant hardware.
C. All bridge components shall be pre-fabricated and assembled by the bridge manufacturer prior to delivery to the site. Exceptions to be pre-approved by both the bridge manufacturer and the County’s project manager.

D. When required, mid-span splices shall be incorporated and adequately designed to meet all criteria specified in this document.

E. Fabricated Components:
   1. Cut material square and remove burrs from all exposed edges.
   2. Make exposed joints butt tight and flush.
   3. Close exposed ends of pipes and tubes by use of appropriate water tight end caps. Close exposed openings in pipes and tubes by use of appropriate water tight cover plates.

F. Painting
   1. Rail members, inclusive of top rail, bottom rail, pickets, and all other handrail components, shall be furnished with a Kynar 500® or equal paint finish.
   2. All aluminum bridge components shall be furnished with a Kynar 500® or equal paint finish.
   3. Paint color(s) shall be chosen by owner.
   4. Where aluminum members are in contact with steel, prime both aluminum and steel members with one coat of paint meeting Federal Specification TT-P-645. Paint aluminum with an additional coat of varnish containing 2 pounds of aluminum pigment per gallon.
   5. Where aluminum members are in contact with porous materials, such as masonry or concrete, apply to the contact surfaces of the aluminum members a heavy coat of alkali resistant bituminous paint.

IV. EXECUTION

A. Field survey clear distance between the abutment locations prior to bridge fabrication. It is the Contractor’s responsibility to coordinate abutment locations with the bridge manufacturer to assure that the bridge span properly correlates with the abutment locations. Contractor shall notify the County Project Manager of any deviations from the information provided in the project drawings prior to fabrication of the bridge and construction of the abutments.

B. Inspect all components and report defects to the manufacturer and County Project Manager prior to erection.

C. Erect bridge in accordance with manufacturer requirements.
SECTION 16001
ELECTRICAL

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This section covers the work necessary for the construction of the electrical system shown on the accompanying Drawings. The work included under this section includes providing all materials, furnishing all labor and except as provided under other sections of these Specifications, by others or by the owner, to install a complete functioning electrical system. This installation shall include all incidental items whether shown on the drawing, call for in these Specifications or not. It is not the intent for the Drawings or these Specifications to show or specify each and every required device, conduit, conductor, control device or other incidental items.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. C80.1, Rigid Steel Conduit-Zinc Coated.
   2. C80.3, Electrical Metallic Tubing-Zinc Coated.

B. Federal Specifications (FS):
   1. W-C-596, Connector, Receptacle, Electrical.

C. National Electrical Contractor’s Association, Inc. (NECA): 5055, Standard of Installation.

D. National Electrical Manufacturers Association (NEMA):
   1. AB1, Molded Case Circuit Breakers and Molded Case Switches.
   2. ICS2, Standard for Industrial Control Devices, Controllers, and Assemblies.
   3. PB1, Panelboards.
   4. TC2, Electrical Plastic Tubing (EB) and Conduit (EPC-40 and EPC-80).
   5. TC3, PVC Fittings for Use with Rigid PVC Conduit and Tubing.
   6. WD1, General Requirements for Wiring Devices.
   7. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).


F. Underwriters Laboratories, Inc. (UL):
   1. 1, Standard for Safety Flexible Metal Conduit.
   2. 651, Standard for Safety Schedule 40 and 80 PVC Conduit.

G. Lightning Protection Institute (LPI): 175, Installation Standard.

1.03 CODES AND PERMITS
A. All work shall be performed in strict accordance with the current addition of Association, IEEE Standards, NECA Standards and shall comply with the Authority having jurisdiction over the project. Conflicts will be resolved at the discretion of the Engineer.

B. Wherever the Specifications or Drawings exceed those of the applicable codes or authorities the requirements contained herein shall govern. Code compliance is mandatory. Nothing contained in these Contract Documents shall be construed as permitting work to be performed outside the requirements of the applicable codes or governing authorities.

C. Obtain all required permits and pay all fees required by any agency having jurisdiction over this project. Upon completion of the work obtain from regulatory authorities signed permits indicating the work is acceptable to the authority having jurisdiction.

1.04 COMPLIANCE

A. All the work executed under this section shall meet the General and Special Conditions sections of this Specification as if fully stated herein.

1.05 SUBMITTALS

A. Furnish submittal and shop drawing information on all major electrical material and equipment.

1.06 INTENT OF DRAWINGS

A. The electrical drawings show only general locations of equipment devices, and raceways, unless specifically dimensioned. The CONTRACTOR shall be responsible for the proper routing of raceways, final sizing of conductors, and location of equipment and connections. The control diagrams for the equipment are diagrammatic and intended to show the desired operation. The CONTRACTOR shall install the controls exactly as shown unless this operation will cause failure of the equipment due to unique operating characteristics of the supplied equipment not known to the ENGINEER. The CONTRACTOR shall notify the ENGINEER of such conflicts within 30 days of the Contract award and receive written resolution before proceeding with the Contract work. Any damages to CONTRACTOR-supplied equipment arising due to improper control shall be the responsibility of the CONTRACTOR.

1.07 PREBID SITE VISIT

A. The CONTRACTOR shall familiarize themself with the site prior to bidding and verify that the specified new equipment and existing equipment modifications can be implemented within their proposed Bid price.

PART 2 - PRODUCTS

2.01 GENERAL

A. Use of new quality materials is required on this project.

B. Only materials suitable for the space provided shall be used.
C. Provide materials and equipment listed by Underwriter Laboratories (UL) wherever standards have been established by that agency.

D. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.

2.02 STANDARD PRODUCTS

A. Unless otherwise indicated, provide materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturer’s latest standard design that conforms to these Specifications.

2.03 EQUIPMENT FINISH

A. Provide materials and equipment with manufacturer’s standard finish system. Provide manufacturer’s standard finish color, except where specific color or materials are indicated. If manufacturer has no standard color, finish equipment in accordance with ANSI No. 61, light gray color.

2.04 RACEWAYS

A. Rigid Steel conduit: Use rigid steel conduit, including threaded type couplings, elbows, nipples, and other fittings, galvanized by hot-dipping, electroplating, sherardizing, or metalizing process and meeting the requirements of ANSI C80, NEMA FB 1, UL, and the NEC.

B. EMT conduit: Use electro metallic tubing conduit, including compression type couplings, elbows, nipples, and other fittings, galvanized by hot-dipping, electroplating, sherardizing, or metalizing process and meeting the requirements of ANSI C80, NEMA FB 1, UL, and the NEC.

C. PVC Conduit: use rigid PVC conduit, Schedule 40, UL listed for concrete encased, underground direct burial and UL listed and marked for use with conductors having 90 degrees C insulation. Use conduits, couplings, elbows, nipples, and other fittings meeting the requirements of NEMA TC 2 and TC 3, Federal Specification W-C-1094, UL, NEC, and ASTM specified tests for the intended use.

D. Flexible Metal Conduit: Use UL listed liquid-tight flexible metal conduit consisting of galvanized steel flexible conduit covered with an extruded PVC jacket and terminated with nylon bushings or bushings with steel or malleable iron body and insulated throat and sealing O-ring.

2.05 RACEWAY FITTINGS

A. Fittings for Rigid Steel conduit:
   1. Fittings for Rigid Steel conduit shall be of the same manufacturer as the conduit.
   2. Use insulated throat bushings of metal with integral plastic bushings rated for 105 degrees C. For insulated throat bushings for rigid steel conduit, use Thomas and Betts Nylon Insulated Metallic Bushings, or O.Z. Gedney Type B.
   3. Use Myers Scru-Tite hubs for rigid steel conduit.
4. Use conduit bodies for rigid steel conduit of metal and sized as required by the NEC (NFPA 70-1984). Use Appleton Form 35 threaded Unilets; Crouse-Hinds Mark 9 or Form 7 threaded condulets; Killark Series O Electrolets; or equal, for normal conduit bodies for rigid steel conduit. Where conduit bodies for rigid steel conduit are required to be approved for hazardous (classified) locations, use conduit bodies manufactured by Appleton, Crouse-Hinds, or Killark.

5. Use only couplings for rigid steel conduit supplied by the conduit manufacturer.

6. Use Appleton Type EYF, EYM, or ESU; Crouse-Hinds Type EYS or EZS; or Killark Type EY or EYS, sealing fittings for rigid steel conduit. Where condensate may collect on top of a seal, provide a drain by using Appleton Type SF or Crouse-Hinds Type EYD or EZD Drain Seal.

7. Use Appleton Type ECDB or Crouse-Hinds ECD drain fittings for rigid steel conduit.

8. Fittings for Liquid-Tight Flexible Metal Conduit: use insulated throat connectors for liquid-tight flexible metal conduit of metal with an integral plastic bushing rated for 105 degrees C, and of the long design type extending outside of the box or other device at least 2 inches. Use Thomas and Betts Super-Tite Nylon Insulated Connectors, or equal.

9. Use cable sealing fittings forming a watertight nonslip connection to pass cords and cables into conduit. Size cable sealing fitting for the conductor OD. For conductors with OD’s of 1/2 inch or less, provide a neoprene bushing where the conductor enters the connector. Use Crouse-Hinds CGBS, Appleton CG Series, or equal, cable sealing fittings.

2.06 CONDUCTORS 600 VOLTS AND BELOW

A. All conductors shall be annealed copper. Wire shall be stranded.

B. Insulation shall be Type THHW or XHHW.

C. Sizes: No wire smaller than size No. 12 AWG shall be installed for lighting, receptacles, or other circuits unless otherwise noted.

D. Wire Color Identification: Neutral wire white, live wire black, red, blue on 120/208-volt system; Neutral wire grey, live wire brown, purple, yellow on 277/480-volt system. Ground wire green.

E. Identification Devices: Sleeve: Permanent, PVC, yellow or white, with legible machine-printed black markings.

2.07 NAMEPLATES

A. Provide laminated nameplates with inscription as shown. Nameplates shall be engraved laminated plastic with white lettering on a black background. Attach nameplate with stainless steel panhead screws.

2.08 ETHERNET CAT 6 UTP CABLE (COPPER)

A. 4 twisted pairs (8 conductors), 23 AWG solid bare copper with Polyolefin Insulation. Model Number – 6NF4+, CommScope or approved alternate.
B. Overall Nominal Diameter: 0.235 inch.

C. Operating Temperature Range: -20°C to +75°C.

D. NEC/UL specification CMR, UL444, UL verified category 6.

2.09 SURGE SUPPRESSION DEVICES

A. This section describes the material and installation requirements for surge suppression devices (SPD) in panelboards and loadcenters for the protection of all AC electrical circuits.

B. SPD shall be listed and component recognized in accordance with UL 1449 and UL 1283.

C. SPD shall be installed and warranted by and shipped from the electrical distribution equipment manufacturer’s factory.

D. SPD shall provide surge current diversion paths for all modes of protection; L-L, L-N, L-G, N-G in WYE systems, and L-L, L-G in DELTA systems.

E. SPD shall be modular in design. Each module shall be fused with a surge rated fuse.

F. A UL approved disconnect switch shall be provided as a means of disconnect.

G. SPD shall meet or exceed the following criteria:

1. Maximum surge current capability (single pulse rated) shall be as follows unless otherwise listed on drawings:
   a. Service entrance panel board 150KA

2. UL 1449 Listed and Recognized Component Suppression Voltage Ratings shall not exceed the following:

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<td>240/120</td>
<td>400V</td>
<td>400V</td>
<td>400V</td>
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<tr>
<td>480Y/277</td>
<td>800V</td>
<td>800V</td>
<td>800V</td>
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</tbody>
</table>

H. SPD shall have a minimum EMI/RFI filtering of -50dB at 100kHz with an insertion ration of 50:1 using MIL STD. 220A methodology.

I. SPD shall be provided with 1 set of NO/NC dry contacts.

J. SPD shall have a warranty for a period of five years, incorporating unlimited replacements of suppressor parts if they are destroyed by transients during the warranty period. Warranty will be the responsibility of the electrical distribution equipment manufacturer.

K. Approve manufactures are:

   1. Current Technology CurrentGuard Series
   2. Cutler Hammer CPS Series
2.11 LOW VOLTAGE SURGE SUPPRESSION (SS/SPD) PROTECTION

A. GENERAL:

1. SS/SPD protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level, and be maintenance free and self-restoring.

2. Instruments shall be housed in a suitable case, properly grounded. Ground wires for all SS/SPD shall be connected to a good earth ground and where practical, each ground wire run individually and insulated from each other. These protectors shall be mounted within the instrument enclosure or a separate NEMA 4X junction box coupled to the enclosure.

3. All analog and discrete inputs and outputs shall be optically or transformer isolated for voltage surge protection and shall meet peak common mode and 3 kV surge to ground withstand capability (SWC) test as specified by ANSI C37.90A-197A (IEEE Standard 472-1974).

4. In the event a standard manufacturers product does not satisfy the above surge requirements, additional protective circuitry to suppress contact bounce and to protect transients from being recognized as data. Input/output modules shall be configured for ease of wiring and maintenance. The modules shall be connected to wiring arms which are movable to permit removal of a module without disturbing field wiring. Covers shall be provided to prevent operator personnel from inadvertently touching the terminals.

B. POWER SUPPLY:

1. Protection of all 120 VAC instrument power supply lines shall be provided. Control panels shall be protected by line noise suppressing isolation transformers and SS/SPD. Field instruments shall be protected by SS/SPD. For control panels, the line noise suppressing isolation transformer shall be Topaz Series 30 Ultra isolators or approved equal. The suppressor shall be Edco HSP-121 or approved equal.

C. ANALOG SIGNALS:

1. Protection of analog signal lines originating and terminating not in the same building shall be provided by SS/SPD. For analog signal lines the SS/SPD shall be Edco PC-642 or approved equal. For field mounted two-wire instruments the SS/SPD shall be encapsulated in stainless steel pipe nipples, and shall be Edco SS64 series or approved equal.

2. For field mounted four-wire 120VAC instruments, the SS/SPD shall be in a NEMA 4X polycarbonate enclosure, Edco SLAC series or approved equal.
2.10 FIBER OPTIC CABLING

A. Multimode fiber cable used shall be tight buffered and have the following characteristics:
   1. Size: Core/Cladding 62.5/125um tight-buffered, riser rated multifiber breakout type.
   2. Maximum Attenuation: 3.5 dB/km at 850nm; 1.0 dB/km at 1310nm
   3. Minimum Bandwidth: 200MHz at 850nm; 500MHz at 1300nm
   4. Gigabit support 300m at 850nm; 550m at 1300nm
   5. Maximum tensile load shall be 600 N
   6. Minimum bend radius shall be 8-1/2 inches.
   7. Operating temperature range shall be -40 to +80 degrees Celsius.
   8. Fiber optic cable shall be UL-listed OFNR rated as manufactured by Phoenix Digital Model #FOC-EXP or approved equal.

B. Fiber Optic Cabling

   1. Fiber optic cable shall be rated by the manufacturer for use in a minimum of Gigabit, high speed wide and local area network environments.

   2. All fiber cable shall be terminated with SC connectors.

   3. Fiber optic connectors in the accompanied fiber patch panels shall be either a count of 6, 12 or 48 and accumulate as needed.

   4. All fiber optic cables shall be installed in inner duct through floors, walls and/or any other penetrated areas to the MDF/IDF.

   5. Fiber optic cable shall be installed in accordance with all manufactures specifications.

   6. Fiber optic cables shall be terminated in accordance with TIA/EIA -598 - Color Coding of Fiber Optic Cables.

   7. The Contractor shall be responsible to perform optical loss (attenuation) measurements and Optical Time Domain Reflectometer (OTDR) tests on all fiber optic cabling.

   8. If any fiber cable loss exceeds either the established optical loss for high speed transmission or the manufacturer's standards, the Contractor shall correct and/or replace as necessary.

2.11 LIGHTNING PROTECTION

A. Shop Drawings:
   1. Down conductor.

       2. Connecting conductor.

       3. Bond strap.

       4. Air terminals.

       5. Fittings.
6. Connectors.

B. Quality Control Submittals: Field test report.

C. Contract Closeout Submittals: Submit to OWNER:
   1. Ground Witness Certification-Form LPI-175A.
   2. Post-Installation System Certification

D. Manufacturers
   1. Thompson Lightning.
   2. IPC Protection.
   3. AC Lightning Security.
   4. Lightning & Grounding Systems, Inc.

E. General
   1. System Material: Copper or high copper content, heavy-duty bronze castings, unless otherwise specified.
   2. All material shall comply in weight, size, and composition for the class of structure to be protected as established by UL 96 and 96A.

F. Air Terminal
   1. Material: Solid copper rods, with tapered points.
   2. Length: Sufficient to extend minimum 18 inches above object being protected.
   3. UL 96 Label B applied to each terminal.

G. Conductors
   1. Copper Cable: Bare medium stranded, having 97.5 percent minimum conductivity.
   2. Main Down Conductor: Per UL and NFPA criteria and based on wall height.
   3. Connecting Conductor: Secondary size per UL and NFPA criteria
   5. All main down and connecting conductors shall bear the UL 96 Label A, applied every 10 feet.

F. Cable Fastener and Accessories
   1. Capable of withstanding minimum pull of 100 pounds.

G. Fittings
   1. Heavy-duty Class II bolt pressure type.

H. Cable Connections and Splicers
   1. As specified in 16001, GROUNDING.

I. CONDUIT
   1. Schedule 40 PVC, as specified in Section 16001, RACEWAYS.
PART 3 – EXECUTION

3.01 GENERAL

A. Technique is the essence of the work in this project.

B. Install materials and equipment in a professional manner utilizing proficient skilled in the particular trade. Provide work which has a neat and finished appearance.

C. Coordinate electrical work with Engineer and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation.

D. Check the approximate locations of light fixtures, equipment, and other electrical system components shown on Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, consult the Engineer. The Engineer’s decision shall govern. Make modifications and changes required.

3.02 PROTECTION DURING CONSTRUCTION

A. Throughout this Contract, Provide protection for materials and equipment against loss or damage in accordance with provisions elsewhere in these Contract Documents. Protect everything from the effects of weather. Prior to installation, store items in clean, dry, indoor locations. Store in clean, dry, indoor, heated location items subject to corrosion under damp conditions, and items containing electrical insulation, such as transformers, conductors, motors, and controls.

B. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. Cap conduit runs during construction with manufactured seals. Keep openings in boxes or equipment closed during construction.

3.03 MATERIAL AND EQUIPMENT INSTALLATION

A. Follow manufacturer’s installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between manufacturer’s instructions, codes and regulations, and these Contract Documents, follow Engineer’s decision. Keep copy of manufacturer’s installation instructions on the jobsite available for review at all times.

3.04 CUTTING AND PATCHING

A. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Engineer. Carefully carry out any cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces neatly to original condition. Use skilled craftsmen of the trades involved.

3.05 LOAD BALANCE
A. The Drawings and Specifications indicate circuiting to electrical loads and distribution equipment; however, after installation, if necessary, balance electrical load between phases as nearly as possible on loadcenters, panelboards, etc.

3.06 CLEANING AND TOUCH-UP PAINTING

A. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish.

3.07 CONDUIT

A. Schedule 40 PVC shall be used for all underground. All non-condition spaces above grade shall be hot dipped rigid galvanized steel. All condition spaces above grade shall be EMT.

B. Conduit shall be sized in accordance with the NEC and shall be of such size and so installed that conductors may be drawn in without injury or excessive strain.

C. Provide all necessary sleeves and chases required where conduits pass through floors or walls seal all openings and finish to match adjacent surfaces. Where exposed, conduits pass through walls, floors or ceilings, provide fill of same materials as the penetrated surface.

D. Galvanized Rigid Conduits entering cabinets, pull boxes or outlet boxes shall be secured with double galvanized locknuts, one on inside and outside of box, and bushings.

E. Conduit shall be sized in accordance with the NEC and shall be of such size and so installed that conductors may be drawn in without injury or excessive strain.

F. Make final connection to motors where flexible connection is required to minimize vibration or where required to facilitate removal or adjustment of equipment, with 18-inch minimum, 60-inch maximum length of liquid-tight, PVC jacketed, flexible steel conduit where the required conduit size is 4 inches or less. For larger sizes, use nonflexible conduit as specified.

G. Flash and counterflash all conduits penetrating membrane. All roof penetration shall be sealed unless directed otherwise by the Engineer.

H. Exposed Raceways: Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes.

I. Changes in Direction of runs: Changes in direction of runs shall be made with symmetrical bends or cast metal fittings. Field made bends and offsets shall be made with an approved hickey or conduit bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Care shall be taken to prevent the lodgment of dirt, or trash in raceways, boxes fittings, and equipment during the course of construction. Clogged raceways shall be entirely freed of obstructions or shall be replaced.
3.08 OUTLET AND JUNCTION BOXES

A. Provide a box suitable for the conditions encountered at each outlet in the wiring or raceway system and sized in accordance with the NEC.

B. Install boxes in a secure, substantial manner, supported independently of conduit attachment to the structure. Use stainless steel hardware in all areas.

C. Install boxes for conduits below grade flush with finished grade.

D. All boxes shall be rated for use in the environment for which they are installed.

3.09 GROUNDING

A. All equipment and enclosures, and the complete conduit system shall be grounded securely in accordance with pertinent sections of Article 250 of NEC. All electrically operated equipment shall be bonded to the grounding conduit system via bonding jumpers, grounding busses, and grounding bushings. Grounding shall include the grounding conductors shown on Drawings and additional grounding as required above. All enclosures shall contain a grounding buss tied to the conduit system and enclosure utilizing bonding jumpers #6 minimum.

3.10 CONDUCTORS

A. No conductor shall be drawn into conduit until conduit system is complete. Lubricant shall be approved by wire manufacturer.

B. Circuit Identification: Identify power, control conductor circuits, and CAT6 cabling at each termination and in accessible locations such as panels, junction boxes, and terminal boxes.

3.11 COLOR MARKINGS

A. Where two or more conduits run to a single outlet box, each circuit shall be color coded as a guide in making connections. Colors shall be carried continuously throughout the system if more than one multiwire branch circuit is carried through a single raceway. All circuit conductors of the same color shall be connected to the same underground feeder conductor throughout the installation.

3.12 CIRCUITS

A. Deviations from conduit runs will be permitted with the Engineer’s approval. Combining circuits in single conduit is permitted with proper identification and wire size increase required by NEC.

3.13 CONNECTIONS TO EQUIPMENT

A. Provide all conduits, wiring, and connections for equipment furnished by the OWNER or under other sections, including line and low voltage wiring for all equipment. Obtain required information from the other trades and rough-in to meet requirements of said equipment. No allowance will be made for failure to comply with obtaining complete information from other trades.
3.14 LIGHTING FIXTURES

A. Furnish and install all lighting fixtures, complete with lamps and accessories, as indicated. Substitutions will be permitted only with prior written approval of the Engineer. Lighting fixtures shall have 5 year warranty for LED Boards and drivers, 1 year warranty against defects in design.

3.15 TOUCH UP

A. After the equipment is installed, touch up any scratches, marks, etc., incurred during shipment or installation of equipment.

3.16 TESTS

A. General: Carry out tests specified hereinafter and as indicated under individual items of materials and equipment specified in other sections.

B. Operations: After the electrical system installation is completed and at such time as the Engineer may indicate, conduct an operating test for approval. Demonstrate that the equipment operates in accordance with the requirements of these Specifications and Drawings. Perform the test in the presence of the Engineer or authorized representative. Furnish all instruments and personnel required for the tests. The OWNER will furnish the necessary electric power.

C. Voltage:
   1. When the installation is essentially complete check the voltage at the point of termination of the power company supply system to the project. Check voltage amplitude and balance between phases for loaded and unloaded conditions.

3.17 LIGHTNING PROTECTION

A. GENERAL
   1. Workmanship to comply with all applicable provisions of LPI 175, UL 96 and 96A, and NFPA 780.
   2. Installation of bare copper materials on aluminum surfaces will not be permitted.
   3. Provide waterproof seal of all penetrations.
   4. Install system in inconspicuous manner so that components blend with wall aesthetics.

B. EXAMINATION
   1. Verify conditions prior to installation. Actual conditions may require adjustments in air terminal and ground rod locations.

C. AIR TERMINALS
   1. Supports: Brackets or braces.
   2. Perimeter Terminals: As called out on drawings.

D. CONDUCTORS
   1. Conceal whenever practical.
   2. Provide 1-inch PVC conduit for main downleads as called out in drawings.
4. Maintain horizontal and vertical conductor courses free from dips or pockets.
5. Bends: Maximum 90 degrees, with minimum 8-inch radius.

E. BONDING
   1. As specified in Section 16001, GROUNDING.

F. GROUNDING SYSTEM
   1. As specified in Section 16001, GROUNDING.

G. FIELD QUALITY CONTROL
   1. Isolate lightning protection system from other ground conditions while performing tests.
   2. Resistance: Test ground resistance of grounding system by the fall-of-potential method.
      b. Install additional ground rods as required to obtain maximum allowable resistance.
   3. Test Report:
      a. Description of equipment tested.
      b. Description of test.
      c. Test results.
      d. Conclusions and recommendations.
      e. Appendix, including appropriate test forms.
      f. Identification of test equipment used.
      g. Signature of responsible test organization authority.

END OF SECTION 16001
June 19, 2008

Mr. George A. Edwards, P.E.
Project Manager IV
Broward County Highway Construction & Engineering Division
One North University Drive, Suite 300B
Plantation, Florida 33324

Subject: Report of a Geotechnical Exploration
NW 21st Avenue Pedestrian Bridge over C-13 Canal
Broward County, Florida
HRES Project No. HR08-613R

Dear Mr. Edwards:

HR Engineering and Services, Inc. (HRES) has completed a geotechnical exploration for the subject project. The purpose of this exploration was to develop information concerning the site and subsurface conditions in order to provide foundation recommendations for support of the new pedestrian bridge. The work was described in our proposal No. HR08-434P dated April 23, 2008 and authorized in a service contract dated May 6, 2008.

We appreciate the opportunity of working with you on this project and look forward to our continued association. Please contact us if you have any questions about this report, or if we may be of further assistance.

Sincerely,

HR ENGINEERING SERVICES, INC.

[Signatures]

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<td>6.5 SAMPLE STORAGE</td>
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APPENDIX A:

- Site Location Map
- Field Exploration Plan
- Report of Core Borings
- Field Exploration Testing Procedures

APPENDIX B:

- Augercast Pile Compression Capacity Tables - North and South End Bents
- Graphs of Allowable Compression Capacities vs. Elevation

APPENDIX C:

- Grain Size Analysis
- Fines Content
- Corrosion Classification
- Laboratory Testing Procedures
1.0 EXECUTIVE SUMMARY

The purpose of this exploration was to develop information concerning the site and subsurface conditions in order to provide foundation recommendations for support of the pedestrian bridge over C-13 Canal.

Our evaluation focused on one deep foundation system: auger cast piles. One diameter was analyzed: 16-inch diameter auger cast piles.

The axial capacities of this deep foundation system rely on the skin friction provided by the pile side and the natural rock. The natural limestone was encountered by the test borings at a depth ranging from approximately 8.0 to 45 feet, measured from the existing ground surface estimated to be at elevation 11.0 feet, NGVD.

Foundation Recommendations

Test Borings B-1 and B-2 (North and South End Bents). B-1 and B-2 encountered the competent limestone at an approximate elevation of -11.0 feet. For an allowable pile capacity of 35 tons, the minimum rock socket is 6 feet (pale tip elevation at -17 feet, NGVD).
2.0 PROJECT INFORMATION

Project information was provided to us by Mr. Julio Gurrea of Broward County. We understand the following:

- We understand that the structure consists of a pedestrian bridge crossing the C-13 Canal. The bridge is supported on the end bents. Each end bent is proposed to be supported on two, 16-inch diameter augercast piles.
- A maximum pile load (allowable capacity) of 35 tons.
- Based on the plans provided to us, we estimated that the existing average elevation of each end bent is 11 feet, NGVD.
3.0 FIELD EXPLORATION AND LABORATORY TESTING

3.1 FIELD EXPLORATION

A total of two (2) test borings were performed on May 19, 2008. The test borings were drilled to a depth of 50 feet below the existing ground surface. The approximate test boring locations are shown on the Field Exploration Plan in Appendix A. The test borings were drilled in general accordance with the procedures presented in Appendix A.

The Report of Core Borings in Appendix A graphically shows the penetration resistance and presents the soil/rock description for each test boring. The stratification lines and depth designations on the Report of Core Borings represent approximate boundaries between soil/rock types. In some instances, the transition between soil/rock types may be gradual. The water levels shown on the Report of Core Borings represent the conditions at the time of our exploration. A brief description of the exploratory drilling and sampling techniques used is presented in the Field Exploration Testing Procedures section in Appendix A.

3.2 LABORATORY TESTING

3.2.1 Soils

In order to aid in classifying and estimate engineering characteristics of the subsurface materials encountered, laboratory classification tests were performed on representative soil samples obtained from the test borings. The laboratory testing program included the following:

- 1 Fines content test
- 2 Sieve Analyses

The soil laboratory test results were classified following the United Soils Classification System (USCS). The laboratory test results are presented on the Report of Core Borings in Appendix A.

3.2.2 Corrosivity Classification Testing

Corrosivity classification testing was performed on one representative groundwater sample obtained from test boring B-1. The water sample was collected by HRES and tested by KSA Environmental Laboratory, Inc. This testing included pH, chlorides, sulfates and resistivity results. The Florida Department of Transportation
Requirements Manual, Chapter 1, Section 1.3 Environmental Classification outlines the ranges of groundwater chemical properties considered corrosive to reinforced concrete substructure. In addition, that section environmentally classifies the superstructure based on factors located near the proposed structure(s). Based on this classification, an environment may be Slightly Aggressive, Moderately Aggressive, or Extremely Aggressive. The following table summarizes the laboratory test results:

Table 3.2.2: Corrosion Classification Test Results

<table>
<thead>
<tr>
<th>Sample Location</th>
<th>Resistivity Ohms-cm</th>
<th>pH</th>
<th>Sulfates ppm</th>
<th>Chlorides ppm</th>
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<td>B-1</td>
<td>120</td>
<td>7.8</td>
<td>340</td>
<td>2480</td>
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</table>

The results show that the substructure will be in an Extremely Aggressive environment. Due to its locations, any superstructure is considered to be in a Slightly Aggressive environment.
4.0 SITE AND SUBSURFACE CONDITIONS

4.1 SITE CONDITIONS

The bridge will be constructed immediately west of the existing vehicular bridge (NW 21st Avenue) over C-13 Canal.

4.2 SUBSURFACE CONDITIONS

4.2.1 General

The Report of Core Borings in Appendix A should be consulted for a detailed description of the subsurface conditions encountered at each boring location. When reviewing the Report of Core Borings, it should be understood that soil/rock condition might vary between boring locations.

4.2.2 Soils/Rock

The following table summarizes the general conditions encountered by the borings. For detailed information, please refer to the Report of Core Borings in Appendix A.

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<thead>
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<th>Range in Depth, Feet</th>
<th>Soil/Rock Description</th>
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</thead>
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<td>0.0-5.0</td>
<td>Medium Dense to Loose brown silty fine SAND with traces of limerock (fill). GM to SM</td>
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<tr>
<td>5.0-8.0</td>
<td>Loose to Very Loose fine SAND, SP or silty fine SAND, SM</td>
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<td>8.0-45.0</td>
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<tr>
<td>45.0-50.0</td>
<td>Dense fine SAND with some limestone lenses, GP</td>
</tr>
</tbody>
</table>

4.2.3 Groundwater

The groundwater level was measured at the boring locations at the time of drilling. Groundwater was encountered at an elevation of approximately 3.0 feet, NGVD. Fluctuation in the observed groundwater levels should be expected due to seasonal climatic changes, construction activity, rainfall variations, surface water runoff, tides, storm surge and other site-specific factors.
5.0 EVALUATION

5.1 BASIS FOR EVALUATION

The following evaluation is based upon the previously presented project information. The field data have been compared with previous performances of similar structures bearing on and within soil/rock conditions similar to those collected for this study. If the project information is incorrect or has changed, please contact us so that our evaluation and recommendations can be reviewed.

We are addressing the following preliminary geotechnical design and construction considerations:

1. As a preferred alternative, a deep foundation support of the structures using 16-inch diameter augercast piles.

5.2 AUGERCAST PILES

The augercast pile foundation system is considered a feasible high capacity deep foundation alternative for support of the planned bridge structure. Sixteen inch diameter augercast piles were analyzed utilizing the subsurface soil and rock conditions encountered by the borings. Augercast piles socketed into the underlying soft to medium limestone layer were considered in our analysis.

Augercast piles derive their axial load capacity from two components; shear transfer between the grout and rock interface, and end bearing or point resistance at the base of the pile. The amount of relative movement between the pile perimeter and the adjacent rock required to fully mobilize the ultimate strength of the rock and shear transfer is usually on the order of 0.10 to 0.25 inch, and typically independent of the pile diameter. However, if the relative movement between the pile perimeter and the adjacent rock exceeds 0.20 to 0.50 inch, the shear strength of the rock reduces from peak to residual. In our augercast pile analysis, we utilized the peak shear strength values of the limestone.

The end bearing or point resistance, however, reaches its maximum load capacity upon tip movement on the order of 5 to 25 percent of the pile diameter, when bearing on soils or weak rocks. Although the end bearing resistance can produce relatively high load-carrying capacities for augercast piles, the movement of the tip required to mobilize the end bearing capacities may result in excessive pile butt movements. Our analysis did not consider the end bearing capacity.

The analysis of axial load-carrying capacities of the augercast piles followed static equilibrium methods of analysis presented in the International Conference of Deep Foundations sponsored by FHWA, December 1994, developed by Hernando R. Ramos, P.E. and Juan Antorena, P.E. The
method generates pile side friction capacity through the use of empirical correlations with Standard Penetration Test (SPT) "N" values. The ultimate mobilized pile capacity is calculated as the sum of the ultimate side friction. In order to arrive to the allowable pile capacity, a factor of safety of 3.0 is applied to the ultimate pile capacity.

The center-to-center spacing of the augercast piles should be at least three times the pile diameter in order to minimize pile tip settlement and capacity reductions caused by group effects.

5.2.1 Augercast Piles Foundation Settlement

The total settlement of an augercast pile bearing in the underlying soft to medium limestone will be less than 0.50 inch with differential settlements of less than 0.25 inch. The majority of this settlement should occur almost immediately with the application of the dead load during construction.
6.0 RECOMMENDATIONS FOR FOUNDATION DESIGN

6.1 AUGERCAST PILES DESIGN CAPACITIES

Test Borings B-1 and B-2 (North and South End Bents). B-1 and B-2 encountered the competent limestone at an approximate elevation of -11.0 feet. For an allowable pile capacity of 35 tons, the minimum rock socket is 6 feet (pile tip elevation at -17 feet, NGVD).

The results of the analyses are presented on tables and graphs of allowable compression capacities versus elevation in Appendix B.

6.2 AUGERCAST PILE INSTALLATION RECOMMENDATIONS

Augercast piles are constructed by rotating a hollow-stem continuous flight auger into the ground until the planned tip depth or termination criteria are achieved. At the termination level, a grout with a relatively thick soupy consistency is pumped under pressure into the hole through the hollow stem auger. As long as pressure is observed in the line, the auger is slowly withdrawn up the hole and the augercast shaft is constructed.

The normal driving criteria and inspection procedures employed in the installation of driven piles are not applicable to augercast piles. Successful installation depends on the experience and skill of the piling contractor. We recommend, therefore, that the installation of all augercast piles be observed by an engineer from this office familiar with the subsurface conditions at this site. The installation procedures that can be monitored include the rate of auger withdrawal, the maintenance of a positive grout pressure, the volume of grout pumped into the pile, and the depth of the pile tip. The full-time monitoring of pile installation will provide a degree of assurance that continuous piles of the proper cross-section are being obtained.

We suggest the following guidelines are used for augercast pile installation:

1. A pressure gauge should be installed close to the pile rig in order to monitor pressure during the grouting operations. The gauge should be positioned so that it can be easily observed by the field engineer.

2. A mechanical counter should be provided on the grout pump to record the number of pump strokes during the installation of each pile.
3. The grout pump should be calibrated prior to initiation of production pile installation by pumping grout into a container of known volume. The pump should then be calibrated as often as deemed necessary by the field engineer.

4. At least one set of six grout cubes should be made for each 50 cubic yards of grout or a minimum of one set for each day of pile installation, or one set per bridge end bent.

5. After achieving the desired maximum depth and criteria, a positive grout pressure should be observed prior to initiating withdrawal of the auger. A continuous fluid return (first slurry, then grout) out of the top of the hole is the best indication that the maximum possible pressure head is being achieved.

6. The auger should be withdrawn slowly and smoothly so that a positive grout pressure is maintained in the hole at all times during auger withdrawal. If the withdrawal of the auger becomes erratic, grout pressure suddenly drops, or if the grout supply is interrupted, the auger tip should be reinserted at least 5 feet below the level where the grouting operation was disrupted prior to resuming withdrawal of the auger. The time rate of withdrawal of the auger should be monitored by the field engineer.

7. A grout factor equal to or greater than that of the successful test piles should be achieved. The grout factor is defined as the actual volume of grout pumped into the pile divided by the theoretical volume of the drilled hole. Although piles should not be rejected solely on the basis of grout factors less than that of the test piles, the contractor should coordinate the rate of withdrawal of the auger so that the desired target grout factor is achieved. As noted previously, significantly higher grout factors may result due to the presence of relatively small voids and cavities in the limestone formations.

8. Clockwise rotation of the auger should be performed during the grouting process, at least until grout is observed flowing out of the top of the drilled hole. Auger rotation helps stabilize the sides of the hole, facilitates the removal of spoil material out of the hole, and prevents bearing formation cuttings from settling-out to the bottom of the hole during grouting.

9. The installation of adjacent piles (located within 4 feet of each other) on the same working day is not recommended at this site due to the potential existence of inter-connected pores or cavities in the limestone layers. We recommend that adjacent piles (located within 4 feet) not be installed until the initial grouted pile has set overnight.

10. Some subsidence of fresh grout may occur in the top of the piles. This subsidence is in part a result of the weight of the grout column "pushing" laterally into pores in the rock layer. It is anticipated that this subsidence will occur within a period of about two hours following the grouting operation. If subsidence occurs while the pile grout is in a fluid state (generally within two hours of forming the pile), we recommend that the pile be "topped" with fresh grout to the proper cutoff elevation immediately. A short length of casing or sleeve inserted into the top of the pile would serve as a good reference to judge whether grout
subsidence has occurred. We recommend that a pile grout subsidence of up to 6 inches be considered acceptable for this project. As stated previously, the pile should be refilled as the subsidence occurs. Conscientious monitoring of the pile grout levels will be required by the contractor and installation monitoring personnel. Piles which subside more than 6 inches overnight or after a two-hour period should be evaluated on an individual basis.

6.2.1 Augercast Pile Installation Monitoring

Because the augercast pile is a cast-in-place pile, the success or failure of this pile type is dependent upon the quality of the piles installed. We recommend that a pile installation monitoring program be implemented so that a quality installation is achieved and that HRES be retained to provide this service. All piles should be socketed into the lower limestone.

Prior to actual installation of the piles, the contractor should demonstrate that the materials and equipment proposed for use are capable of installing the production piles. The contractor should provide an accurate method of determining the depth and alignment of the auger. Grout pressure gauges should be accessible to the field engineer/geologist at all times. Gauges, which become blocked with grout, should be cleaned or replaced.

The duties of the augercast pile observer should include the following:

1. Calibrating the grout pump (in units of cubic feet per stroke).
2. Monitoring the addition of any water and/or admixtures to the grout at the site. Performing flow cone tests, as required.
4. Observing the drilling process and noting any relevant irregularities.
5. Approving the pile augering termination criteria and recording the pile tip elevation prior to pumping.
6. Observing and documenting the grouting procedure, noting the depth to the auger tip during any delays in grouting, and the time of any delay during pumping.
7. Recording the total number of pump strokes for determination of the actual grout volume pumped into each pile. Calculating theoretical pile volume and grout factors.
8. Recording the grout pressure during pumping and the rate of withdrawal of the auger.
9. Monitoring the setting process of the fresh grout based on actual samples taken at the time of arrival on-site. Grout, which has reached its initial set, should not be used.
10. Observing freshly-grouted piles to determine whether any settling or grout subsidence has occurred.
11. Monitoring of the installation of reinforcing steel in the piles.
6.3 AugerCast Pile Test Program

Since the maximum compression loading per pile is less than 40 tons, no pile load test is required by the South Florida Building Code to confirm the design.

6.4 Surface Water and Shallow Groundwater Control

The need for significant groundwater control during construction is not anticipated. The need for surface water runoff control should be anticipated during the site preparation and foundation construction process. Lack of proper controls could result in ponding surface water on compaction surfaces. The ponded water will also impede or prevent necessary soil compaction operations and make construction trafficability difficult.

6.5 Sample Storage

We will keep the soil samples retrieved for this exploration program at our office for a period of 60 days from the date of this report. After that, we will discard these samples.
APPENDIX A

SITE LOCATION MAP
FIELD EXPLORATION PLAN
REPORT OF CORE BORINGS
FIELD EXPLORATION TESTING PROCEDURES
FIELD EXPLORATION PROCEDURES

Test Borings - The test borings were made in general accordance with ASTM D-1586, "Penetration Test and Split-Barrel Sampling of Soils." The borings were initially advanced by augering. A rotary drilling process was subsequently used. At regular intervals, the drilling tools were removed and soil samples were obtained with a standard 1.5-inch I.D., 2.0 inch O.D., split-tube sampler. The sampler was first seated six inches and then driven an additional foot with blows of a 140 pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot is designated the "Penetration Resistance." The penetration resistance, when properly interpreted, is an index to the soil strength and density.

Representative portions of the soil samples, obtained from the sampler, were placed in glass jars and transported to our laboratory. An engineer then examined the samples in order to verify the field classifications.
APPENDIX B

AUGERCAST PILE COMPRESSION CAPACITY TABLES –  
NORTH AND SOUTH END BENTS  
GRAPHS OF ALLOWABLE COMPRESSION CAPACITIES VS. ELEVATION
## AUGERCAST PILE COMPRESSION CAPACITY

NW 21st AVENUE PEDESTRIAN BRIDGE OVER C-13 CANAL - BROWARD COUNTY
BORING B-1 (SOUTH END BENT)

HRES PROJECT No. HR08-613R

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### AUGERCAST PILE COMPRESSION CAPACITY

**NW 21st AVENUE PEDESTRIAN BRIDGE OVER C-13 CANAL - BROWARD COUNTY**

**BORING B-2 (NORTH END BENT)**

**HRES PROJECT No. HR08-613R**

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NW 21st AVENUE PEDESTRIAN BRIDGE OVER C-13 CANAL
BORING B-2 (NORTH END BENT)
HRES Project No. HR08-613R

- 16" Dia. Pile

ALLOWABLE COMPRESSION CAPACITY, TONS
Notes:
The peak rock shear strength was estimated from the following formula:
\[ f_u = 2 + 0.2 \times N_{AE} \] in tsf
where \( f_u \) is the peak shear strength of the rock. The formula was developed from correlations between SPT values and measured shear strength values of the Florida rock. See "Design and Construction of Deep Foundations", Volume II, pages 699 to 711. International Conference of Deep Foundations, by U.S. Federal Highway Administration (FHWA), December 1994.

To obtain the factored compression capacity values, multiply the ultimate compression capacity by a resistance factor of 0.60.

To obtain the uplift compression capacity values, multiply the ultimate compression capacity by a resistance factor of 0.50.

\( N_a = \) Blows per foot values obtained with an automatic hammer
\( N_s = \) Blows per foot values obtained applying a value of 1.24 to covert from automatic hammer to safety hammer
APPENDIX C

GRAIN SIZE ANALYSIS
FINES CONTENT
CORROSION CLASSIFICATION
LABORATORY TESTING PROCEDURES
# GRAIN SIZE ANALYSIS

**Project Name:** PEDESTRIAN BRIDGE OVER C-13 CANAL  
**Project No.:** HR08-613R  
**Boring No.:** B-1  
**Sample No.:** 1B  
**Depth:** 0.7'-2.0'  
**Date:** 05/23/2008  
**Tested By:** A.P.

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Particle Size, gr</th>
<th>Weight on Sieve, gr</th>
<th>Accumulated Weight, gr</th>
<th>Percent Retained</th>
<th>Percent Passing</th>
<th>REMARKS</th>
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USCS Classification: SM

Total Dry Weight Before Wash, (gr) = 236.8

Percent Finer than No. 200 Sieve by Wash Method = 12%

Note: The test was performed in general accordance with ASTM D-422, D-2216, D-2974 and AASHTO T-11 T-27, T-285, T-267

Respectfully Submitted,

HR Engineering Services, Inc.

Hernando R. Ramos, P.E.
Florida Registration No. 42045
## GRAIN SIZE ANALYSIS

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Particle Size, gr.</th>
<th>Weight on Sieve, gr.</th>
<th>Accumulated Weight, gr.</th>
<th>Percent Retained</th>
<th>Percent Passing</th>
<th>REMARKS</th>
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Total Dry Weight Before Wash, (gr) = **310.86**

Percent Finer than No. 200 Sieve by Wash Method = **9%**

Note: The test was performed in general accordance with ASTM D-422, D-2216, D-2974 and AASHTO T-11 T-27, T-285, T-267

Respectfully Submitted,

HR Engineering Services, Inc.

[Signature]

Hernando R. Ramos, P.E.
Florida Registration No. 42045
REPORT OF MOISTURE AND PERCENT PASSING THE No. 200 SIEVE

Project Name: PEDESTRIAN BRIDGE OVER C-13 CANAL    Project No.: HR08-613R
Boring No.: B-2    Sample No.: 4B    Depth: 6.5'-7.5'
Date: 05/23/08

Technician: A. P.

| A) Wt. of Dry Soil + Can Before Wash, grams | 121.80 |
| B) Wt. of Can, grams No. | 658 |
| C) Wt. of Dry Soil Before Wash, grams (A-B) | 113.49 |

Time in / Out of Oven: 06/03/08 4:00 PM TO 06/04/08 4:00 PM

D) Wt. of Dry Soil + Can After Wash, grams | 95.42 |
E) Wt. of Dry Soil After Wash, grams (D-B) | 87.11 |
F) Total Loss, grams (C-E) | 26.38 |
G) Percent Finer Than No. 200 Sieve (F/C x 100) | 23%

Note: The test was performed in general accordance with AASHTO T-267-86, T-11, ASTM D 2974-87

Respectfully Submitted,
HR Engineering Services, Inc.

Hernando R. Ramos, P.E.
Florida Registration No. 42045
### Wet Chemistry

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<th>MDL</th>
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<th>Prep Date/Time</th>
<th>Analysis Date/Time</th>
<th>Analytical Batch</th>
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LABORATORY TESTING PROCEDURES

Grain Size Distribution – The grain size tests were performed to determine the particle size and distribution of sample tested. Each Sample was dried, weighed, and washed over a #200 mesh sieve. The dried sample was then passed through a standard set nested sieves to determine the grain size distribution of the soil particles coarser than the #200 sieves. This test was conducted in general accordance with ASTM D-22.

Percent Fines Content – In this test, the sample is dried and then washed over a #200 mesh sieve. The percentage of soil by weight passing the sieve is the percentage of fines or portion of the sample in the silt and clay size range. This test was conducted in general accordance with ASTM D-1140.
THIS PREVIOUS DESIGN BRIDGE DRAWING IS INCLUDED WITH THE GEOTECHNICAL REPORT ONLY FOR THE PURPOSE OF ESTABLISHING THE TEST HOLE LOCATIONS. REFER TO PLANS PREPARED BY EAC CONSULTING FOR CURRENT BRIDGE DESIGN.