Charleston County SCHOOL DISTRICT
excellence is our standard

Malcolm C. Hursey
New Montessori School

Bid Documents
12.17.2021

Volume 3 – Division 26-Appendix

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BROWNSTONE

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DIVISION NO. 26 – ELECTRICAL

SECTION 260501 - GENERAL ELECTRICAL REQUIREMENTS, MATERIALS & METHODS

PART 1 - GENERAL

1.1 SCOPE

A. The General and Special Conditions are a part of this Section of the Specifications.

B. Provide all labor, equipment, material, and operations required for complete, safe, and quietly operating electrical systems in accordance with Specifications and Drawings and subject to terms and conditions of the contract.

C. Drawings and Specifications are complementary and what is called for by either shall be as binding as if called for by both. Bring any conflicts between the two to the attention of the Engineer prior to bid time

D. Examine other drawings and Specifications and bring any omissions or discrepancies to the attention of the Architect prior to bid time.

1.2 DRAWINGS

A. Project Drawings: The Drawings accompanying this Specification are generally diagrammatic and do not show all details of bolts, nuts, connections, and the like required for the complete system, and do not indicate the exact location of conduit, fixtures, equipment, etc., unless definitely dimensioned or noted. While these Drawings shall be followed as closely as possible, all dimensions shall be checked at the building and any necessary changes shall be made to accord with structural and architectural conditions, equipment to be installed or with the work of the different trades, without additional cost to the Owner, and as directed by the Architect. Any component item which is necessary for the proper operation of any system under this contract shall be furnished and installed by the Contractor without extra charge.

1.3 EXAMINATION OF CONDITIONS

A. It is understood and agreed that the Contractor has, by careful examination, satisfied himself as to the nature and location of the work, the conformation of the ground, the character, quality, and quantity of the materials to be encountered, the general and local conditions, and to all other matters which can affect the work under this contract.

1.4 WORKMANSHIP

A. Workmanship shall be of the best quality and none but competent mechanics skilled in their trades shall be employed. The Contractor shall furnish the services of an experienced superintendent, who will be constantly in charge of the erection of the work, until completed and accepted.

1.5 MANUFACTURER'S INSTRUCTIONS

A. Prior to purchasing equipment, procure product manufacturer's application, installation, and operating instructions for use in conjunction with the system design drawings and specifications during construction. If there exists any conflict between the manufacturer's publications and the design drawings and specifications, immediately notify the Engineer, in writing. Upon notification by the Engineer, proceed in accordance with his instructions.

PART 2 – PRODUCTS

2.1 MATERIALS:

A. Workmanship shall be of the best quality and none but competent mechanics skilled in their trades shall be employed. The Contractor shall furnish the services of an experienced superintendent, who will be constantly in charge of the erection of the work, until completed and accepted.

B. Unless otherwise hereinafter specified, all materials and equipment shall be new, of best grade, and as listed in printed catalogs of the manufacturer. Each article of its kind shall be the standard product of a single manufacturer.

C. The Architect shall have the right to accept or reject material, equipment and/or workmanship, and determine when the Contractor has complied with the requirements herein specified. Where departures from indicated arrangements are required, written approval for such changes shall be obtained from Architect's representative.

D. All manufactured materials shall be delivered and stored in their original containers. Equipment shall be clearly marked or stamped with the manufacturer's name and rating.

E. All material and equipment used on this project shall be stored in a weatherproof, bonded warehouse. Contractor shall submit insurance certificate to the Architect prior to storing any materials or equipment. No equipment or materials used on this project shall be stored outside exposed to the weather. Before final payment can be made, a notarized statement with the material invoiced to the Owner must be furnished to the Architect.

2.2 APPROVALS AND SUBSTITUTIONS

A. All requests for substitutions shall be submitted so as to be received by the Engineer at least ten (10) calendar days before bid date. Approved material will be listed in addendum form.

B. Contract prices shall be based on material and equipment as specified, unless written approval is obtained for any deviations. Requests for substitutions before bid date may be submitted by Contractors or by Equipment Manufacturer's Representatives.

C. Requests for approvals should be submitted in the form of a letter (with one copy minimum) on a letterhead of submitting firm, along with a self-addressed, stamped, return envelope. Letter shall be addressed to the Engineer and referenced to this project.

D. If there are no deviations between the items submitted and the plans and specifications, then the submittal letter should contain the statement, "Items are in accordance with plans

and specifications with no deviations". An item with deviations from the plans and specifications may be submitted for approval consideration. Letter should then state, "Item submitted is in accordance with plans and specifications, except for the following deviations." Deviations should then be listed in itemized form.

E. Items approved shall not be construed as authorizing deviations from the plans and specifications. Contractor shall be responsible for verifying all dimensions with available space conditions with provisions for proper access, maintenance, and part replacement, and for coordination with other trades - mechanical, plumbing, structural, etc., for proper services and construction requirements.

F. Where such approved deviations require a different quantity and arrangement of wiring, conduit and equipment from that specified or indicated on the drawings, the Sub-Contractor shall furnish and install any such structural supports, controllers, starters, electrical wiring and conduit, and any other additional equipment required by the system, at no additional cost to the Owner.

PART 3 - EXECUTION

3.1 CODES, RULES, PERMITS, FEES, AND APPLICABLE PROVISIONS

A. Comply with the National Electrical Code, International Building Code, Life Safety Code, and Municipal Code requirements. The applicable code versions shall be as listed in on the plans. In case of conflict, Municipal Code shall govern.

B. The Contractor shall give all requested notices, obtain necessary permits, and pay all required fees.

C. Deliver to Architect permits and certificates.

3.2 COORDINATION WITH OTHER TRADES

A. Coordinate work with other trades to avoid interferences and establish necessary space requirements and tie-ins for each trade.

B. Prior to starting installation, furnish to the General Contractor and all Sub-Contractors concerned, copies of approved shop drawings showing location of equipment, piping, and etc.

C. Schedule periodic meetings with other trades before and during installation to avoid conflicts and assure that conduits and equipment are installed in the best manner, taking into consideration head-room, maintenance, appearance, and replacement.

D. The electrical contractor shall provide concrete foundations, curbs and pads for electrical equipment and fixtures. Unless otherwise noted, set all floor and/or ground mounted equipment on 6" high concrete pads reinforced with 6 x 6 10/10 mesh. Pads shall be approximately 6" larger than equipment base and have 1" x 1" chamfer on all edges. Pads to have carborundum brick rubbed finish. Surface finish shall be uniformly smooth.

E. General Contractor will provide flashing of conduits into roofing. The electrical contractor shall provide counterflashing.

F. Provide complete power wiring and connections for mechanical systems specified under the mechanical specifications. This work includes all raceways, conductors, outlets, and pull boxes, line voltage, on-off switches where indicated and disconnecting means as indicated and required by applicable codes. Where magnetic motor starters (controllers) are furnished by others, install and wire complete; where controllers are provided already mounted on equipment, wire complete. In all cases, provide power wiring to controller and load controlled. Wire sizes between controllers and loads shall be the same as feeder size to controller, do not reduce. Make all connections and color code per this DIVISION. Safety switch enclosures shall be NEMA Type 3R outdoors and wet locations; NEMA Type 1 elsewhere. Not included in this DIVISION are temperature control wiring, equipment control wiring and interlock wiring required to operate the mechanical system. Refer to the mechanical specifications for a summary list of types of equipment provided under that DIVISION. The electrical contractor shall provide outlet box for thermostat with 3/4" conduit to corresponding mechanical unit. The electrical contractor shall provide a 3/4" empty conduit between indoor air handling unit and exterior heat pump on split system units; this conduit is in addition to thermostat conduit noted above.

3.3 GENERAL REQUIREMENTS FOR INSTALLATION:

A. Piping, fixtures, equipment, etc., shall be located to avoid interference with structural and architectural conditions, or with the work of different trades. Provide off-sets where necessary to avoid footings, piers, columns, beams, windows, other piping, mechanical systems, and other systems, etc., specifically inform the General Contractor as to the correct size and location of all chases, openings, supports, sleeves, etc., required for the system. Furnish and install sleeves, inserts, bolts, etc., and arrange for the cutting of walls, floors, roofs, etc., and the proper closing of all openings. Cutting of construction, where unavoidable, must be done by the General Contractor, but shall be paid for by the electrical contractor. No part of the building may be broken out, cut, burned, or permanently removed without the approval of the Architect.

3.4 SHOP DRAWINGS

A. The Sub-Contractor shall submit for approval detailed shop drawings of all equipment and all material required to complete the project, and no material or equipment may be delivered to the job site or installed until the Sub-Contractor has in his possession the approved shop drawings for the particular material or equipment. The shop drawings shall be complete as described herein. The Sub-Contractor shall furnish the number of copies required by the General and Special Conditions of the contract, but in no case less than six (6) copies.

B. Prior to delivery of any material to the job site, and sufficiently in advance of requirements to allow Architect ample time for checking, submit for approval detailed, dimensioned drawings or cuts, showing construction, size, arrangement, operating clearances, performance characteristics and capacity. Each item of equipment proposed shall be a standard catalog product of an established manufacturer and of equal quality, finish, and durability to that specified.

C. Samples, drawings, specifications, and/or catalogs submitted for approval shall be properly labeled indicating specific service for which material or equipment is to be used,

section and article number of specifications governing, Contractor's name, and name of project.

D. Catalogs, pamphlets, or other documents submitted to describe items on which approval is being requested, shall be specific and identification in catalog, pamphlet, etc., of item submitted shall be clearly made in ink. Data of a general nature will not be accepted.

E. Approval by the Architect and/or Engineer of shop drawings for any material, apparatus, devices, and layouts shall not relieve the electrical contractor from the responsibility of furnishing same of proper dimension, size, quantity, quality, and all performance characteristics to efficiently perform the requirements, and intent of the contract documents. In addition, approval shall not relieve the electrical contractor from responsibility for errors of any sort on the shop drawings. If the shop drawings deviate from the contract documents, the electrical contractor shall advise the Architect and/or Engineer of the deviations, in writing, accompanying the shop drawings, including the reasons for deviations.

F. Failure of the Sub-Contractor to submit shop drawings in ample time for checking shall not entitle him to an extension on contract time, and no claim for extension by reason of such default will be allowed.

G. The table in Appendix 1 shall be included in the front of the shop drawing submittal. Sections of the specifications that are included in the specifications manual for this project shall require a submittal for each item listed. Incomplete or partial submittals shall be rejected.

3.5 OPENINGS - CUTTING, REPAIRING:

A. The electrical contractor shall cooperate with the work to be done under other Sections in providing information as to openings required in walls, slabs, and footings for all conduits and equipment, including sleeves, where required.

B. All drilling, cutting, and patching required for the performance of work under this Section shall be performed by the General Contractor and the cost thereof shall be borne by the electrical contractor.

C. Holes in Concrete: Sleeves shall be furnished, accurately located and installed in form before pouring of concrete. The electrical contractor shall pay all additional costs for cutting of holes as the result of the incorrect location of sleeves. All holes through existing concrete shall be either core drilled or saw cut. All holes required shall have the approval of the Structural Engineer prior to cutting or drilling.

3.6 EXCAVATION AND BACKFILL:

A. General: The Contractor shall do all excavating and backfilling necessary to receive the work shown on the drawings.

B. Excavations shall be made to the proper depth, and the trenches shall be graded uniformly to provide solid bearing along the entire length of the conduit. All trenches shall be excavated so that conduits will have at least (6) inches clearance on each side.

Conduits in fill or loose sand shall have trench bottom tamped to 95% maximum density compaction prior to laying conduits.

C. Backfilling: Do not fill any trenches until all conduits have been inspected. After the work is installed, tested, inspected, and approved, the trenches shall be refilled in six-inch layers with clean, damp earth, with each layer thoroughly tamped before proceeding with additional layers. Remove from site all excess earth, rock and other debris resulting from excavation and backfill work.

3.7 NAMEPLATES:

A. On all panelboards, disconnect switches, transformers, and enclosures provide engraved phenolic plastic nameplates. Unless otherwise noted, nameplates to be 1/16" thick plastic with 1/4" high white letters on black background. Hand lettering, typing under tape, embossed letters on plastic, etc., will not be acceptable

B. Attach nameplates with two rivets.

3.8 CLEANING EQUIPMENT AND MATERIALS:

A. Provide for the safety and good condition of all materials and equipment until final acceptance by the Owner. Protect all materials and equipment from damage. Provide adequate and proper storage facilities during the progress of the work.

B. All fixtures, conduits, finished surfaces, and equipment shall have all grease, adhesive labels, and foreign materials removed.

3.9 CLEANING UP:

A. Remove from the premises all unused material and debris resulting from the performance of work under this Section.

3.10 DAMAGES:

A. Cost of repairing damage to building, building contents, and site during construction and guarantee period resulting from this work is a part of this contract.

3.11 TEST PERFORMANCE:

A. Upon completion of the work, the system shall be free of faults, including short circuits, grounds, and open circuits, and loads balanced across phases to obtain minimum neutral current in all feeders and branch circuits. All communications systems shall operate at a standard representative of the best state of the art for the particular system involved. All life safety systems shall be demonstrated and certified as to operation in compliance with the codes and the intent of these Specifications. Test system in the presence of the Engineer or his representative, and operate to comply with the true intent of Plans and Specifications. Cost of all adjustments required to correct deficiencies and replacement of defective material and equipment are the sole responsibility of the electrical contractor.

3.12 AS BUILT PLANS:

A. As-built Drawings: Upon completion of the work, the Contractor shall furnish and deliver to the Owner two (2) sets of as-built drawings to correspond in size to the tracings, showing among other things, layouts of utility systems and functional systems (such as public address, fire alarm and telephone). All pertinent dimensions and elevations of buried work shall be given.

3.13 OPERATIONS AND MAINTENANCE MANUALS

A. Prior to project closeout, the Sub-Contractor shall submit for approval, a completed operations and maintenance hard back, three-ring file manual to the engineer for review. The operations and maintenance manual shall contain at least the following items. Exclusion of items is permissible only when the scope of electrical work outlined in these contract documents does not include an item listed below:
   1. Electrical Contractor's warrantee / guarantee showing dates of acceptance and duration.
   2. Product data sheets, diagrams, performance curves, and charts published by the manufacturer. Complete electrical characteristics and manufacturer's part numbers shall be provided for all equipment.
   3. Charts which explain the conduit color coding scheme used for conduit and wire throughout the facility.
   4. Insulation resistance test results for all feeders.
   5. Operating & users instruction manual(s) for Lighting control systems
   6. Final circuit breaker trip and time delay settings
   7. Chart listing fuse ampacity, type and manufacturer's part number installed in each disconnect.
   8. Operating & users instruction manual(s) for any generators, transfer switches, or lighting inverters.
   9. Copy of the UL "Master Label" for any lighting protection system required elsewhere in the contract documents.
   10. Operating & users instruction manual(s) for the fire alarm system.
   11. As built shop drawings and plans for the fire alarm system indicating device locations and all calculations.
   12. Digital media with as built fire alarm system program and all required programming password & user names.
   13. Copy of the fire alarm system paperwork required by the NFPA to be completed by the fire alarm system installer.
   14. Operating & users instruction manual(s) for the security, telephone, public address, or sound augmentation and reinforcement systems.
   15. A copy of the seismic submittal for electrical installation signed and sealed by the seismic engineer.
   16. Written documentation that service grounding system resistance measures no more than 5 ohms. Measurements shall be made using the fall of potential method.
   17. Provide the manufacturer's recommended maintenance procedures for all electrical devices installed on the project and the frequency with which each is to be done.
   18. A copy of the lighting control sensor test report listing sensor location, and final settings from the sensor manufacturer's representative.

3.14 TRAINING:

A. The Contractor shall instruct the Owner's Representative in complete detail as to the proper operation of the overall systems. Advise the Owner as to where to order common replacement items. Deliver to the Owner the manufacturers' agent's name, address, and the telephone number of each piece of equipment.

B. The Contractor shall instruct and demonstrate each maintenance function to the Owner's Representative. The Owner's Representative shall in turn sign the maintenance sheets indicating his under-standing of the instructions. Coordinate all equipment start-ups with the Owner, so that they may be present.

3.15 GUARANTEE:

A. The Contractor agrees:

1. To correct defects in workmanship, materials, controls, equipment, and operation of the system for a period of one (1) year from the date of acceptance.

2. To remove any item not specified or given written approval and replace it with the specified item.

3. That the systems installed will safely, quietly, and efficiently perform their respective functions in accordance with the design.

3.16 APPENDIX 1: Required shop drawing submittals

Spec Section	#	Item Description
General Completion	1	Insurance Certificate indicating that stored materials are held in a bonded warehouse
	2	Superintendent's name, job trailer phone and fax numbers
	3	Name Plates type and attachment method
Conduit	1	Conduit , Cables, Tubing
	2	Supports
	3	Fittings and connectors
	4	Expansion joints
	5	Ground Bushings
	6	Tracing tape
	7	Sealants
	8	Fire Wall Penetrations (Provide U.L. Listing Number)
Wires and Cables	1	Wire – minimum size, manufacturer, insulation type
	2	Connectors and lugs
Outlets, Switches & Boxes	1	Outlet boxes
	2	Floor Boxes
Wall Switches	1	Switches (Also indicate color, load type, terminal type, and rating)
	2	Plates
Receptacles	1	Receptacles
	2	Plates
Lighting Control Sensors	1	Sensors
	2	Power Packs
Panel boards	1	Panel boards (also indicate short circuit current rating and withstand rating)
Fuses	1	Fuses
	2	Fuse Cabinet
Main Switchboard	1	Main Switchboard (also indicate short circuit current rating and withstand rating)
Motor & Circuit Disconnects	1	Disconnect Switches
Dry Type Transformers	1	Dry type transformers

Spec Section	#	Item Description
External TVSS / SPD	1	Surge Protective Devices
Service and Metering	1	Meter sockets
	2	CT cabinets
Grounding	1	Grounding devices and fitting
	2	Ground rods
Lighting Fixtures	1	Light Fixtures
	2	Lighting Control Systems
	3	Arc Keeper Devices
	4	Generator Transfer / Switch bypass devices (GTD)
	5	Occupancy Sensors
	6	Lighting Inverter Systems
Fire Alarm System	1	Fire Alarm System Control Panel
	2	Power Supply / Batteries
	3	Smoke Detectors / Heat Detectors
	4	Addressable modules
	5	Cables and Wiring
	6	Manual Pull Stations
	7	Notification Devices
	8	Documentation that certifies that the installer has been factory trained on the submitted system.
Telecom Infrastructure	1	Cable trays and supports
	2	Fire wall penetrations
	3	Grounding equipment
	4	Hand Hole Boxes and Covers
	5	Cables
	6	Communication outlets
	7	Grounding equipment
Vibration & Seismic Control	1	Complete set of calcs and shop drawings with PE seal certifying that the design meets seismic req.
	2	Seismic design errors and omissions insurance certificate.

END OF SECTION 260501

SECTION 260519 - WIRES AND CABLES

PART 1 - GENERAL

1.1 CONDUCTORS

A. Provide soft-drawn copper conductors in raceways as shown on Drawings. Conductors shall conform to the latest NEC requirements and meet ASTM specifications, with 75/90 degree C, Type THHN/THWN-2 insulation.

B. All wire and cable shall be new, with size, grade of insulation, voltage and manufacturer's name permanently imprinted on outer covering at regular intervals, and delivered to the job site in complete coils and reels. All wires sized #10 and smaller shall be solid, and sizes #8 and larger shall be stranded.

1.2 COLOR CODING

A. Phase and grounded neutral conductors #10 awg and smaller shall have continuous factory colored insulation. Phase and grounded neutral conductors larger than #10 may be have either continuous colored insulation of be color coded in the field using Scotch color tape, E-Z code, Brady, or equal wire markers.

B. Equipment grounding conductors #6 awg and smaller shall have continuous factory colored insulation. Equipment grounding conductors larger than #6 may be have either continuous colored insulation of be color coded in the field using Scotch color tape, E-Z code, Brady, or equal wire markers.

C. Color coding shall be as follows:

120/240V or 120/208V 3 PHASE SYSTEMS	480/277V 3 PHASE SYSTEMS
Phase A - Black	Phase A - Brown
Phase B - Red	Phase B - Orange
Phase C - Blue	Phase C - Yellow
Neutral - White	Neutral – Gray

120/240V or 120/208V SINGLE PHASE SYSTEMS
Phase A - Black
Phase B - Red
Neutral – White

For all systems:
Equipment Grounding Conductor - Green
Isolated Ground – Green w/ Orange Stripe

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Wire and cable shall be as manufactured by Colonial Wire & Cable, Encore Wire Corporation, Southwire Co., General Cable, Cerro Wire, or approved equal.

2.2 CONNECTORS

A. Connectors, lugs, and terminals, shall be as manufactured by 3M Company, Ideal, Anderson, Thomas & Betts, OZ Electrical Mfg. Co., or approved equal.

2.3 VARIABLE SPEED DRIVES

A. Cables between variable speed drives and motors shall be rated 600v, with three grounds, overall uncoated copper tape shield, and PVC outer jacket equal to Southwire TC-VFD power cable.

PART 3 - EXECUTION

3.1 CONDUCTORS

A. Minimum wire size for all branch circuits shall be #12 except where indicated otherwise. If the distance from the panelboards to the first outlet exceeds 50 ft., the minimum size conductor for this run shall be #10. If the distance from the panelboards to the first outlet exceeds 100 ft., the minimum size conductor for this run shall be #8. If in special cases this distance must be exceeded, larger conductors of sizes noted on the plans shall be installed.

B. Do not pull conductors before completion of masonry, concrete, and other trades which generate dust and debris.

C. Wire and cables shall be suitably protected from weather during storage and handling and shall be in good condition when installed.

3.2 TERMINATIONS

A. Conductors #8 and larger shall be connected to equipment by means of pressure type mechanical lugs. Where multiple conductors are connected to the same terminal, each conductor shall be provided with an individual lug.

B. Solderless connectors of the proper type shall be used for all wiring connections. Where compression type connectors are noted on the plans and in the specifications, they shall be installed with approved hydraulic tools to assure a permanent, mechanically secure, high-conductivity joint. Where soldered joints are specified, the cable joint shall be mechanically strong before soldering. Solder shall be carefully applied without use of acid. Soldered

connection shall be wrapped with rubber and friction or insulating plastic tape in a manner approved for circuit voltage.

3.3 TAPS AND SPLICES

A. All cable taps, and splices shall be made secure with solderless pressure type connectors, unless otherwise specified. Where compression type connectors are noted on the plans and in the specifications, they shall be installed with approved hydraulic tools to assure a permanent, mechanically secure, high-conductivity joint. Where soldered joints are specified, the cable joint shall be mechanically strong before soldering. Solder shall be carefully applied without use of acid. Soldered connection shall be wrapped with rubber and friction or insulating plastic tape in a manner approved for circuit voltage.

B. All high-voltage conductor and cable splices, connections, and terminations shall be made with termination or splicing kits containing the necessary connectors and insulating materials for the specific cable size and type involved.

C. Where conductors are to be connected to metallic surfaces, the coated surfaces of the metal shall be polished before installing the connector. Lacquer coating of conduits shall be removed where ground clamps are to be installed.

D. Join conductors with twist on wire connectors sized for the number and gauge of conductors or by soldering, brazing, or welding. Tape all soldered or brazed connections or cover with approved prefabricated insulating devices to provide insulation resistance at the connection equal to that of the wire. Make splices in boxes or fittings only. Push in type wire connectors shall not be used.

3.4 INSULATION RESISTANCE TESTING

A. All panel board and switchboard feeders shall be tested prior to energizing. 480V feeders shall be tested at 1000 VDC, 208V and 240V feeders shall be tested at 500 VDC.

B. All current carrying and neutral conductors in every set of conductors shall be tested. Each current carrying and neutral conductor shall be tested to ground and to each other.

C. All resistance measurements shall be recorded after 60 seconds and all measurements shall be temperature corrected to 60 degrees F.

D. For each test measurement, the electrical contractor shall record the following information: Project name, date, temperature, humidity, testers name, testing device manufacturer and model number, feeder origin and termination points, test voltage, set number (for parallel feeders), conductor length, conductor size, measurement origin and termination (for example “A phase to ground “or” A phase to B phase”), insulation resistance in meg-ohms per foot at 60 degrees F, and the signature of the tester. A sample form is attached and a spreadsheet which calculates the corrected insulation readings in meg-ohms per foot at 60 degrees F is available from the engineer.

E. All feeder insulation resistance measurements shall be forwarded to the engineer for review prior to energizing of the feeder. Copies shall also be collected into a binder and submitted to

the owner as part of the operations and maintenance (O & M) documentation.

F. Cables with an insulation resistance measurement corrected to 60 degrees F, which is less than 2 meg-ohms per foot shall be replaced by the electrical contractor at no additional cost to the owner.

END OF SECTION 260519

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at Ron McNair Campus

Red Iron Architects | Building No. 0734 | 12/17/2021

Project Name			Tester's Name		
Test Date			Tester's Signature		
Test Voltage (use 1000 volts for 480V, 500 volts for 208 /240V)		Volts DC	Testing Device (Make & Model)		
Feeder Origin			Feeder Destination		
Feeder Operating Voltage		Volts	Feeder Length		Feet
Temperature		Degree F	Humidity		% RH

	MEASURED INSULATION READING (in Meg Ohms at ambient temperature)													
Set #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A TO B														
A TO C														
B TO C														
A TO N														
B TO N														
C TO N														
A TO G														
B TO G														
C TO G														
N TO G														

	CORRECTED INSULATION READING (Meg Ohms/ft at 60 deg F temperature)													
Set #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
A TO B														
A TO C														
B TO C														
A TO N														
B TO N														
C TO N														
A TO G														
B TO G														
C TO G														
N TO G														

SECTION 260526 – GROUNDING AND BONDING

PART 1 - GENERAL

1.1 PURPOSE

A. Furnish and install grounding system to comply with NEC and as shown on Drawings.

PART 2 - PRODUCTS

2.1 DEVICES

A. Grounding devices and fittings shall be as manufactured by Thomas & Betts, Appleton, OZ Electrical Mfg. Co., or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Ground main service by exothermic welding the grounding conductor to main cold water pipe, building steel, footing rebar, and at least three 3/4" diameter x 10' long ground rods driven 10' apart outside building in unpaved earth. The rods shall be loop interconnected with a 500 mcm bare copper conductor thermal welded, using the proper style mold, to each rod below grade. The conductor from the service disconnect to the rod loop shall be sized as shown on the electrical drawings.

B. Electrical Contractor shall provide Engineer with written documentation that service grounding system resistance measures no more than 5 ohms. Measurements shall be made using the fall of potential method. Supplemental grounding electrodes and / or soil supplements shall be installed as necessary to achieve the specified resistance. Copies shall also be collected into a binder and submitted to the owner as part of the operations and maintenance (O & M) documentation.

C. All ground rods and fittings used shall be free from paint, grease, and other poorly conducting material, and contact surfaces shall be cleaned thoroughly to insure good metal-to-metal contact.

D. Install bonding jumpers between all panelboards and feeder raceways connected thereto; across pull box and raceway expansion joints and across water meters located within buildings.

E. All connections to equipment grounding conductors shall be accessible for inspection and shall be made with solderless connectors thermal welded, using the proper style mold, to the equipment or structure to be grounded. Unless otherwise indicated on drawings, grounding conductors within raceway system shall be installed in exposed rigid steel conduit with both conductor and conduit bonded at each end.

F. Provide all motor related equipment, kitchen equipment, transformers and fans with an equipment ground. Equipment grounding conductors shall be sized in accordance with NEC Article 250.

G. Do not use flexible metal conduit fittings as a grounding means. Pull a green ground wire in or around each piece of flexible conduit and screw to conduit system with lugs at both ends.

H. Telecommunication systems shall be grounded and bonded per the telecommunication infrastructure specifications found elsewhere in these construction documents.

END OF SECTION 260526

SECTION 260529 – SUPPORTING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Support and align all raceways, cable trays, wireways, cabinets, boxes, fixtures, equipment, etc., in an approved manner.

B. Supports shall be in conformance with the requirements of the current building codes and local amendments, or the requirements of this Section, whichever is more stringent.

C. Seismic anchorages, seismic restraints and fixture and equipment supports shall be in accordance with National Uniform Seismic Installation Guidelines (NUSIG).

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Support raceways on approved types of wall brackets, ceiling trapeze hangers or malleable iron straps. "Perforated plumbers' strap" not permitted as means of support.

1. Acceptable manufacturer's of support brackets and hangers: "Uni-strut," "Kindorf" or "B-line."
2. "Caddy" fasteners are permitted for support of conduit to concealed metal studs and for conduit concealed above suspended acoustical ceilings.
3. All supporting devices located outdoors or in areas subject to moisture shall be hot-dip galvanized or stainless steel.

B. Do not support raceways or equipment from ceiling tie wire or T-bar, piping or ductwork. Support independently.

C. Provide safety wires (a minimum of four [4] 12 gauge hangers) or equivalent chains for each light fixture installed in T-bar or other ceiling suspension systems. Safety wires and chains shall be securely attached to diagonally opposite corners of each fixture and to structure.

D. Surface mounted lighting fixtures supported from T-bar grid shall be attached to the grid with a positive clamp device that completely surrounds the supporting member similar to Caddy "IDS." Provide safety wires as specified in the foregoing.

E. Provide safety wires (a minimum of two [2] 12 gauge hangers) or equivalent aircraft cable for each pendant mounted fixture. Hangers or cable shall be securely attached to fixture, then routed through stem and securely attached to structure.

F. Earthquake Anchorages:

1. Anchor all equipment, raceways, cable trays, etc., to the building structure to resist earthquake forces in accordance with the requirements of the National Uniform Seismic Installation Guidelines for Architects, Engineers, Inspectors and Contractors.
2. Total lateral (earthquake) force shall be not less than 1.00 times the equipment weight acting laterally in any direction through the equipment center of gravity. Provide adequate backing at structural attachment points to accept the forces involved.
3. Provide equipment supported by flexible isolation mounts with earthquake restraining supports positioned as close to equipment as possible without contact in normal operation (earthquake bumpers). The maximum lateral displacement due to the computed earthquake force from above shall not exceed 1.5". Floor mounted equipment weighing less than 2,000 lbs may have one (1) 6 x 6 x 3/8 x 18" steel angle bolted to the floor with four (4) 5/8" diameter bolts placed on four (4) sides of the equipment.

G. Independent support wires above lay in ceilings shall be orange in color.

2.2 HARDWARE, COMPOSITIONS AND FINISHES

A. In dry indoor areas, all threaded fasteners and associated hardware shall be steel, with a zinc or cadmium plated finish.

B. In general, fasteners in outdoor, damp or corrosive environments shall be of the largest trade size that will fit the item being fastened, shall have the coarsest threads commercially available in that size, and shall be hot-dip galvanized steel. Zinc electroplate will be acceptable only in the smaller sizes where hot-dip galvanized is not commercially available. On metal construction, install with the full length of the threads and the hole wet with cold galvanized touch up compound (Z.R.C. or accepted equal).

C. Where PVC, liquidtight flex or plastic-coated conduit is installed on wood construction in outdoor, damp or corrosive environments, fasteners shall be made of monel or stainless steel alloy suitable for marine environments, such as alloys 430, 446, 18-8, 304, 316 or 347.

2.3 STRUT

A. U-channel strut for use in heated indoor areas shall be steel. For installations that will be finish painted as part of the project, factory finish of the strut shall be paintable galvanizing, or phosphatized and primed. For installations that will not be finish painted, the factory finish of the strut shall be galvanized.

B. For outdoor installation of galvanized conduits and boxes, strut shall be steel with hot-dip galvanized finish. All field-cut ends and other breaks in the finish shall be thoroughly treated with cold galvanized touch-up compound (Z.R.C. or accepted equal).

C. U-channel strut for support of PVC or plastic-coated conduits in outdoor, damp or corrosive environments shall be fiberglass, RobRoy "Rob-Glass" or accepted equal, assembled with the manufacturer's standard end sealant and corrosion-protected hardware and accessories.

PART 3 - EXECUTION

3.1 FASTENING

A. Secure boxes, wall brackets, cabinets and hangers by means of toggle bolts in hollow masonry; preset inserts or expansion bolts in solid masonry and concrete; machine screws, bolts or welding on metal surfaces; and wood or sheet metal screws in wood construction. Obtain permission from ANC before using any type of powder powered studs.

3.2 FIXTURE SUPPORTS

A. For other than T-bar ceiling fixtures and for all fixtures weighing more than 56lbs, support luminaries from structural members capable of supporting total weight, under seismic conditions and independently from wiring system. Attach to steel members by approved beam clamps and rods.

3.3 PENDANT FIXTURES

A. Loop and hook or swivel hanger assemblies for pendent fixtures shall be fitted with a restraining device to hold the stem in the support position during earthquake motions. Pendent-supported fluorescent fixtures shall also be provided with a flexible hanger device at the attachment to the fixture channel to preclude breaking of the support. The motion of swivels or hinged joints shall not cause sharp bends in conductors or damage to insulation.

3.4 ASSEMBLY MOUNTED OUTLET BOX

A. A supporting assembly that is intended to be mounted on an outlet box shall be designed to accommodate mounting features on 4” boxes, 3” plaster rings and fixture studs.

3.5 WALL-MOUNTED EMERGENCY LIGHT UNIT

A. Each wall-mounted emergency light unit shall be secured in a manner to hold the unit in place during a seismic disturbance.

3.6 SAFETY WIRES

A. Attach safety wires to lighting fixtures so that no part of the fixture, in event of ceiling suspension system failure, will drop more than 6” below normal ceiling height. Each end of each wire shall be secured with a minimum of three (3) tight wraps.

3.7 STRUCTURAL ATTACHMENTS

A. Provide adequate backing at structural attachment points to accept the forces involved.

B. Attachment to plaster or gypsum board not permitted unless specifically approved in writing by ANC on case-by-case basis. Where approved, such attachment shall be by means of molly or toggle bolts.

3.8 ELECTRICAL BOXES INSTALLED IN ACOUSTIC PANEL CEILING

A. Electrical boxes installed in acoustic ceiling tiles shall be of the type outlined in the electrical boxes section of these specifications.

B. They shall be supported from Caddy (Erico) 512HDEEP heavy duty T Grid box hangers with 512HDXT extension brackets as necessary.

C. Electrical boxes installed in acoustic ceiling tiles shall have one independent safety wire attached to structure secured with a minimum of three (3) tight wraps.

END OF SECTION 260529

SECTION 260533 - CONDUIT

PART 1 - GENERAL

1.1 REQUIREMENTS

A. Minimum size conduit shall be ½". Other sizes shall be as indicated on the Plans, or required by the National Electrical Code for number and size of conductors installed. All conduit joints shall be cut square, threaded, reamed smooth and drawn tight. Bends or offsets shall be made with standard conduit ells, field bends made with an approved bender or hickey, or hub-type conduit fittings. Number of bends per run shall conform to National Electrical Code limitations. All wiring, regardless of voltage, shall be in conduit.

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT (OR IMC)

A. Shall be used for:

1. Exposed branch circuits where subject to damage.

2. Service entrance, Branch, & feeder circuits underground where outside of building line if not installed under 3" of concrete.

2.2 RIGID NONMETALIC CONDUIT (RNC)

A. Shall be used for:

1. Branch and feeder circuits underslab where inside of the building line (ground floor only).

2. Service entrance, Branch, & feeder circuits underground where outside of the building line and below at least 3" of concrete or within duct banks

B. Shall be schedule 40 PVC.

2.3 PVC COATED RIGID GALVANIZED METAL CONDUIT

A. Shall be used for:

1. Corrosive exterior environments around cooling towers.

2.4 ELECTRICAL METALLIC TUBING (EMT)

A. Shall be used for:

1. All areas not listed in paragraphs 2.01, 2.02 and 2.03.

PART 3 - EXECUTION

3.1 RACEWAYS

A. Horizontal and vertical conduit runs may be supported by one hole malleable straps, clamp-backs or other approved devices with suitable bolts, expansion shields, or beam clamps for mounting to building structure or special brackets. Adjustable hangers may be used to suspend large conduits when separately located. If adjustable trapeze hangers are used to support groups of parallel conduits, U-bolt or similar type clamps shall be used at the end of a conduit run and at each elbow. J-bolts or approved clamps shall be installed on each third intermediate trapeze hanger to fasten each conduit. Hangers shall be painted with two coats of oil paint. Where excessive corrosive conditions are encountered, hanger assemblies shall be protected, after fabrication, by sheradizing or galvanizing, special paint, or other suitable preservative methods. The use of perforated iron straps, wire, etc., for supporting conduits will not be permitted. The required strength of the supporting equipment and the size and type of anchors shall be based on the combined weight of conduit, hanger, and cable.

B. Conduit installed in exterior wall shall be routed in stud or block cavity not in air spaces between block and brick.

C. Where any run of rigid conduit may change to a run of EMT, or vice-versa, such a change shall be made in a junction or outlet box, as elsewhere required, with each conduit terminating separately therein.

D. Conduit shall be continuous from outlet to outlet and from outlets to cabinets, pull boxes or junction boxes, and shall be secured to all boxes with locknuts and bushings in such a manner that each system shall be electrically continuous throughout. Conduit ends shall be capped to prevent entrance of foreign materials during construction.

E. Conduit terminals at cabinets and boxes shall be rigidly secured with locknuts and bushings as required by the National Electrical Code and other electrical codes. All conduit bushings shall be of the insulating type with two locknuts.

F. All conduit shall be installed complete before conductors are pulled in. All conduit shall be cleaned and free of foreign matter inside before any conductors are pulled in. A run of conduit which has become clogged shall be entirely freed, or shall be replaced.

G. A pullwire shall be left in each run of empty conduit. Pullwire shall be 16 gauge galvanized steel.

H. Run all conduit at right angles to or parallel to walls of building.

I. Use short pieces, approximately two feet, of flexible metal conduit to connect motors and other devices subject to motion and vibration.

J. Support conduit and secure to forms when cast in concrete so that conduit will not be displaced during pouring of concrete. Stuff boxes and cork fittings to prevent entrance of contaminants during concrete pouring and at other times during construction prior to completion of conduit installation.

K. Use expansion fittings with copper bonding jumpers to assure ground continuity across expansion joints in walls, floors, and ceilings. Use double locknuts and bushings on panel feeders at panel enclosures.

L. Install grounding bushing on all conduit entering or leaving main switchboard. Connect each bushing to switchboard ground bus with a separate #4 bare copper conductor, lugged to bus.

M. Any EMT connectors must be all steel compression type with insulated throat. EMT couplings shall be all steel compression type. No cast fittings of any type will be accepted.

N. Color coding shall be provided every 8'-0" on conduit or factory colored conduits shall be used and shall be as follows:

1. 480 volt, single and three phase - Orange

2. 208 or 240 volt, single and three phase - Green

3. 120 volt - Yellow

4. Fire alarm system - Red

5. Motor and other control systems - Blue

6. Telephone and communications - Purple

7. Security and access controls - Black.

O. All firewall penetrations shall be properly fireproofed with U.L. listed system that conforms to the wall or floor type, wall or floor fire rating, and to the size and number of conduits penetrating the wall or floor.

P. Conduit shall not be routed within 1.5” of the underside of a corrugated metal roof deck and shall not be fastened to or supported from the underside of a corrugated metal roof deck.

Q. Underground conduits outside of the building line shall be installed as follows:

1. Conduits shall be a minimum of 30" below grade.

2. Rigid non-metallic conduit shall have an electronically detectable tracing tape installed above them.

3. Rigid non-metallic conduit bends shall be pre-manufactured “factory” bends or field made bends using “hot box” style conduit benders.

4. Rigid non-metallic conduit shall be installed below a minimum of 3" of concrete

5. Rigid non-metallic conduit joints shall be made per the manufacturer's instructions including use of primer prior to application of glue.

R. Underground conduits inside of the building line shall be installed as follows:

1. Conduits shall be run under vapor barrier and shall be routed or shall be installed deep enough to prevent penetration of building footers or other structural supports.

2. Conduit shall have rigid steel 90's installed where penetrating slab. Rigid steel 90's shall have two coats of asphaltum and all wrench marks and etc., shall be touched-up after conduit has been assembled.

3. Rigid non-metallic conduit joints shall be made per the manufacturer's instructions including use of primer prior to application of glue.

S. Conduits shall not be installed within the concrete slabs of intermediate floor levels.

T. Conduits which are subjected to large temperature differences or those which enter the building from the exterior shall be sealed. The sealing method shall be equal to poly water FST. Conduits to be sealed include:

1. Those which enter the building from the exterior.

2. Those which enter coolers or freezers.

3. Those which pass through unconditioned portion of the building.

4. Those which supply rooftop equipment.

U. Conduits shall not be installed above or on top of a roof without expressed permission of the engineer. Conduits serving rooftop equipment shall be routed within the building and penetrate the roof plane vertically at the equipment being supplied.

V. Conduits installed in masonry construction shall be routed vertically in block cavities. They shall not be routed horizontally for more than 24" within block wall where such installation requires excessive cutting or notching of each block.

W. Where surface mounted conduits are permitted, they shall be painted to match the adjacent wall surfaces.

X. Bridging between steel joist framing shall not be used to support conduits.

Y. Parallel sets of conductors routed below grade shall be installed in duct banks.

1. Duct bank shall be encased in concrete with at least three inches of concrete at the top and bottom and two inches on each side. A horizontal and vertical separation between the ducts of 3 inches shall be maintained by installing thermoplastic high impact spacers at 4 foot intervals. Spacers shall be equal to Carlon #SPxW30-2.

2. Stagger the joints of the conduits by rows and layers so as to provide a duct line having the maximum strength.

3. During construction, protect partially completed duct lines from the entrance of debris such as mud, sand and dirt by means of suitable conduit plugs.

4. As each section of a duct line is completed, draw a testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the size of the conduit through each conduit, after which draw a brush having the diameter of the conduit, and having still bristles through until the conduit is clear of all particles of earth, sand, and/or gravel; then immediately install conduit plugs.

5. Conduits shall be sized as indicated on project drawings. Provide steel reinforcing in concrete duct bank as indicated on drawings. Separate conduit as indicated.

6. Install the top of the concrete envelope not less than 30 inches below grade or as indicated on project Drawings.

Z. Concrete used to cover below grade conduits shall be 3000 psi concrete with 1 inch maximum aggregate

END OF SECTION 260533

SECTION 260534 - ELECTRICAL BOXES

PART 1 - GENERAL

1.1 OUTLET BOXES

A. All outlet boxes shall be standard galvanized steel type, at least 4" x 4" x 1-1/2" deep, single or ganged of size to accommodate devices noted. Boxes shall be equipped with plaster ring or cover as necessary. Standard deep type boxes shall be used in floor slab construction so that concealed conduits entering sides of boxes can clear steel reinforcing rods. Extension rings, plaster rings and device extension covers shall be all steel.

1.2 FLOOR BOXES

A. Boxes for floor outlets shall be the cast-metal, threaded conduit entrance waterproof type with means for adjusting the cover plate to finished floor level. Boxes shall have an approved gasket or seal between adjusting ring and box. Cover plates on floor boxes shall be of heavy brass, with permanent ring or flange and rubber gasket.

1.3 JUNCTION BOXES

A. Where indicated on the plans, and where necessary to terminate, tap-off or redirect multiple conduit runs, the Electrical Contractor shall furnish and install appropriately designed junction boxes. They shall have full access screw covers mounted with corrosion-resistant machine screws. Box size shall be as required by the NEC for the number of conduits and conductors entering and leaving it.

1.4 PULL BOXES

A. Furnish and install pull boxes where necessary in the raceway system to facilitate conductor installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Boxes shall be as manufactured by Steel City, Thomas & Betts, OZ Electrical Mfg. Co., Raco, Appleton, Circle F Mfg., or approved equal.

B. Floor outlets shall be as manufactured by Wiremold, Hubbell, T&B, Raco, or Steel City.

PART 3 - EXECUTION

3.1 GENERAL

A. Electrical Contractor shall furnish and install plugs for all knockout openings.

B. Surface mounted exterior boxes shall be weatherproof aluminum.

C. Masonry boxes shall be used in masonry walls.

3.2 OUTLET BOXES

A. Electrical Contractor shall coordinate the mounting heights listed in this section with the general contractor to ensure that there are no conflicts with structural bond beams or other elements.

B. Electrical Contractor shall grout any gap between flush mounted boxes and the wall surface that is larger than 1/8”.

C. Convenience outlets shall be located 1'-4" to bottom of box above finished floor, unless otherwise indicated on the plans.

D. Wall-switch outlets shall be located 4'-0" to top of box above finished floor. When located near doors, they shall be installed on the lock side of the door, unless otherwise indicated on the plans.

E. Clock outlets shall be installed 7'-4" to bottom of box above finished floor, unless otherwise indicated on the plans.

F. Outlet boxes for concealed telecommunication systems shall be of the 4" square type 2 1/8” deep with single gang plaster ring and bushed opening cover plate. Telecommunication outlet boxes shall be installed at 1'-4" to bottom of box above finished floor unless otherwise indicated on the plans. Telecommunication boxes shall be installed with blank cover plates when cabling is not being installed by the electrical contractor

G. Outlet boxes in firewalls which require a cutout larger than 16 square inches or where multiple boxes are shown whose combined area of cutouts exceeds 100 square inches in any 100 square foot of wall spaces shall have putty pads or other UL listed materials and methods and shall be installed per the UL listing of the chosen system.

3.3 JUNCTION BOXES

A. Where intermediate cable supports are necessary because of box dimensions, provide insulated cross-brackets to support the conductors. Boxes shall be supported independently of conduits entering them. Brackets, rod hangers, bolts, or other suitable supporting means may be used.

3.4 PULL BOXES

A. In general, conduit runs of more than 100 feet, or more than three right angle bends, shall have a pull box installed at a convenient intermediate location. All boxes shall be of metal gauge and size as required by the NEC for the number and size of conduits and conductors involved. Boxes shall have removable screw covers. Boxes shall be securely mounted on the building structure with supporting facilities independent of the conduits entering or leaving the box.

3.5 ELECTRICAL BOXES INSTALLED IN ACOUSTIC PANEL CEILINGS

A. Electrical boxes installed in acoustic ceiling tiles shall be double deep boxes with single gang extension rings supported as per the Supporting device section of these specifications.

3.6 ELECTRICAL BOXES INSTALLED ABOVE ACOUSTIC PANEL CEILINGS

A. Electrical boxes installed above acoustic ceiling tiles shall be lowered to be within 24” of the acoustic tile.

3.7. FIRE PROOFING:

A. Electrical boxes shown in one or two hour rated walls shall be wrapped in intumescent putty pads equal to 3m #MPP+ when installed in any of the conditions listed below. Pads shall be installed per the manufacturer’s installation instructions and in accordance with the requirements of the UL system for the applicable wall type.

1. Boxes larger than 16 square inches.
2. If horizontal spacing between boxes is less than 24 in.
3. When multiple boxes are located in one stud cavity
4. If the aggregate of all boxes exceeds 100 sq. in. per 100 sq. ft. of wall.

END OF SECTION 260534

SECTION 260548 - VIBRATION AND SEISMIC CONTROL

PART 1 - GENERAL

1.1 REQUIREMENTS

A. All vibration isolation and seismic control materials specified herein shall be provided by a single manufacturer to assure single responsibility for their proper performance. Installation of all vibration and seismic control materials specified herein shall be accomplished following the manufacturer's written instructions.

B. The Contractor shall furnish a complete set of shop drawings and other necessary information, of all electrical equipment to receive vibration isolation and seismic devices, to the vibration isolation and seismic control materials manufacturer. The information to be furnished shall include operating weight of the equipment to be isolated, distribution of weight to support points and dynamic characteristics along with any internal isolation systems to be analyzed. The Contractor shall also furnish a complete layout of raceways to be isolated, including vertical risers, showing size or weight and support points of the system, to the vibration isolation and seismic control materials manufacturer, for selection and layout of mountings.

C. The vibration and seismic control materials manufacturer shall use the above listed information to design a complete system of vibration and seismic mounts in accordance with the contract documents along with the International Building Code Section, and SMACNA “Seismic Restraint Manual”. The vibration and seismic control materials Contractor shall analyze all “multiple degree of freedom” systems, and provide properly designed isolation systems avoiding all resonance frequencies. To accomplish this, the vibration and seismic control materials supplier shall employ an Engineer registered in the State of South Carolina to design all isolation and restraint systems and prepare a complete set of calculations and shop drawing submittals with his professional Engineer’s seal certifying that the design meets all requirements of these contract documents.

D. The vibration and seismic control Engineer or his designated representative shall provide field observation of the project upon completion of the applicable work and provide written notification of any deviations from the approved shop drawing submittals.

E. Vibration and seismic control systems shall be provided by Vibration Mounting and Controls, Mason Industries, or Consolidated Kinetics.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATION

A. Electrical equipment so designated shall receive external vibration isolation. Internal component isolation of equipment shall not be considered equivalent, but shall be considered when analyzing systems with multiple degrees of freedom.

B. Vibration isolators shall be selected based upon known operating weight distributions and dynamic characteristics of the isolated equipment, with the quantity and location as required by

the component drawing. Isolator type shall be tabulated for each isolated piece of equipment. Complete calculations of vibration analysis shall be included with submittals, including but not limited to fundamental and harmonic frequencies.

C. Isolators shall have either known non-deflected heights of spring element or calibration markings so that, after adjustment, when carrying their load, the deflection under load can be verified to determine if the load is within the proper range of the isolator and if the correct degree of vibration isolation is being provided.

D. Isolators shall function in the linear portion of the load versus deflection curve. Theoretical vertical natural frequency shall not differ from the design objectives by more than + 10%.

E. Spring mounts shall have seismic housings as required by Paragraph 2.02.

F. Isolation of equipment shall be as follows:

1. Emergency generator as noted shall be mounted on a rigid structural steel base. The equipment including the base shall be mounted on vibration isolators. Base shall be VMC Type WFB.

PART 3 - EXECUTION

3.1 SEISMIC CONTROL

A. All electrical panels, generators, dry type transformers, switch gear, cable trays, busways, and light fixtures shall be provided with seismic restraints in accordance with the International Building Code requirements, as a minimum.

1. All equipment isolated or not, shall be bolted to the structure to allow for seismic acceleration with no failure or displacement. All connections shall be positive bolted type; no friction clamps of any kind are allowed.
2. Provide cable and connection sets for suspended equipment at each of four corners secured to the building structure.
3. Floor mounted equipment shall be provided with seismically housed springs or springs with seismic snubbers as determined by the equipment to be isolated
4. Bridging between steel joist framing shall not be used to secure seismic restraints.

END OF SECTION 260548

SECTION 260850 – THIRD PARTY TESTING OF ELECTRICAL SYSTEMS

PART ONE - GENERAL:

1.01 SCOPE OF WORK:

A. Furnish all materials, labor, tools, safety and test equipment and all other items necessary to provide a complete program of Electrical Services and Maintenance for the Owner's Electrical Distribution Systems, automatic transfer switches, lighting contactors, motor starters, motor control centers, and variable speed drives. The program shall apply to all building electrical power distribution equipment identified in the contract documents.

B. The 3rd party electrical testing contractor shall make a site visit to familiarize himself/herself with the buildings and respective electrical system components to be serviced under the Electrical Services and Maintenance Program. This site visit must be coordinated with the Project Superintendent.

C. The 3rd party electrical testing contractor shall provide as part of his/her bid package a technical proposal which shall include all items as indicated in the respective sections of this specification.

D. The 3rd party electrical testing shall not absolve nor diminish the project's electrical contractor from any requirement for equipment performance or warrantee of work performed as outlined elsewhere in these contract documents.

E. The 3rd party electrical testing contractor shall be sub-contracted by the General Contractor, and the cost of electrical testing required by this specification shall be included in the General Contractor's bid.

1.02 GENERAL ELECTRICAL REQUIREMENTS:

A. The 3rd party electrical testing contractor shall possess, maintain and utilize a computerized maintenance management system to allow for (1) scheduling of each service visit and each work task to be performed on each visit for each component, (2) tracking of equipment information, (3) trending of electrical measurements taken, (4) cataloging of digital images (standard and infrared), (5) analyzing recorded equipment problems, and (6) visually show the relationship of each component and its power source. The 3rd party electrical testing contractor shall provide computerized maintenance scheduling through its relational database application to assure that the electrical equipment is properly inventoried, and that all scheduled tasks are performed.

1.10 COORDINATION WITH OTHER TRADES:

A. The 3rd party electrical testing contractor shall be notified by the general contractor 30 days prior to substantial completion in order to schedule electrical testing detailed in this specification.

B. The 3rd party electrical testing contractor shall perform all of the testing required by this specification after substantial completion and before occupancy by the owner. Where project schedules do not allow for completion of the 3rd party electrical testing before occupancy, 3rd party electrical testing shall be scheduled with the owner.

C. The project's electrical contractor shall correct all deficiencies identified by the 3rd party electrical testing contractor.

PART TWO – TESTING SERVICES:

2.01 SUPPLIERS:

A. Approved suppliers of third party Electrical Testing shall be certified TEGG Service Contractors in South Carolina or neighboring states.

2.02 TEST EQUIPMENT:

A. The 3rd party electrical testing contractor shall provide for his/her use all required materials, tools, equipment, etc. necessary to appropriately carry out all testing, infrared and ultrasonic surveying, and preventive maintenance tasks and procedures outlined under this specification.

B. For infrared surveying, the 3rd party electrical testing contractor shall utilize thermographic test equipment which meets or exceeds the following specifications for either short wave or long wave electromagnetic radiation:

1. Short Wave Electromagnetic Radiation
   System Type: Focal plane array camera
   Spectral Range: 3.6 to 5 Microns (Std.)
   Detector: PtSi Nybrid Silicon FPA

   Image Storage Capability: Image storage transferable to a color computer. Imaging and printing capability of problem areas.

   Ultra high resolution 320 by 244 focal plane array detector (78,080 pixels) (FPA required-rotating polygons and scanning mirrors unacceptable)

   Single element temperature measurement
   Full ratio metric 12-bit images (4,096 thermal levels)

2. Imaging and Measurement Capabilities For Long Wave Electromagnetic Radiation:

System:	Focal plane array infrared camera
Spectral Range:	7.5 – 13 microns
Detector:	Uncooled microbolometer
Temperature Measurement Accuracy:	+ 2% of range or 2º

C. For Ultrasound Inspecting, the 3rd party electrical testing contractor shall utilize ultrasonic test equipment which meets or exceeds ASTM E1002-93 requirements for leak detection and the following specifications:

CIRCUITRY:	Solid state heterodyne receiver with temperature compensation.
FREQUENCY RESPONSE:	Detect ultrasonic frequencies between 20 kHz and 100 kHz, continuously variable. Frequencies are converted to 100 Hz to 3 kHz audio.

Scanning Module:	Patented TRISONIC plug-in type consisting of a phased array of multiple transducers for airborne ultrasound. This probe is shielded against RF interference.
Frequency tuning adjustment dial:	Scale 20 – 100 kHz with "fixed band" position for ultra-narrow frequency response.
Bi-Modal Meter Switch:	For logarithmic and linear meter scale adjustments.
Auxiliary Mode:	Selection for chart recorder output: 0 – 50 mV, Precision 10 turn adjustment dial with numerically calibrated sensitivity increments for finite gain adjustment.

PART THREE - EXECUTION:

3.01 3RD PARTY ELECTRICAL TESTING CONTRACTOR QUALIFICATIONS:

A. The 3rd party electrical testing contractor shall have fully-trained and certified personnel capable of providing engineering, supervision, system evaluation and the appropriate troubleshooting services to the Owner. The 3rd party electrical testing contractor shall perform all work in compliance with International Electrical Testing Association (NETA) standards, the National Electrical Code, and the National Fire Protection Association standards.

B. The 3rd party electrical testing contractor shall provide professionally trained technical service personnel to perform and complete all services specified for this Electrical Services and Maintenance Program. Service personnel shall be skilled electrical journeymen wiremen with IR certification, and shall have individual experience with electrical systems analysis, testing procedures and preventive maintenance services. Service personnel shall be trained in OSHA requirements for working on or near energized and/or de-energized electrical equipment.

3.02 ENERGIZED TESTING AND INSPECTION:

A. The 3rd party electrical testing contractor shall provide the safety equipment, service instruments, and labor to conduct, interpret, and document the results of the applicable comprehensive diagnostic services and inspections that can be safely performed on the covered electrical component(s) and/or connection(s). These services shall be performed annually, at a minimum, and while the Owner's electrical distribution system is energized. The following testing and inspection services, as appropriate, shall be conducted:

1. True RMS Voltage and Current Testing: Capture and record the square root of the average square of the instantaneous magnitude of the voltage and current. This service is used to determine if the correct voltage and current is present to properly operate the Owner's equipment and optimize its life cycle.

2. Infrared Thermographic Imaging Service: Measure and record to identify temperatures that exceed NFPA Standard 70B recommendations, i.e., high resistance electrical connections, current overload, defective circuit breakers and/or defective insulator conditions. This service is used to reduce the risk of brown-outs and black-outs, as well as safety and fire hazards.

3. Ultrasonic Testing: Measure and record sound waves and/or vibrations that are above audible sound (16-18 KHZ). This service is used to complement the thermographic imaging service and determine if corona discharge, tracking, arcing and vibration are present, and to assure the quality and integrity of the Owner's electrical system.

4. Visual and Mechanical Inspections: Interior and exterior of all components will be inspected to ascertain, and if necessary, make certain adjustments to ensure that its performance remains within specified limits. The 3rd party electrical testing contractor will also identify corrosion, rust and discoloration, leaks, safety hazards, applicable electric code violations, grounding, physical damage and the general condition of components.

5. Phase-Balance Measurements: Assure that the phases in the Owner's electrical system are balanced. This service is used to address unbalanced components that increase power-quality problems, total harmonic distortion as well as increased temperature rise of devices and current-carrying conductors.

3.03 DE-ENERGIZED TESTING AND INSPECTION:

A. The 3rd party electrical testing contractor will provide the safety equipment, service instruments and labor to conduct, interpret, and document the results of the applicable comprehensive diagnostic services and inspections that can be safely performed on the covered electrical component(s) and/or connection(s). These services shall be performed at a mutually agreed schedule, while the Owner's electrical distribution system and/or electrical component(s) is de-energized and include, as appropriate, the following:

1. Insulation Resistance: Measure and record the resistance of insulation under specified conditions set forth by applicable standards such as NFPA Standard 70B. This service is designed to assure that the Owner's electrical system and components' insulation values are at an acceptable level, reducing the risk of explosions, fires and catastrophic breakdowns.

2. Winding Resistance Service: Measure, record and compare the winding resistance of components. This service will assure that components are operating to applicable specifications, extending useful life, and reducing the risk of catastrophic failure.

3. Contact Resistance Service: Measure and record the resistance between contact surfaces. This service addresses poor contact surfaces that would cause increased voltage drop, increased heat and reduced life expectancy, causing brown-outs, black-outs, explosions, fires and catastrophic failures.

4. Circuit Breaker Testing (Low Voltage): Measure, test, record and document findings regarding all applicable low voltage circuit breakers. The proper testing and inspection of the Owner's circuit breakers will reduce the risk of business interruption, fire and catastrophic failure.

5. Ground Resistance Testing: Measure and record the resistance of conductors, connections and devices. This service will reduce the risk of power quality, harmonic and safety issues.

6. Transformer Service: Measure, record and monitor all appropriate services and inspection to applicable standards such as NFPA Standard 70B. This service and inspection is performed to reduce the risk of transformer failure, which could result in fire, and/or catastrophic failure.

7. Motor Service: Measure, record and monitor all appropriate services and inspection to applicable standards such as NFPA Standard 70B. This service and inspection is performed to monitor and trend the motor and to reduce the risk of failure.

8. Visual and Mechanical Inspection: Interior and exterior of all components will be inspected to ascertain and, if necessary, make certain adjustments to ensure that its performance remains within specified limits. The 3rd party electrical testing contractor will also identify corrosion, rust and discoloration, leaks, safety hazards, applicable electric code violations, grounding, physical damage and the general condition of components.

3.04 PREDICTIVE AND PROACTIVE SERVICE:

A. The 3rd party electrical testing contractor shall provide the safety equipment, service instruments, and labor to perform the predictive and proactive services tasks that can be safely performed, as appropriate, in either an energized or de-energized state. These predictive and proactive service tasks shall be performed on the covered electrical component(s) and/or connection(s). The following tasks, as appropriate, shall be conducted:

1. Compare equipment nameplate data with drawings and specifications.
2. Inspect physical, electrical, and mechanical condition.
3. Measure the torque of all connections and terminations to applicable specifications.
4. Verify appropriate anchorage, required area clearances, and inspect for physical damage.

D. Exercise all active components (when applicable).

E. Inspect all mechanical indicating devices for correct operation and indication.

3.05 ELECTRICAL SYSTEMS ANALYSIS:

A. Any immediate safety or hazard concern that is identified during any visit shall be shared with the Owner's authorized representative while on-site.

B. At the completion of each visit, the 3rd party electrical testing contractor shall compile the results of all inspections, measurements, surveys and predictive and proactive service activities. The 3rd party electrical testing contractor shall then analyze these results to ascertain the condition of the electrical devices and/or components. The initial analysis shall be documented in the form of an Electrical Systems Analysis Report, made available in hard copy and electronic interactive format that both the Owner and 3rd party electrical testing contractor can easily update, and shall be presented to the Owner's authorized representative(s).

3.06 REPORTING:

A. The 3rd party electrical testing contractor shall furnish each of the following reports for review by the Owner and general contractor.

1. A report shall include each component identified in the Inventory of Equipment Schedule. As a minimum, the report shall include the following information: Component, purpose, size, type, quantity, manufacturer, electrical ratings, location, inspection/tests performed, inspection/test results, deficiencies found, probable cause(s), photographs, and infrared images.

2. An Infrared and Ultrasonic Survey Exception Report shall be provided for all identified concerns or potential failures. As a minimum, the Infrared Survey Exception Report shall consist of a color graphic report of abnormal temperature readings identified by the infrared survey, and detail ambient, caution, and warning conditions.

3. An Electrical Systems Analysis Report shall be provided for all identified concerns or problems. As a minimum, the Electrical Systems Analysis Report shall include for each identified concern or problem a detailed description of the situation, a color photograph of the deficiency, an explanation as to the cause, the result, the consequences if not corrected, the recommended course of action to be taken, and a list of the required action steps that would properly rectify the situation.

END OF SECTION 260850

SECTION 260923 – LIGHTING CONTROL SENSORS

1.1 SCOPE OF WORK

A. Occupancy detection technology requirements:

1. The occupancy sensor system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions.
3. Sensors with an additional “dual” technology shall be used to adequately detect maintained occupancy.
4. All sensing technologies shall not interfere with other electronic devices within the space (such as electronic white board readers).

B. Occupancy sensor operation requirements:

1. Sensors shall offer a minimum on timer of at least 15 minutes. This timer shall be in addition to the regular occupancy time delay that keeps lights on after last detected occupancy. User shall be able to disable/enable and change the value of this timer.
2. Sensors shall utilize an occupancy time delay that keeps lights on after last detected occupancy. Factory default setting of the occupancy time delay shall be 10 minutes.
3. Manual adjustment to the occupancy time delay so as to increase it shall be accommodated.
4. Installer, in accordance with manufacturer’s recommendation, shall determine final sensor location. All sensors shall be factory calibrated for optimum performance for its installed PIR lens.
5. All sensor setting adjustments shall be digital and made using a push-buttons, dip switches, or analog dials. Sensors which require the use of tools of any kind shall not be accepted.
6. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

C. Contractor responsibilities:

1. Furnish, coordinate, receive, mount, connect, and place into operation all equipment.
2. Furnish all conduit, wire, connectors, hardware, and other incidental items necessary for the complete and properly functioning lighting control system as described herein and shown on the plans.

1.2 CODE AND STANDARD COMPLIANCE

A. All electrical work shall be in accordance with the codes and agencies listed in the contract documents.

1.3 LISTING REQUIREMENTS

A. All applicable products must be UL / CUL Listed.

1.4 SUBMITTAL REQUIREMENTS

A. Request for substitutions:

1. Refer to the “Basic Materials and Methods” specification for details and requirements.

B. Product Submittals and shop drawings:

1. Refer to the “Basic Materials and Methods” specification for details and requirements.

C. As-Built drawings:

1. Refer to the “Basic Materials and Methods” specification for details and requirements.

1.5 BASIS OF DESIGN

A. The basis of design is interior products manufactured by Sensor Switch and exterior products manufactured by Wattstopper as listed elsewhere in this specification. It shall be the responsibility of the electrical contractor to verify the requirements of any approved alternate manufacturer’s equipment prior to ordering materials. Modifications to any electrical system required for equipment which differs from the basis of design shall be the responsibility of the electrical contractor. In no case shall substitution of equipment result in additional costs to the owner.

1.6 COORDINATION WITH OTHER TRADES

A. The electrical contractor shall review the proposed locations of all equipment in this specification with other trades prior to rough in. Conflicts with the work of other trades which require relocation of any equipment in this specification shall be approved by the Engineer of Record.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved manufacturers:

1. Sensor Switch, Inc.
2. Leviton
3. Wattstopper
4. Hubble Building Automation

2.2 WALL SWITCH OCCUPANCY SENSORS

A. Sensor shall provide wall-to-wall PIR detection such that small hand motions are detected out to 20 ft (6.10 m).

B. Sensors that utilize dual technology detection shall be used (as specified in above section, Occupancy Sensor Technology Requirements).

C. For applications requiring independent control of two loads, a sensor with two dual relays and dual override switches shall be required. Each relay shall have independent programmable occupancy time delays.

D. Sensors shall be capable of switching both 120 VAC and 277 VAC and run off of 50/60 Hz power. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, and ¼ HP motor load.

E. Sensor shall recess into single gang switch box and fit a standard GFI opening.

F. Sensor shall meet NEC grounding requirements by providing a dedicated ground connection and intrinsically grounding through its mounting strap.

G. Line and load wire connections shall be interchangeable, such that installer cannot make an improper connection to a line/load in a manner that will cause malfunction or damage to the sensor.

H. Sensor shall not require a neutral connection regardless of number of poles and/or detection technology.

I. Sensor shall not allow any leakage of current to pass to the load when sensor is in the unoccupied (off) condition. Sensor shall not require a minimum load to be connected in order to function.

J. Sensor shall have optional features for photocell/daylight override, vandal resistant lens, low temperature/high humidity operation.

K. All sensor settings, including time delay and photocell settings shall be digital and accessible for adjustment via a push-button without requiring removal of cover plate or tools of any kind.

L. Wall Switch sensors shall have field programmable adjustments for selecting operational modes, occupancy time delays, minimum on time, and photocell set-point as applicable.

M. All models shall be capable of both Auto-On and Manual On operation.

N. All models shall be capable of a “Reduced Turn On” operation where the initial PIR turn on level is higher in order to eliminate PIR from reflective surfaces from being detected. PIR shall be returned to normal levels upon initial PIR detection.

O. All models shall have a “Predictive Off” mode where user can manually turn the lights off when leaving the room and still have them come on automatically when they return to space.

P. All models shall be capable of disabling override switch.

Q. Occupancy sensor shall be equal to the following Sensor Switch model number. Device color and optional features as specified on individual datasheet.

1. WSD PDT

R. Vacancy sensor shall be equal to the following Sensor Switch model number. Device color and optional features as specified on individual datasheet.

1. WSX PDT SA

2.3 WALL SWITCH OCCUPANCY SENSORS – LARGE AREAS

A. Sensor shall provide wall-to-wall PIR detection such that small hand motions are detected out to 40 ft (12.19 m).

B. Sensors that utilize dual technology detection shall be used (as specified in above section, Occupancy Sensor Technology Requirements).

C. For applications requiring independent control of two loads, a sensor with two dual relays and dual override switches shall be required. Each relay shall have independent programmable occupancy time delays.

D. Sensors shall be capable of switching both 120 VAC and 277 VAC and run off of 50/60 Hz. A version capable of switching 347 VAC shall also be available. Load ratings shall be 13A each pole, ¼ HP motor load.

E. Sensor shall meet NEC grounding requirements by providing a dedicated ground connection and intrinsically grounding through its mounting strap.

F. Line and load wire connections shall be interchangeable, such that installer cannot make an improper connection to a line/load in a manner that will cause malfunction or damage to the sensor.

G. Sensor shall not require a neutral connection regardless of number of poles and/or detection technology.

H. Sensor shall not allow any leakage of current to pass to the load when sensor is in the unoccupied (Off) condition. Sensor shall not require a minimum load to be connected in order to function.

I. Sensor shall be equal to the following Sensor Switch model number. Device color and optional features as specified.

1. LWS(H) PDT

2.4 LOW VOLTAGE OCCUPANCY SENSORS

A. The installing contractor shall install one or more sensors with PIR coverage areas that cover the entire space and all entrance points. Exact placement and quantity required shall be per manufacturer’s best practice recommendations.

B. Sensors that utilize dual technology detection shall be used (as specified in above section, Occupancy Sensor Technology Requirements).

C. Sensors shall utilize a digital PIR detector (dual element pyro-electric detector) component, so as to provide a high degree of RF immunity.

D. Sensors shall operate on 12 to 24 VAC or VDC and consume no more than 5 mA so that up to 14 sensors may be connected to a single power pack.

E. Upon initial power up, sensors must immediately turn on. Power packs may be wired on the line or load side of local switching and must not exhibit any delays when switch is energized.

F. Each designated zone shall contain one sensor with a SPDT class 2 auxiliary relay, providing an input to building automation system (BAS). All sensors in designated zone shall communicate to sensor with relay for status to BAS. Sensor relay coil shall energize in the unoccupied state to load share the low voltage current from power pack. Note that power pack must be installed on the Line side of the local toggle switch for auxiliary relay to work properly.

G. Sensors shall have test mode that temporarily shortens/disable all time delays (e.g., minimum on, occupancy, photocell transition, dimming rates) such that an installer can quickly test operation of sensor. Test mode shall time out and return sensor to normal operation should the installer forget to disable test mode after installation.

H. Sensors shall have optional features for on/off photocell control, automatic dimming control photocell, high/low occupancy based dimming, and usage in low temperature/high humidity environments.

I. Sensors shall be equal to the following Sensor Switch model numbers.

1. CM PDT 10 (Dual tech, Ceiling Mount, Extended Range)
2. WV PDT 16 (Dual tech, Corner Mount, Wide View) with WV-BR bracket.
3. CM 6 (PIR, Ceiling Mount, High Bay 360°)

J. Sensors with a recessed profile are acceptable substitutes for above ceiling mount sensors

K. Fixture mounted box sensors are acceptable substitutes for above ceiling mount sensors

2.5 POWER PACKS

A. Power packs shall accept and switch 120 or 277 VAC, be plenum rated, and provide class 2 power for up to 14 remote sensors.

B. Power pack shall incorporate a Class 1 relay and an AC electronic switching device. The AC electronic switching device shall make and break the load, while the relay shall carry the current in the on condition. This system shall provide full 20 Amp switching of all load types, and be rated for 400,000 cycles.

C. Power packs shall be single circuit, or two circuits. Slave packs may be used to control additional circuits. When two circuit power packs, or slave packs are used, the power packs must be wired directly to circuit breaker. Otherwise, power packs may be wired on the line or load side of the local switch.

D. Power packs shall be equal to the following Sensor Switch model numbers.

1. PP20 (Single Pole)
2. PP20 2P (Two Pole)
3. SP20 (Slave Pack)

2.6 LINE VOLTAGE OCCUPANCY SENSORS

A. Sensors shall be self-contained and accept Class 1 wiring directly without the use of a power pack. The use of bases which accept line voltage and allow the use of low voltage sensors shall be acceptable.

B. The installing contractor shall install one or more sensors with PIR coverage areas that cover the entire space and all entrance points. Exact placement and quantity required shall be per manufacturer's best practice recommendations.

C. Sensors that utilize dual technology detection shall be used (as specified in above section, Occupancy Sensor Technology Requirements).

D. Sensors shall utilize a digital PIR detector (dual element pyro-electric detector) component, so as to provide a high degree of RF immunity.

E. Line and load wire connections shall be interchangeable, such that installer cannot make an improper connection to a line/load in a manner that will cause malfunction or damage to the sensor.

F. Multiple sensors controlling the same load shall be wired in parallel.

G. For applications requiring independent control of two loads, a sensor with two dual relays shall be required. Each relay shall have independent programmable occupancy time delays.

H. Dual relay sensors shall have an optional operational mode called "Alternating On" where when during unoccupied periods, one relay is always left closed (thus one load is always on). The particular relay that is left closed alternates each cycle so that the aging of the connected lamps is even.

I. Sensors shall be capable of switching both 120 VAC and 277 VAC and run off of 50/60 Hz power. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, and ¼ HP motor load.

J. High bay sensors controlling HID Bi-Level must incorporate a "Start to High" timer on initial power up to provide full light output for up to 20 minutes to prevent shortened lamp life.

K. Sensors shall have test mode that temporarily shortens/disable all time delays (e.g., minimum on, occupancy, photocell transition, dimming rates) such that an installer can quickly test operation of sensor. Test mode shall time out and return sensor to normal operation should the installer forget to disable test mode after installation.

L. Sensors shall have optional features for on/off photocell control, automatic dimming control photocell, high/low occupancy based dimming, and usage in low temperature/high humidity environments.

M. Sensors shall be equal to the following Sensor Switch model numbers.

1. CMR PDT 10 / CMR PDT 10 2P (Extended Range 360□, Dual Technology, Ceiling Mount – Single / Two Pole)
2. CMRB PDT 10 / CMRB PDT 10 2P (Extended Range 360□, Dual Technology, Fixture Mount Box – Single / Two Pole)
3. WVR PDT 16 / WVR PDT 2P (Wide View, Dual Technology, Wall Mount – Single / Two Pole) with WV-BR bracket
4. CMR 6 / CMR 6 2P (High Bay 360□, PIR, Ceiling Mount – Single / Two Pole)
5. CMRB 6 / CMRB 6 2P (High Bay 360□, PIR, Fixture Mount Box – Single / Two Pole)

N. Sensors with a recessed profile are acceptable substitutes for above ceiling mount or fixture mount sensors

2.7 INDOOR PHOTOCELLS AND DAYLIGHT HARVESTING CONTROLS

A. Low voltage photocell shall accept 12 to 24 VAC or VDC and provide a SPDT relay for interface with remote switching system. Sensor shall interface with occupancy sensors, directly with power pack, or other system as shown.

B. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.

C. Photocell set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating an "Automatic Set-point Programming" procedure. Further adjustment may be made manually if needed.

D. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).

E. Low voltage dimming sensors shall accept 12 to 24 VAC or VDC (from power pack or other low voltage source) and control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of class 2 current (typically 40 or more ballasts).

F. Low voltage dimming sensor's set point shall be automatically calibrated through the sensor's microprocessor by initiating the "Automatic Set-point Programming" procedure. Min and max dim settings as well as set-point may be manually entered.

G. Low voltage dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the "auto set-point" setting.)

H. Combination photocell/dimming sensors shall accept 12 to 24 VAC or VDC (from power pack or other low voltage source) and control the on/off function as well as the dimming function of 0 to 10 VDC dimmable ballasts.

I. Combination photocell/dimming sensor's set-point and deadband shall be automatically calibrated through the sensor's microprocessor by initiating the "Automatic Set-point

Programming" procedure. Min and max dim settings as well as set point may be manually entered.

J. Combination photocell/dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the "auto set-point" setting.)

K. Dual zone option shall be available for photocell, dimming, or combination units. The second zone shall be controlled as an "offset" from the primary zone and shall be the zone farthest from the natural light source.

L. Stand alone ambient light sensors (CM ALC version only) shall interface directly with the 0 to 10 VDC, without any other power source connection, and control dimmable ballasts by sinking up to 20 milliamps of class 2 current. Sensor shall incorporate a photodiode viewing out of a ceiling enclosure at a 30 degree angle from horizontal to detect diffused light from the ambient and artificial sources. Sensor shall allow for removal of response delays for adjustment, however provide dampening delay for normal operation. Settings shall be made manually.

M. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching both 120 VAC and 277 VAC and run off of 50/60 Hz power. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, and ¼ HP motor load.

N. Line voltage versions of the above described dimming sensors shall be capable of powering off 120/277 VAC.

O. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching 5 Amps of two phase power (208/240 or 480 VAC) shall be available. These sensors shall always simultaneously switch both phases as per NEC guidelines.

P. Sensors shall be equal to the following Sensor Switch model numbers.

1. CM PC (Photocell, On/Off, Low Voltage, Ceiling Mount)
2. CM ADC (Dimming Photocell, Low Voltage, Ceiling Mount)
3. CM PC ADC (Combination Photocell/Dimming Sensor, Low Voltage, Ceiling Mount)
4. CM PC DZ, CM ADC DZ, or CM PC ADC DZ (Dual Zone, Low Voltage)
5. CM ALC (Stand Alone Ambient Light Sensor for Daylight Harvesting)
6. CMR PC (Photocell, On/Off, Line Voltage, Ceiling Mount)
7. CMR ADC (Dimming Photocell, Line Voltage, Ceiling Mount)
8. CMR PC ADC (Combination Photocell/Dimming Sensor, Line Voltage, Ceiling Mount)
9. CMR PC DZ, CMR ADC DZ (Dual Zone, Line Voltage)

Q. Sensors with a recessed profile are acceptable substitutes for above ceiling mount or fixture mount sensors

R. Fixture mounted box sensors are acceptable substitutes for above ceiling mount sensors

2.8 MOMENTARY SWITCHES FOR VACANCY SENSORS

A. Momentary switches shall be equal to the following Sensor Switch model numbers. Device color and optional features as specified on individual datasheet.

1. SPODM-SA
2. SPODM-SA-3X (Three way)

2.9 EXTERIOR MOTION SENSORS

A. Sensor shall be a completely self-contained device capable of detecting presence in the controlled range by detecting changes between infrared energy in motion and the background space.

B. Sensor shall employ dual PIR detectors and a three level Fresnel lens.

C. Pulse Count Processing and Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of the signal received by the sensor to ensure response only to those signals caused by human motion.

D. Line voltage sensors shall use Zero Crossing circuitry.

E. Sensor shall utilize mixed signal ASIC (application-specific integrated circuit) technology that combines analog and digital processing into one microprocessor.

F. Sensor shall be capable of mounting vertically or horizontally onto a standard outdoor junction box in a variety of locations, such as walls, ceilings, or eaves.

G. Sensor shall cover up to 52.5 feet, with a field of view of 270 degrees.

H. Sensor shall have an operating temperature range of -40°F to +130°F.

I. Sensor shall carry a UL rating of 773A as a rain tight device.

J. Sensor shall be manufactured with precision double-shot tooling and contain internal silicon gaskets.

K. Sensor shall include a built-in light level sensor, adjustable by the user, which will keep lights from turning on during daylight hours.

L. Sensor shall have user-adjustable time delay settings, including an override ON option that enables controlled lights to be turned on remotely for the length of the time delay.

M. Sensor shall have an additional single pole, double throw isolated relay with normally open, normally closed, and common outputs rated for 1 Amp at 24 VDC.

N. Sensor shall operate at either 120 VAC or 277 VAC, 60 Hz.

O. Sensor shall be compatible with all electronic ballasts and PL lamp ballast systems.

P. Sensors shall be equal to the following Wattstopper model numbers.

1. EW-200

2.10 SPARE PARTS

A. Electrical contractor shall furnish an additional 2% of each type and number of the designed sensors, power packs, & switches (but not less than one of each type) to be turned over to the owner, new and unopened at project substantial completion.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Product Requirements in other specification sections.

B. Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

C. Delivery

1. Deliver materials in manufacturer's original, unopened, undamaged packages with intact identification labels.
2. Deliver to other trades in a timely manner.

D. Storage and Protection: Store materials away from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

3.2 INSTALLATION

A. Do not install equipment until the following conditions can be maintained in spaces to receive equipment:

1. Ambient temperature: 0° to 50° C (32° to 122° F).
2. Relative humidity: Maximum 90 percent, non-condensing.
3. Lighting control system must be protected from dust during installation.

B. Coordinate, receive, mount, connect, and place into operation all equipment.

C. Install equipment in accordance with manufacturer's installation instructions.

D. Provide complete installation of system in accordance with Contract Documents.

E. Maintain performance criteria stated by the manufacturer without defects, damage, or failure.

F. Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.

G. Ensure that daylight sensor placement minimizes sensors view of electric light sources; ceiling mounted and fixture-mounted daylight sensors shall not have direct view of luminaries.

H. Furnish all conduit, wire, connectors, hardware, and other incidental items necessary for a properly functioning lighting control system as described herein and shown on the plans. The Electrical Contractor shall maintain performance criteria stated by the manufacturer without defects, damage, or failure.

I. Compliance: Contractor shall comply with manufacturer's product data, including shop drawings, technical bulletins, product catalog installation instructions, and product carton instructions for installation.

J. Cable runs are continuous between connected devices, no splicing allowed.

K. All class 2 low voltage and network wiring shall be run separate from line voltage wiring and in its own metallic conduit per NEC and best practices.

L. Power: The contractor shall test that all branch load circuits are operational before connecting loads to sensor system load terminals, and then de-energize all circuits before installation.

M. Initial Settings:

1. Contractor is responsible for proper sensitivity and time delay settings. Occupancy sensors shall be configured for 16 min delay in all spaces except group toilets which shall be configured for 32 min delay.
2. Auto sensitivity and auto adaptation features shall be enabled on all sensors

N. In spaces with only one occupancy sensor. The sensor shall operate on line voltage or be furnished with line voltage power bases. Spaces which are shown to have multiple circuits or multiple sensors shall utilize power packs.

O. Emergency lights utilizing battery packs shall be provided with unswitched hot conductor for charging of the batteries. Power to battery packs shall not be switched by the occupancy sensor.

P. Electrical contractor shall furnish 3 spare sensors and power bases to owner to serve as spares.

Q. All sensor locations on the drawings are approximate. Refer to manufacturer's installation instructions prior to installation.

R. Sensors shall be located a minimum of six (6) feet from hvac supply/return vents.

S. Sensors mounted over doorways shall be placed one (1) foot inside threshold.

T. Occupancy sensor power packs shall be furnished and mounted in two (2) dedicated two gang surface boxes above the lay in ceiling directly over the wall switch for the room. Furnish and install a blank cover plate for these boxes with a phenolic label which states "Occupancy Sensor Power Pack". Electrical contractor shall furnish and install phenolic label on ceiling grid directly below power pack location which states "power pack". The contractor is responsible for field verification of required number of power packs:

1. One power pack is required for each controlled circuit.
2. Each power pack can supply up to 150ma. Refer to installation guide for maximum number of sensors connected to power pack.

3. If multiple circuits are to be controlled by a single sensor, auxiliary relays shall be used in conjunction with a power pack.

3.3 TESTING AND COMMISSIONING

A. Upon completion of all line, load and interconnection wiring, and after all fixtures are installed and lamped, a qualified factory representative shall completely check the installation prior to energizing the system. Each installed occupancy sensor shall be tested in the test mode to see that lights turn off and on based on occupancy.

B. Upon installation of all furnishings, a qualified manufacturer's representative shall adjust the sensors sensitivity and install masking devices as necessary to prevent motion in adjacent spaces from turning on the controlled lights. Sensitivity shall be set to the maximum setting which does not result in falsely triggering the sensor. Manufacturer's representative shall provide written test report of sensor location, and final settings to the engineer for review and include in the O&M manual.

3.4 WARRANTY

A. Sensors, power packs and other components shall have a 5 year warranty.

3.5 TRAINING

A. At the time of checkout and testing, the owner's representative shall be thoroughly instructed in the proper operation of the system.

END OF SECTION 260923

SECTION 262213 - DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall furnish and install single-phase and three-phase general purpose individually mounted transformers and mini-power centers of the two-winding type, self-cooled, as specified herein and as shown on the contract drawings.

B. Provide transformers and mini power centers complete and ready for operation, as indicated on Drawings. All transformers shall be dry type, air-cooled, and capable of continuous operation at 100% of Nameplate capacity in ambients up to 40 degrees C. Enclosures shall not exceed 50 degrees C surface temperatures at any continuous load up to and including 100%.

1.2 SUBMITTAL REQUIREMENTS

A. Request for substitutions:

1. Refer to the “Basic Materials and Methods” specification for details and requirements.

B. Product Submittals and shop drawings:

1. Refer to the “Basic Materials and Methods” specification for details and requirements.

C. Coordination drawings:

D. As-Built drawings:

1. Refer to the “Basic Materials and Methods” specification for details and requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Transformers and mini power centers shall be manufactured by same manufacturer as panels.

2.2 STANDARD FEATURES

A. Wiring compartment shall be front accessible and lugs shall be provided for cable sizes used. Enclosures shall be drip-proof and adequately ventilated to maintain UL temperature limits.

B. KVA ratings shall be as scheduled on Drawings.

C. Sound level of each transformer shall not exceed NEMA sound level limits for the KVA rating specified.

D. Transformers shall be 3 phase, 60 Hz, 2 winding type, with 480 volt Delta primary winding and 208Y/120 volt WYE secondary winding with grounded neutral. Primary windings shall be provided with taps, two 2-1/2% FCAN and four 2-1/2% FCBN.

E. Transformers indicated on drawings to be outside shall be mounted in NEMA 3R enclosure. Provide non fused primary disconnect in NEMA 3R enclosure mounted adjacent to transformer.

F. Transformers shall utilize natural-draft ventilation. Transformers which utilize fan assisted cooling means will not be accepted.

G. Transformers shall have 80°C temperature rise, shall have U. L. insulation class 155 or higher, and shall meet or exceed NEMA TP-1 Class 1 efficiency.

H. K-rated transformers shall have electrostatic shielding between the primary and secondary winding and grounded to the housing of the transformer. Electrostatic shield shall provide:

1. Primary to secondary winding capacitance between 24 and 18 picofarads over the range of 100 Hz to 20 kHz.

2. Common mode noise attenuation: Minus 80 dBA minimum at 0.1 kHz to 1.5 kHz; minus 55 dBA minimum at 1.51 kHz to 100 kHz when tested per MIL-Std-220A, Method of Insertion Loss Measurement, with matched impedance no load technique.

3. Normal mode (Transverse mode) noise attenuation: Minus 35dBA minimum at 1.5 kHz to 10 kHz when tested per MIL-Std-220A, Method of Insertion Loss Measurement, with matched impedance no load technique.

2.3 MINI POWER CENTERS

A. CONSTRUCTION

1. Each mini-power center shall include a primary main breaker, an encapsulated dry-type transformer and a panel board with secondary main breaker.
2. Primary main, secondary main and feeder breakers shall be enclosed with a pad lockable hinged door.
3. Mini-power centers shall be suitable for service entrance application and labeled as such.
4. Core and Coil Assemblies

   a. Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade aluminum with continuous wound construction.
   b. The core and coil assembly shall be completely encapsulated in a proportioned mixture of resin and aggregate to provide a moisture proof, shock-resistant seal. The core and coil encapsulation system shall minimize the sound level.
   c. The core of the transformer shall be grounded to the enclosure
   d. Provide two (2) 5% FCBN taps

B. BUS

1. Secondary bus shall be aluminum

C. WIRING/TERMINATIONS

1. All interconnecting wiring between the primary breaker and transformer, secondary main breaker and transformer and distribution section shall be factory installed.
2. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring.

D. MAIN DEVICES

1. Each mini-power center shall include a primary main breaker with an interrupting rating of 65kA at 277/480 volts; and a secondary main breaker with an interrupting rating of 10kA at 120/240 volts, and a panel board.

E. FEEDER DEVICES

1. The secondary distribution section shall accommodate one-inch bolt-on breakers with 10 kA interrupting capacity.

F. ENCLOSURE

1. The enclosure shall be made of heavy-gauge steel and the maximum temperature of the enclosure shall not exceed 90 degrees C.
2. The enclosure shall be totally enclosed, non-ventilated, NEMA 3R, with lifting provisions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide isolating pads between equipment and foundation or structural support and connect circuits through flexible metal conduit of 6" length to prevent transmission or vibration to structure or raceway system.

B. Provide housekeeping pad for each transformer as per the general electrical completion specification. Transformers shall be secured to housekeeping pads. Bolt size, embedment depth, pad thickness, and pad size shall be determined by seismic calculations required elsewhere in these specifications. Minimum pad height shall be 6”.

C. Transformers which are indicated on the electrical drawings to be installed on rooftops shall be mounted on 48” equipment rails which match the roof composition. Equipment rails shall span multiple joists or structural members, shall be rated in excess of the transformer weight and shall be installed by the general / roofing contractor. Bolt size and method of attachment to the equipment rails shall be determined by seismic calculations required elsewhere in these specifications.

D. The secondary X0 terminal (grounded neutral terminal) of each dry type transformer shall be bonded to the primary feeder equipment grounding conductor, secondary side feeder equipment grounding conductor, transformer case, and the facility's grounding system. The connections to the facility's grounding system shall be made to all available electrodes at each dry type transformer including building Steel.

3.2 NAMEPLATES

A. On all transformers, provide engraved phenolic plastic nameplates. Unless otherwise noted, nameplates to be 1/16" thick plastic with 1/4" high white letters on black background. Hand lettering, typing under tape, embossed letters on plastic, etc., will not be acceptable.

B. Attach nameplates with two rivets.

C. Label shall indicate, transformer name, suppling panel, load served, and voltage and phasing similar to:

TRANSFORMER T3 SUPPLIED FROM 277/480V PANEL MA1 SERVING 120/208V PANEL PA1

END OF SECTION 262213

SECTION 262413 - MAIN SWITCHBOARD

PART 1 - GENERAL

1.1 Description of Work

A. Provide a service entrance switchboard as indicated on drawings and as specified herein.

1.2 Submittal Requirements

A. Where indicated on the plans, manufacturer shall furnish a selective coordination report with the product submittal. This report shall include all of the time current curves for all of the overcurrent devices in the indicated system.

1.3. Basis of Design

A. The overcurrent protection system basis of design is GE. Any changes necessary to achieve selective coordination of other approved manufacturer's equipment shall be the sole responsibility of the electrical contractor. Systems requiring selective coordination shall be as noted on the drawings.

1.4 Operation and Maintenance

A. Manufacturer shall supply a complete set of operating and maintenance manuals to the Owner.

PART 2 - PRODUCTS

2.1 SWITCHBOARD

A. Manufacturers

1. Switchboards shall be manufactured by the same company as panelboards.

B. Materials and Components

1. Provide NEMA Type 1, free-standing, totally enclosed, dead front enclosure, with screw on or hinged and locked cover plates to prevent unauthorized and unintentional access to current carrying parts. Enclosure shall be treated by an approved rust preventive system and painted the manufacturer's standard color. Before final inspection, all bent cover plates shall be straightened, all fasteners secured, and all scratched and dented surfaces touched up and repaired.
2. Provide bussing as indicated on Drawings. Sections shall be bussed, not cabled, together.
3. Bussing shall be copper and shall be supported, spaced and insulated to comply with codes and standards of good practice. Provide full sized copper neutral and grounding busses continuous throughout the switchboard and grounding connections for circuits and switchboard frame as required by codes.
4. All lug sizes for connection of conductors shall be of size to fit conductors connected.

5. Provide overcurrent protection and disconnecting means for branch circuit feeders connected to switchboards.
6. Provide each branch circuit feeder protection unit with a nameplate stating load served and provide each switchboard with a nameplate stating voltage, phase, and wire characteristics and the words "Main Switchboard".
7. Voltage and current ratings of switchboard shall be as shown on the panel schedules. Switchboard shall be for application at 3 phase, 4 wire.
8. Switchboards shall be braced for a fault current of 65,000 amperes and shall have an interrupting rating of 50,000 amperes (symmetrical) unless otherwise noted.
9. All spaces denoted on the panel schedules shall be equipped with a 100% rated vertical buss for future addition. Tapered busses shall not be allowed.
10. The switchboard shall be designed, manufactured, tested, and installed in compliance with NEMA PB2. Main section devices individually mounted. Distribution section devices group mounted. Auxiliary section devices group mounted.
11. Switchboard shall be furnished with internal surge protective device (spd)
12. Main breaker shall be gfi protected / shunt tripped
13. Switchboard shall be furnished with factory installed Power Quality Meter equal to GE EPM 7000-6-5A-A-HI-C20-E1. The Power Quality Meter shall have the following features:

    a. Factory supplied CTs
    b. The meter shall provide a simultaneous voltage and current waveform recorder. The meter shall be capable of recording 512 samples per cycle for a voltage sag or swell or a current fault event.
    c. The meter shall provide pre- and post-event recording capability.
    d. The meter shall have a programmable sampling rate for the waveform recorder.
    e. The meter shall have an advanced DSP design that allows power quality triggers to be based on a 1 cycle updated RMS.
    f. The meter shall allow up to 170 events to be recorded.
    g. The meter shall store waveform data in a first-in, first-out circular buffer to insure that data is always being recorded.
    h. The meter shall include a three-line, bright red, .56” LED display.
    i. The meter shall fit in both DIN 92mm and ANSI C39.1 round cut-outs.
    j. The meter must display a % of Load Bar on the front panel to provide an analog feel. The % Load bar shall have not less than 10 segments.
    k. The meter shall measure, display, and record Volts, Amps, kW, kVAR, PF, kVA, Freq., kWh, kVAh, kVARh for each phase.
    l. Readings for kW, kVAR, kVA and PF shall be calculated using utility demand features.
    m. All other parameters shall offer max and min capability over the user selectable averaging period.
    n. Voltage shall provide an instantaneous max and min reading displaying the highest surge and lowest sag seen by the meter.
    o. The meter shall have Ethernet Card and shall provide the meter with 100BaseT Ethernet functionality to allow the meter to speak with 12 simultaneous sockets of Modbus TCP, so that multiple requests for data can be received simultaneously. It shall allow auto transmit/receive detection for straight or null RJ45 cables.
    p. The Meter shall provide 4 channel, 4-20mA outputs assignable to any measured parameter with 0.1% of Full Scale accuracy throughout range and load. It shall have a maximum load impedance to 850 Ohms, with no accuracy losses and be Loop powered using up to 24 Volts DC.

PART 3 - EXECUTION

3.1 SWITCHBOARD

A. Installation

1. Prior to energizing the switchboard, electrical contractor shall set the main breaker electronic trip setting to the following:

instantaneous trip	= 10 x rating
short term trip	= 5 x rating
long term trip	= 1 x rating
ground fault trip	= 1 x rating

2. Manufacturer shall finalize all breaker trip parameters with the owner present. Any specialized tool required for the setting of breaker trip parameters shall be provided to the Owner at this time.
3. General contractor shall furnish and install leak protection pans under all non-electrical piping systems which pass over switchboard and pitch pan to drain away from electrical equipment.

B. Training

1. Manufacturer’s representative shall provide Owner’s representatives with eight (8) hours of training on the operation and maintenance of the switch gear. This training shall be scheduled with the Owner at his/her discretion. This training shall be videotaped with two (2) copies provided to the Owner for future reference.

C. NAMEPLATES:

1. Provide engraved phenolic plastic nameplate. Unless otherwise noted, nameplates to be 1/16" thick plastic with 1/4" high white letters on black background. Hand lettering, typing under tape, embossed letters on plastic, etc., will not be acceptable.
2. Attach nameplates with two rivets.
3. Label shall indicate, switchboard name, voltage and phasing similar to:

MAIN SWITCHBOARD MDP1
277/480 VOLTS / 3 PHASE

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1- GENERAL:

1.1. Description of Work

A. Where shown on the plans, indicated in the riser diagram, or listed in the panelboard schedule, furnish and install power, distribution, and lighting panels of the size and type indicated.

1.2. Submittal Requirements

A. Where indicated on the plans, manufacture shall furnish a selective coordination report with the product submittal. This report shall include all of the time current curves for all of the overcurrent devices in the indicated system.

1.3. Basis of Design

A. The overcurrent protection system basis of design is GE. Any changes necessary to achieve selective coordination of other approved manufacturer's equipment shall be the sole responsibility of the electrical contractor.

PART 2 - PRODUCTS:

2.1. Manufacturers

A. Panelboards shall be manufactured by General Electric, Square D, Siemens, Cutler Hammer, or prior approved equal.

2.2. Materials and Components

A. Distribution and power panelboards shall be of the dead-front safety type, equipped with thermal-magnetic circuit-breaker branches of sizes and types noted on the Drawings or indicated in the panelboard schedule. Breakers shall provide instantaneous trip on short circuits and time-delay trip on overloads. Main busbars shall be equipped with solderless lugs and all spaces shall be bussed. Panelboard assembly shall be enclosed in a code - gauge steel cabinet with ample wiring gutters on top, sides, and bottom. Cabinet doors shall be equipped with spring latches with locks and shall be keyed alike.

B. Lighting panelboards shall be of the circuit breaker type of sizes listed in the panelboard schedule or noted on the Drawings. The panels shall have mains only with solderless lugs on the main busbars. Branches shall have circuit breakers of the sizes indicated on the panel schedule. Cabinets shall be of the code - gauge steel with ample wiring gutters for all wires and connections. Doors shall be the single type with spring latches with locks and all keyed alike.

C. Unless otherwise indicated on the drawings, all panelboards shall have a fully rated symmetrical short circuit fault current rating of at least 22,000 amperes. Series rated panels are not acceptable.

D. All panelboards shall have bolt on breakers. Plug in breakers are not acceptable.

E. Circuit breakers shall be 20 amp, 1 pole unless indicated otherwise.

F. Panels shall be 17" minimum width.

G. Surface Mounted panels which are noted elsewhere in these contract documents to have TVSS/SPD protection shall have TVSS/SPD units mounted adjacent to the panels. See the details and other specifications for more details.

H. Flush mounted panels which are noted elsewhere in these contract documents to have TVSS/SPD protection shall have integral units with Performance characteristics as close as possible to the external units. Integral TVSS/SPD units shall be furnished by the panelboard manufacturer.

I. Buses for all phases, ground and neutral shall be copper.

PART 3 - EXECUTION:

3.1 Installation

A. From each flush mounted panelboard, stub a minimum of five ¾" inch empty conduits into area above ceiling.

B. Install in each panelboard a plastic-covered typewritten circuit directory in metal frame. Indicate name, address and service telephone number of installer. Directory shall list the load served and the location of the load for each breaker. Directory shall indicate the final room numbers designated by the owner and not necessary those shown by the architect on the floor plans.

C. All multiwire branch circuits shall have a handle tie supplied by the panel board manufacture installed to simultaneously open all ungrounded conductors. The electrical contractor may substitute multi pole breakers for this purpose at his discretion. All conductors that comprise the multiwire branch circuit shall be bundled and tye-wrapped together at the point where they enter the panel.

D. Electrical contractor shall furnish and install leak protection pans under all non-electrical system piping which passes over electrical panels and pitch pan to drain away from electrical equipment.

E. The electrical contractor shall apply warning label which states “Warning arc flash hazard appropriate PPE required”. The warning label design shall comply with ANSI Z535.4

F. Except where existing panels are being replaced, conductors shall not be spliced within a panel or pass through a panel. Conductors shall be neatly routed within the panel and excess wiring shall be removed.

G. All branch spaces shall be numbered to match panels schedules.

H. All branch spaces shall have factory supplied blank covers installed.

I. Panels interior shall be cleaned and free of debris.

J. Where necessary, conductors shall be tie together with ty-wraps for support. The use of wires for this purpose shall not be accepted.

3.2 MARKING:

A. Electrical Contractor shall install 2” wide black / yellow marking tape on the floor in front of each panel to delineate the perimeter of the NEC required clear working space in front of the panel. Working space requirements are 30” wide by 36” deep for 120/208v panels and 30” wide by 42” deep for 277/480v panels”

3.3 NAMEPLATES:

A. On all panelboards, provide engraved phenolic plastic nameplates. Unless otherwise noted, nameplates to be 1/16" thick plastic with 1/4" high white letters on black background. Hand lettering, typing under tape, embossed letters on plastic, etc., will not be acceptable.

B. Attach nameplates with two rivets.

C. Label shall indicate, panel name, suppling panel or transformer, voltage and phasing similar to:

PANEL PA1 120/208 VOLTS / 3 PHASE SUPPLIED FROM 45 KVA TRANSFORMER T1

END OF SECTION 262416

SECTION 262701 – SERVICE AND METERING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Provide a service entrance of type, size, and length shown on the Drawings.

B. Provide temporary power services to facilitate construction operations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Secondary Termination Cabinets (where shown on plans).

1. Maysteel
2. Easter Owens and Associates Inc.
3. Hubble / Trinetics
4. Others by prior approval.

2.2 MATERIALS AND COMPONENTS

A. Secondary Termination Cabinets (where shown on plans).

1. The contractor shall furnish and install a Lockable Nema 3R, utility type, pad mounted secondary termination cabinet. Electrical characteristics shall be as shown on the drawings.
2. Two enclosures shall be bussed together if necessary to accommodate number of conductors shown on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. The electrical contractor shall coordinate with the power company and comply with special conditions of service; including any primary conduits, secondary lugs, costs for primary service to pad mounted transformer and concrete pad, if necessary.
2. Protect all service entrance conductors against physical damage by installation in rigid metallic conduit, the conduit to terminate at the main distribution panel.
3. The contractor shall Install and maintain permanent property corners prior to the start of work by the Utility Company.

4. The contractor shall initiate stabilization measures as required both before and after installation of underground lines and include this activity in sequencing of construction activities in the Storm Water Pollution Prevention Plan. contractor will be responsible for temporary stabilization, if necessary, once final grade is established and prior to Utility Company trenching activities. Do not initiate final stabilization on easement prior to Utility Company installing underground lines. Any inlet protection will be responsibility of the contractor.
5. The contractor shall establish final grade and tamp any required filling or grading before the start of any underground distribution construction. Costs incurred due to changes in earth grades after the start of construction will be borne by the contractor.
6. The contractor shall Furnish and install all necessary conduits, pull wire, pull boxes, bends, including necessary trenching and back filling, in accordance with Utility Company drawings and specifications, from the transformer location to the source. This shall include galvanized bends, transformer entrance conduit and the first section of galvanized conduit up the pole (which must be grounded to meet National Electric Code requirements). Installation by the contractor shall comply with Utility Company Drawings and be subject to Utility Company acceptance.
7. The contractor shall furnish, install, own, and maintain the meter base for services as determined by the Utility Company. The contractor shall consult the Utility company to confirm proper equipment needed for each situation.
8. The contractor shall keep the transformer and primary cable unencumbered and accessible for maintenance and provide suitable vehicular barriers where required per Utility Company.
9. The contractor shall notify Palmetto Utility Protection Service (811) for marking of underground facilities prior to digging. Hand dig foreign utility trenches in areas crossing electrical cables already in place to eliminate contact with electrical cables.
10. The contractor shall furnish and install secondary conduit and conductors, including connectors for connection at service point. The contractor shall consult the Utility company to confirm which connectors are required.
11. The contractor shall take service at the service point identified by the Utility Company. Secondary service cables shall comply with the National Electrical Code, as a minimum when installed. Secondary cables carrying metered energy shall be installed in separate conduit or raceways from all other cables or wires.
12. The contractor will be fully responsible for compliance with any tree or buffer ordinances affecting the utility company easements. Any funding or tree replacement will be the responsibility of the contractor. Buffer requirements are in addition to and separate from the utility company easements. The contractor shall be fully aware of all appropriate ordinances that can affect the utilities' right of way and should take this into account when assigning the easement.
13. The contractor shall be fully responsible, as required by local ordinances, to establish and maintain tree barricades around all trees required to be preserved. Any required barricades shall be in place prior to the utility company beginning design or installation of underground facilities. The standard method of construction will be by an open-trench (trencher or back hoe). Any encroachments in barricaded areas will require directional bores to protect trees and shall be considered as non-standard service to the contractor and at the contractor's expense. The contractor shall be solely responsible and liable for any tree damages incurred during the installation of underground electric facilities that are caused by the contractor's failure to properly barricade any significant trees, as prescribed by local ordinances.

14. The contractor will be responsible for coordination of the approval of governmental agencies required for the development (i.e.; buffer zones, wetlands, storm water permitting, zoning, etc.)
15. The contractor shall determine the locations and elevations of all foreign utilities and obstructions in areas of conflict with primary and secondary cables and transformer pads. The location of all crossing facilities shall be clearly marked by the contractor.
16. The contractor is responsible for making rights-of-way (including easements) available to the Utility Company and for all stabilization requirements, sediment and erosion control measures, and clean up of debris from right-of-way clearing operations to include but not limited to limbs, trees and stumps. Obstructions to the performance of Utility Company work such as construction materials and equipment shall have been cleared away by the contractor prior to the start of Utility Company construction.
17. The contractor is responsible for trench excavation and backfill. It is the contractor's responsibility to ensure compliance with OSHA and other Federal, State and local requirements while doing this work. Backfill shall be dirt, sand, or soil excavated from the trench, or other suitable soils, free from rock, organic materials, construction materials or other debris.
18. The contractor shall furnish and install 1/2" empty conduit from the building's telecom backboard or cable tray to the utility company's meter for future communications cable.
19. At direction of utility company, the contractor shall furnish and install CT cabinet mounted adjacent to the meter in the location shown on the drawings.
20. Underground conduits shall be routed so as to maintain clearance requirements from other underground services as per the utility company.
21. Bends in primary and secondary service conduits shall have a minimum radius of 36".

B. Underground Service

1. Pole Mounted Transformers

   a. The contractor shall furnish and install up to 30' of rigid metallic conduit with weather head at pole as directed by utility company.
   b. The contractor shall furnish and install an extra 25' of secondary conductor at weather head as directed by utility. Leave coiled and secured to weather head.
   c. At direction of utility company, contractor shall furnish and install hand hole at base of the utility service pole.

2. Pad mounted Transformers

   a. The contractor shall furnish, install, own and maintain the concrete transformer pad and vehicular protection bollards, if shown in the drawings.
   b. Pad location is to be coordinated with utility company representative before forming or pouring concrete.
   c. Pad foundation must support the weight of the transformer. If soil conditions will not support the weight of the transformer, the area of the pad must be increased or piling installed.
   d. Steel reinforcing rebar must be intermediate grade billet steel with 40,000 psi minimum yield strength.
   e. Concrete for pad shall confirm to class A structural concrete and shall have a 28 day strength of 4000 psi, contain no more than 6% entrained air, and have no larger than 1" aggregate mixture. Limestone aggregate is not acceptable.

f. Conduits must be extended above surface of top of concrete pad to be between one and 6 inches above the pad.
g. All metal conduits shall have bonding bushings and be bonded to ground rods and system neutral installed be utility company.
h. Primary conduit shall be furnished and installed by the contractor and shall galvanized rigid metallic conduit and be a minimum of 36” BFG with.

END OF SECTION 262701

SECTION 262726 - SWITCHES

PART 1 - GENERAL

1.01 SWITCHES

A. Furnish and install white switches for lighting as shown on the Drawings.

B. Switches shall operate quietly in any position. Mechanisms shall be the mechanical type, containing no fluids, and shall be suitable of control of both incandescent, fluorescent, LED lighting loads, as well as motor and appliance loads up to 85% of rated switch capacity.

C. Terminals shall be screw type with terminals arranged for back or side wiring.

D. Switches shall be rated 20 amps and for 120 or 277 volt circuits.

1.02 PLATES

A. Plates for switches shall be the same manufacturer as switch and shall be oversized stainless steel, unless indicated otherwise on the Drawings.

B. Weatherproof exterior covers shall be cast equal to Legrand #CA1GL series.

C. Plates for exhaust fans shall have phenolic label with text: “EXHAUST FAN”

D. Plates for hot water circulation pumps shall have phenolic label with text: “CIRC PUMP”

E. Plates for motorized backboards shall have phenolic label with text: “BACKBOARD”

F. Plates for motorized projection screens shall have phenolic label with text: “SCREEN”

G. Plates for Key operated switches shall be equal to P & S style #302

H. Plates for narrow applications such as in or on metal frames of storefront and curtain wall glass assemblies shall be Equal to Pass and Seymour #SSN11

PART 2 - PRODUCTS

2.01 SWITCHES

A. Approved switch manufacturers are as follows:
1. Hubbell/Bryant
2. Eaton/Cooper/Eagle/Arrow Hart
3. P & S / Legrand
4. Leviton
5. Other by prior approval

B. Switches shall be selected from the make and models listed in the chart below. Other makes or models shall be substituted only by prior approval obtained per the substitution policies outlined elsewhere in these specifications.

SYMBOL	SWITCH CHARACTERISTICS	HUBBLE/ BRYANT	COOPER/ EAGLE / EATON	P&S/ LEGRAND	LEVITON
	SINGLE POLE SWITCH	1221x	1221x	CSB20AC1x	1221-Sx
3	3 WAY SWITCH	1223x	1223x	CSB20AC3x	1223-Sx
4	4 WAY SWITCH	1224x	1224x	CSB20AC4x	1224-Sx
2	DOUBLE POLE SWITCH	1222x	1222x	CSB20AC2x	1222-Sx
K	KEYED SWITCH			20ACx-KL	
D	INCANDESCANT DIMMER. 1500W	AS153		CD1600	
D1	INCANDESCANT DIMMER. 2000W	AS203		CD2003	
FD	FLOURESCENT DIMMER, MARK X		SF8AP7	ADFE277-10A	IPX12
D10	0-10V DIMMER		SF10P	CD4FBL	AWSMT-7DW
EP	EXPLOSION PROOF	FXS-41C	EDSx2129/30/40		
P	PILOT LIGHT SWITCH (Illuminated on)	HBL1221/3/ILx	AH1221/3/4LT	PS20AC1/3-CPL	1221-PLC
CF	CEILING FAN		SFS5P	ADFC-6A	6627-PW
M	MOMENTARY			LVS-1	

2.02 EMERGENCY STOP BUTTONS / SHUNT TRIP BUTTONS

A. Emergency stop and Shunt trip buttons shall be mushroom head, maintained push / pull operation equal to GE #CR104PBM01R5A with Ring guard (GE # CR104PXG14) and Emergency Stop nameplate.

2.03 SWITCH BYPASS DEVICES

A. Switch bypass devices shall be equal to LC&D #GR2001 emergency shunt relay

2.04 ROTARY TIMERs

A. Rotary time switch shall be rated 10 amps, 4 hours, no hold equal to Intermatic FF4H

PART 3 - EXECUTION:

3.01 IDENTIFICATION:

A. The panel and circuit number(s) supplying each switch shall be indicated with permanent markings on the inside of each cover plate.

3.02. DEVICES:

A. Branch circuit wiring shall be long enough to allow removal of the switch 2” beyond the face of the wall surface without disconnection of conductors.

B. Use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.

C. Use a torque screwdriver when a torque is recommended or required by the manufacturer.

D. When conductors larger than No. 12 AWG are installed, splice No. 12 AWG pigtails for device connections.

E. Tighten unused terminal screws on the device.

F. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

3.03. LOCATION:

A. Verify locations in relation to door swings, and place devices on the strike side.

B. Gang plates where two or more similar devices occur at the same location.

3.04. MOUNTING:

A. Switches shall be installed flush and level with the wall surface. Oversize gaps which are visible around the exterior of the cover plate shall be sealed and painted to match adjacent surfaces.

B. Switches shall be installed so that top of box is 48” above finished floor unless otherwise indicated.

3.05 EMERGENCY STOP BUTTONS / SHUNT TRIP BUTTONS

A. Emergency stop and Shunt trip buttons shall be installed in Nema enclosure appropriate for the location shown on the plans with additional labels as detailed on the electrical drawings.

B. Exterior shunt trip buttons shall be installed in stainless steel weather proof enclosure with lockable cover.

END OF SECTION 262726

SECTION 262727 - RECEPTACLES

PART 1 - GENERAL:

1.1 RECEPTACLES:

A. Furnish and install white receptacles for power as shown on Drawings.

B. Duplex receptacles shall be grounding type, rated 15 or 20 amp, as indicated, 125V, have screw type terminals arranged for back and/or side wiring, and shall be equipped with break-off or equivalent means for split wiring.

C. Receptacles shall be by the same manufacturer as the switches.

D. Receptacles installed indoors shall be tamper resistant.

1.2 PLATES, AND COVERS:

A. Cover plates for standard receptacles shall all be by the same manufacturer as receptacle, and shall be oversize stainless steel, unless indicated otherwise on Drawings.

B. Cover plates for receptacles with locking covers shall be equal to P&S #460026P.

C. Cover plates for weather proof receptacles (subnote “WP” on drawings) shall be cast metallic and equal to P&S #4511, Hubble #RW51040 or Cooper/Eagle #S1966.

D. Cover plates for while in use receptacles (subnote “WIU” on drawings) shall be cast metallic, extra duty, while in use equal to Intermatic #WP1010MXD, P &S #WIUCAST1, Hubble #WP26E, or Cooper/Eagle #WIUMH-1.

PART 2 - PRODUCTS:

2.1 RECEPTACLES:

A. GFCI Receptacles shall include indicator light that is lighted when device is tripped. They shall Conducts an automatic test every three seconds, ensuring ground fault protection. If protection is lost, power to the unit is disconnected and indicator light flashes indicating that the unit should be replaced.

B. Outdoor receptacles shall be 20 Amp, GFCI protected, tamper resistant, and weather resistant.

C. Controlled receptacles shall have a marking which is permanently printed, molded, or stamped on the face of the receptacle and in compliance with Controlled Receptacle Marking requirements stated in Article 406.3(E) of the National Electrical Code.

D. Receptacles shall be selected from the make and models listed in the chart below. Other makes or models shall be substituted only by prior approval obtained per the substitution policies outlined elsewhere in these specifications.

CHARACTERISTICS									HUBBLE/ BRYANT	COOPER/ EAGLE	P&S/ LEGRAND	LEVITON
	20A	TR X	IG	HG	USB	GFI	WR	RC	CBRS15XXTR	TR5262	TR5262	
	X	X							CBRS20XXTR	TR5362	TR5362	
	X	X	X						IG5352TR	AHTR165362		
		X		X					BRY8200XXTR	TR8200	TR62H	
	X	X		X					BRY8300XXTR	TR8300	TR63H	8300-SGG
	X	X			X				USB20X2	TR7756	TR5362USB	5832
	X	X				X	X		GFTWRST20	TWRSGF20	2095TRWR	
	X	X		X		X			GFTRST83	TRSGFH20	2097HGTR	
	X	X				X			GFTRST20	TRSGF20	2097TR	
	X	X						X			TR26362CD	

NOTES:

TR	TAMPER RESISTANT
IG	ISOLATED GROUND
HG	HOSPITAL GRADE
USB	USB CHARGING
GFI	GROUND FAULT INTERRRUPTING
WR	WEATHER RESISTANT
RC	CONTROLLED (per NEC 406.3)

PART 3 – INSTALLATION:

3.1 IDENTIFICATION:

A. The panel and circuit number(s) supplying each receptacle shall be indicated with permanent markings on the inside of each receptacle cover plate.

3.2. DEVICES:

A. Branch circuit wiring shall be long enough to allow removal of the receptacle 2” beyond the face of the wall surface without disconnection of conductors.

B. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.

C. Use a torque screwdriver when a torque is recommended or required by the manufacturer.

D. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

E. Tighten unused terminal screws on the device.

F. When mounting into metal boxes, remove the fiber or plastic washers used to hold device

mounting screws in yokes, allowing metal-to-metal contact.

3.3. ORIENTATION:

A. Receptacles shall be installed with the ground pin in the “up” position.

3.4. MOUNTING:

A. Receptacles shall be installed flush and level with the wall surface. Oversize gaps which are visible around the exterior of the cover plate shall be sealed and painted to match adjacent surfaces.

END OF SECTION 262727

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 MATERIALS AND COMPONENTS

A. Fuses shall be listed and meet UL and/or NEMA Standards for Class K5, J, L, and RKI fuses, or as indicated on the drawings.

B. Where fuses are required elsewhere in the specifications or on the drawings for individual motor circuit protection, for motor control centers, and for motor starters, these fuses shall be class K5 fuses unless otherwise indicated. Class K5 fuses shall be dual element cartridge design with high interrupting capacity, current limiting effect, 200,000 ampere RMS symmetrical at rated voltage minimum, and a minimum time delay of ten (10) seconds at five hundred percent (500%) load.

C. Class J and L fuses shall be provided as indicated on the Drawings for protection of non-motor loads.

D. Fuse voltage rating shall be 250 volts for 120/208 volt system and 480 or 600 volts for 277/480 volt system.

1.2 SPARE FUSE CABINET

A. All spare fuses shall be stored in their original cartons in a spare fuse cabinet furnished and installed by the electrical contractor. The cabinet shall be steel, surface mounted, with a hinged door, phenolic “Spare Fuse” label, flush lock, finished with gray baked enamel, and sized as required to house all spare fuses. A directory listing type and location of each fuse shall be mounted on the inside of the door. Spare fuse cabinet shall be similar to BUSSMAN Cat. No. SFC.

B. The spare fuse cabinet shall be wall mounted within sight of the main service panel or switchboard.

PART 2 - PRODUCTS

2.1 FUSES

A. Fuses shall be as manufactured by BUSSMAN or GOULD SHAWMUT.

B. Fuses over 600 amps up to 6,000 amps shall be UL Class ‘L’ time-delay fuses equal to BUSSMAN “HI-CAP” KRP-C. The fuses shall hold five hundred percent (500%) of rated current for a minimum of four (4) seconds and clear twenty (20) times rated current in 0.01 seconds or less.

C. Fuses up to 600 amps used for service entrance equipment shall be UL Class RKI dual-element fuses equal to BUSSMAN “LOW-PEAK” LPN-RK for 250 volts or LPS-RK for 600 volts. The fuses shall hold five hundred percent (500%) of rated current for a minimum of ten (10) seconds.

D. Fuses protecting other than service entrance equipment rated over 100 amps up to 600 amps shall be UL Class K5 dual-element fuses equal to BUSSMAN “FUSETRON” FRN-R for 250 volts or FRS-R for 600 volts unless otherwise noted on the Drawings.

E. Fuses 100 amps and under shall be UL Class K5 dual-element fuses equal to BUSSMAN “FUSETRON” FRN-R for 250 volts or FREER for 600 volts unless otherwise noted on the Drawings.

PART 3 - EXECUTION

3.1 FUSES

A. The electrical contractor shall furnish and install fuses for all switches, switchboards, distribution panel, or any other electrical equipment furnished under this division of these specifications requiring fuses.

B. The electrical contractor shall furnish one additional set of each type and rating of fuse as spare as well as any required puller or installation devices. These shall be installed in the original boxes in the spare fuse cabinet.

C. The electrical contractor shall provide a chart listing fuse ampacity, type and manufacturer’s part number installed in each disconnect. A copy shall of this chart shall be collected into a binder and submitted to the owner as part of the operations and maintenance (O & M) documentation

D. Where fused disconnects are shown for mechanical equipment, the electrical contractor shall review the approved mechanical shop drawings prior to installing the disconnects and:

1. Where the approved shop drawings list a smaller fuse size then is scheduled on the electrical drawings, install the smaller fuse.

2. Where the approved shop drawings list a larger fuse size then is scheduled on the electrical drawings, notify the electrical engineer.

END OF SECTION 262813

SECTION 262816 - MOTOR AND CIRCUIT DISCONNECTS

PART 1 - GENERAL

1.1 DISCONNECTS

A. Furnish and install heavy-duty disconnect switches at locations shown on Drawings, and in accordance with NEC requirements. Operating mechanisms shall be the quick-make, quick-break type, with arc-suppressing characteristics. Enclosures shall be NEMA Type 1 indoors and NEMA Type 3R in outdoor and wet locations; equipped with cover interlock and provisions for padlocking operating handle in "ON" and "OFF" position.

B. Fuses shall be as per the fuse specification.

PART 2 - PRODUCTS

2.1 DISCONNECTS

A. Disconnect switches shall be by the same manufacturer as panelboards.

PART 3 - EXECUTION

3.1 NAMEPLATES

A. On all disconnects, provide engraved phenolic plastic nameplates. Unless otherwise noted, nameplates to be 1/16" thick plastic with 1/4" high white letters on black background. Hand lettering, typing under tape, embossed letters on plastic, etc., will not be acceptable.

B. Attach nameplates with two rivets.

C. Label shall indicate, load served, suppling panel and breaker, voltage and phasing similar to:

AHU #1A
120/208 VOLTS / 3 PHASE
SUPPLIED FROM
PANEL PA1 CIRCUIT 32

3.2 MOUNTING

A.. Disconnects mounted to mechanical units shall not be mounted to or interfere with the operation of access covers. They shall not obstruct any unit nomenclature or nameplates.

B. Disconnects for mechanical equipment shall be installed adjacent to equipment in such a way that NEC required working space clearance requirements are not infringed.

3.3 COORDINATION WITH OTHER TRADES

A. Where fused disconnects are shown for mechanical equipment, the electrical contractor shall review the approved mechanical shop drawings prior to installing the disconnects and:

1. Where the approved shop drawings list a smaller fuse size then is scheduled on the electrical drawings, install the smaller fuse.

2. Where the approved shop drawings list a larger fuse size then is scheduled on the electrical drawings, notify the electrical engineer.

END OF SECTION 262816

SECTION 264313 – EXTERNAL SURGE PROTECTION DEVICES

PART 1- GENERAL

1.1 DESCRIPTION

These specifications describe the electrical, mechanical, and installation requirements for a high-energy Surge Protective Devices (SPDs), formerly TVSS, for the protection of AC electrical circuits. The specified system shall provide effective high-energy surge current diversion, sine wave tracking for electrical line noise filtering and be suitable for application in ANSI/IEEE C62.41 Category B environments, as tested by ANSI/IEEE C62.11, C62.45 and MIL-STD-220A. The system shall be connected in parallel with the protected system; no series connected elements shall be used which limit load current or kVA capability.

1.2 STANDARDS - Most Recent Editions of:

A. Underwriters Laboratories; UL 1449 4th Edition
B. Underwriters Laboratories; UL 1283 (complimentary listing for Type 2)
C. ANSI/IEEE C62.11, C62.41, C62.45
D. National Electrical Code: Article 285
E. National Fire Protection Association (NFPA 20, 70, 75 and 780)
F. ISO 9001 for manufacturing, design and service.

1.3 LISTING REQUIREMENTS

The individual SPD / TVSS units shall be UL listed under UL 1449 fourth Edition to ensure comparable test evaluations and accessibility of UL's website to verify spec compliance.

A. SPD / TVSS shall bear the UL Mark and shall be Listed to the 4rd edition of UL 1449 and the most recent UL 1283. "Manufactured in accordance with" is not equivalent to UL listing and does not meet the intent of this specification. The surge ratings shall be permanently affixed to the SPD / TVSS. The unit shall also be complementary listed to UL 1283 Standard for EMI/RFI Facility Filters.

B. SPD / TVSS and performance parameters shall be posted at www.UL.com under Category Code: VZCA. Products or parameters without posting at UL.com shall not be approved.

1.4 SUBMITTAL REQUIREMENTS

These specifications are based on the products as manufactured by those listed in section 2.5 below. All other manufacturers shall submit for 10 day prior-approval, and provide detailed compliance or exception statements to all provisions of this specification to allow consideration. Additionally, manufacturers shall submit the following documentation. Failure to do so will result in product disapproval.

A. Submittals shall include UL 1449 Listing documentation which indicates:
   1. Short Circuit Current Rating (SCCR)
   2. Voltage Protection Ratings (VPRs) for all modes
   3. Maximum Continuous Operating Voltage rating (MCOV)
   4. I-nominal rating (I-n)
   5. Device Type Listing

B. Submittals shall include shop drawings including manufacturer installation instruction manual and line drawings detailing dimensions and weight of enclosure, internal wiring

diagram illustrating all modes of protection in each type of SPD / TVSS required, wiring diagram showing all field connections and manufacturer's recommended wire and breaker sizes.

C. Upon request, an un-encapsulated but complete SPD / TVSS shall be presented for visual inspection; proprietary technology included. MOV type & quantity shall reflect kA ratings on cutsheets, verification of diagnostic monitoring, thermal & overcurrent protection, etc.

1.5 QUALITY ASSURANCE

The manufacturer shall be ISO 9001 certified. The specified interconnect assembly shall be designed and manufactured in the USA by a qualified manufacturer of SPD / TVSS products and line conditioning equipment. The manufacturer shall have been engaged in the design and manufacture of such products for a minimum of 10 years.

1.6 ENVIRONMENTAL REQUIREMENTS

Storage Temperature:	-55 to +85°C (-67 to +185°F)
Operating Temperature:	-40 to +60°C (-40 to 140°F)
Relative Humidity:	0% to 95%
Audible Noise:	less than 45dB at 5 feet (1.5m)
Operating Altitude:	0 to 18,000 feet above sea level

The unit shall not generate any appreciable magnetic fields and shall be suitable for use directly inside computer rooms.

1.7 SYSTEM DESIGN

The SPD/Filter shall be constructed using multiple surge current diversion arrays of metal oxide varistors (MOV), matched to a variance of ±1 volt. The array shall consist of multiple gapless metal oxide varistors, with each MOV individually fused. The arrays shall be designed and constructed in a manner that ensures MOV surge current sharing. No gas tubes, or selenium plates/rectifiers shall be used. Designs which use only silicon avalanche diodes are not acceptable. The status of each array shall be continuously monitored and a green LED shall be illuminated if the array is in full working order. All protection modes, including N-G, shall be monitored and internally fused for compliance with NEC article 110.9, 110.10 and 280.22.

1.8 ELECTRICAL REQUIREMENTS

The Nominal System Operating Voltage, configuration, phase, number of wires shall match the associated panelboards to which the SPD / TVSS is connected.

1.9 MAXIMUM CONTINUOUS OPERATING VOLTAGE (MCOV)

The SPD / TVSS and all components in the suppression path (including all current diversion components) maximum continuous operating voltage (MCOV) shall be greater than 115% of the nominal system operating voltage to ensure the ability of the system to withstand temporary RMS over-voltage (swell conditions).

1.10 OPERATING FREQUENCY

The operating frequency range of the system shall be 47 - 63 Hz.

1.11 LIFE CYCLE TESTING

The SPD shall be duty life cycle tested to withstand 6000 10kA (8x20µs), 20kV (1.2x50µs)

(IEEE C62.41 Category C) surges with less than 5% degradation of clamping voltage.

1.12 OVERCURRENT PROTECTION

Fusing: All suppression components shall be individually fused and rated to allow maximum specified surge current capacity. Devices that utilize a single fuse to protect two or more suppression paths are not excepted. Individual surge components shall be sand packed and shall be UL listed to be capable of interrupting up to 100 kA symmetrical fault current with 480 VAC applied. Replaceable fusing is unacceptable. Overcurrent protection that limits specified surge currents is not acceptable.

1.13 PERFORMANCE RATINGS

Surge Current Capacity: The SPD / TVSS surge current capacity, based on an 8 x 20 microsecond waveform, shall be at least 130kA Surge Rating per Phase and 50kA Surge Rating per mode. If the surge rating is listed on the panel schedules, these shall be provided in lieu of the sure current ratings listed in this section.

1.14 UL 1449 RATINGS

A. The maximum UL 1449 listed surge ratings for each and/or all of the specified protection modes shall not exceed the following:

System Voltage	UL 1449 4th Edition VPR			
	L-N	N-G	L-G	L-L
120/240	700	600	700	1000
120/208	700	600	700	1000
240	N/A	N/A	1000	1000
277/480	1200	1200	1200	2000
480	N/A	N/A	1800	2000
346/600	1500	1500	1500	2500

B. The UL 1449 Nominal Discharge Current Rating shall be a minimum of 20kA.

1.15 NOISE ATTENUATION

The filter shall provide an attenuation of 50 db max from 10 kHz to 100MHz, per 50 Ohm Insertion Loss Methodology from MIL 220A. The system shall provide up to 120-dB 60 insertion loss from 100 kHz to 100 MHz when used in a coordinated facility system.

1.16 RESPONSE TIME

The typical response time of all suppression components shall be 1 nanoseconds.

1.17 PROTECTION MODES:

The SPD shall provide protection as follows: All modes, L-N or L-L, L-G and N-G (where applicable). Note: L = Line, G = Ground, N = Neutral

PART 2- PRODUCTS

2.1 ENCLOSURE FOR EXTERNAL SPD'S

The unit case shall be an enclosure rated to NEMA 4 standards.

2.2 CONNECTIONS FOR EXTERNAL SPD'S

The unit shall be designed to be installed using the flexible conduit provided by the SPD / TVSS

manufacturer.

2.3 STANDARD FEATURES

A. Unit Status Indicators - The unit shall have an integral status circuit that monitors the operational status of all modes of protection, including Line to Neutral, Line to Ground and Neutral to Ground. No manual testing is required to confirm the integrity of the suppression and filter systems. If the unit does fail, the green LED will go out and the red LED will be lit.

B. Audible Alarm - Unit shall be equipped with an audible alarm that is activated during a fault condition. In conjunction with the alarm, an alarm enable/disable feature shall be provided to silence the alarm.

2.5 MANUFACTURERS:

Subject to compliance, the following manufacturers are acceptable:

1. Innovative Technology
2. Datek
3. Liebert (Emerson)
4. Eaton
5. Square D
6. GE

PART 3 - EXECUTION

3.1 INSTALLATION:

A. The installing contractor shall connect the SPD / TVSS in parallel to the power source. The contractor shall follow the SPD / TVSS manufacturer's recommended installation practices and comply with all applicable codes.

B. At distribution, MCC and branch panelboards, SPD / TVSS shall have an independent means of servicing disconnect such that the protected panel remains energized. A 30A breaker shall serve this function.

C. SPD / TVSS shall be installed on the load side of the main service disconnect.

D. Before energizing, installer shall verify service and separately derived system Neutral to Ground bonding jumpers per NEC.

E. All parallel connections to the SPD / TVSS shall be kept as short as possible (less than 24"). The connection to the SPD / TVSS shall be made using #10 AWG (ring terminal shall be provided). The contractor shall twist the SPD / TVSS input conductors together to reduce input conductor impedance.

F. SPD / TVSS units shall be mounted adjacent to surface mounted panels. Flush mounted panels which are noted elsewhere in these contract documents to have TVSS/SPD protection shall have integral units with performance characteristics as close as possible to that specified for the external units described in this specification. Integral TVSS/SPD units shall be furnished by the panelboard manufacturer.

G. External TVSS units shall be installed and tested when panelboards are initially energized. Test results shall be documented and forwarded to the engineer and after initial testing, feeding breakers shall be turned off until substantial completion or as

directed by the owner.

3.2 WARRANTY

The manufacturer shall provide a 10-year parts limited warranty from date of shipment against failure when installed in compliance with manufacturer's written instructions, UL listing requirements, and any applicable national or local electrical codes. Manufacturer shall make available for consultation, local engineering service support.

END OF SECTION 264313

SECTION 265100 - LIGHTING FIXTURES

PART 1 - GENERAL

1.1 SCOPE OF WORK:

A. Electrical Contractor shall furnish all luminaries, lighting equipment and components shown on the Plans, listed in the fixture schedule, and specified herein. He shall furnish all labor and materials required to install specified equipment in the manner indicated. All luminaries and lighting equipment shall be delivered to the building complete with suspension accessories, canopies, hickeys, casings, sockets, holders, reflectors, ballasts, diffusing material, louvers,plaster frames, recessing boxes, etc., all wired and assembled as indicated.

1.2 LISTING REQUIREMENTS:

A. All fixtures shall be listed for the installed location shown of the plans.

1.3 SUBMITTAL REQUIREMENTS:

A. Request for Substitutions:

1. Refer to the “Basic Materials and Methods” specification for details and requirements.

B. Product Submittals and shop drawings:

1. Refer to the “Basic Materials and Methods” specification for details and requirements.

2. All lamps and ballasts require performance documentation to be submitted which shows the combined system performance.

C. As-Built Drawings:

1. Refer to the “Basic Materials and Methods” specification for details and requirements.

1.4 BASIS OF DESIGN:

A. The basis of design of fluorescent lamps and ballasts is OSRAM-Sylvania. Products with identical features and performance which are manufactured by Philips or GE are acceptable.

B. LED lamps and drivers shall be energy efficient and shall be suitable for interior and exterior installations as scheduled. They shall be compatible with the designed lighting controls.

1.5 OPERATIONS AND MAINTENANCE REQUIREMENTS:

A. Refer to the “General Completion, Electrical” specification for details and requirements.

PART 2 – PRODUCTS

2.1 MANUFACTURERS:

A. Refer to the light fixture symbol schedule on the drawings.

B. Fixtures of other manufacturers may be acceptable provided they offer equal or superior performance and quality and are approved for substitution. Contractors seeking substitutions shall be in a position to furnish samples of both specified and alternate equipment for comparison, if required.

2.2 STANDARD FEATURES:

A. Luminaries shall be wired as per the National Electrical Code. No splice or tap shall be located within arm, stem, or chain. Wire shall be continuous from splice in outlet box of the building wiring system to lamp socket or ballast terminals. All fluorescent ballasts, as indicated, shall be of the high-power-factor Class P Type and their design and construction shall conform to Certified Ballast Manufacturer's Standards. Provide regulating, HPF ballasts in H.I.D. lighting fixtures.

B. Catalog numbers given are not necessarily total fixture specification. The general description, type and number of lamps, and pertinent details are to be considered in determining the appearance, performance and quality intended. Any major discrepancies in any particular fixture specification should be reported to the Architect prior to submitting a proposal.

C. Exterior light poles shall be furnished with hand hold covers and mounting bolt covers secured with stainless-steel tamper-proof fasteners.

2.3 OPTIONAL EQUIPMENT:

A. Where indicated elsewhere on the drawings, fixtures are shown to have emergency ballast on the drawings, they shall be of the type indicated below:

1. Recessed, linear fluorescents – Bodine B30.

2. Surface a flange mounted linear fluorescents – Bodine B50 or B50LP.

3. Linear fluorescents which are indicated to have cold weather ballasts – Bodine B50 cold pack.

4. Compact fluorescent – Bodine B4CFG.

5 Compact fluorescent fixtures which are indicated to have cold weather ballasts – Bodine B4CF1, B4CF2, or B4CF3.

B. Lamps shall be furnished and installed by the electrical contractor for all fixtures throughout the project, whether or not furnished by the contractor.

2.4 ADDITIONAL FIXTURES:

A. If indicated elsewhere on the drawings, additional fixtures shall be furnished in the quantities listed below, and installed in locations as directed by the engineer. Fixtures not installed shall be given to the owner for use as spares. Additional fixtures shall match those installed in every way.

1. Emergency lights – 2% of the number of fixtures shown on the lighting plans.

2. Exit Signs – 2% of the number of fixtures shown on the lighting plans.

PART 3 - EXECUTION

3.1 INSTALLATION

A. For installations in which occupancy sensors are specified, the following shall apply.

1. Upon completion of the installation, the system shall be completely commissioned by the manufacturer's factory authorized technician who will verify all adjustments and sensor placement to ensure a trouble-free occupancy-based lighting control system. Labor and materials necessary to adjust the sensor locations shall be by the electrical contractor.

2. The commissioning shall be scheduled prior to occupancy but after mechanical units are in operation and, whenever possible, after furniture has been installed. The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the desired commissioning date.

3. At the time of the system commissioning, the factory authorized technician shall provide the proper training to the owner's personnel in the adjustment and maintenance of the sensors.

B. Connect recessed lighting fixtures to outlet boxes by means of a 6 foot piece of flexible metal conduit, 1/2 inches minimum. Branch circuit shall be routed to tap box above fixture with flexible metal conduit down to fixture. Routing from fixture end to fixture end will not be accepted. Boxes above fixtures shall be no more than 24” above the fixture. Whips shall not be resting on the ceiling tiles or ceiling grid. Support wires used to keep whips off the grid or tiles shall be orange in color.

C. Light fixtures shall be supported independently from building structure. Fixtures shall not utilize ceiling system for support. Provide four (4) supports per fixture. Contractor may use chain or 9 gauge galvanized hanger wire.

D. Electrical contractor shall clean all light fixture lenses and replace any spent lamps prior to substantial completion. Labor and materials shall be the responsibility of the electrical contractor.

E. Where wall mounted emergency lights are used, the electrical contractor shall furnish and install phenolic label on each emergency light. The label shall have a unique number to identify the emergency light to facilitate maintenance record keeping.

F. Electrical contractor shall grout under exterior light poles after leveling.

3.2 LABELING

A. Electrical contractor shall furnish and install unique numeric label on each wall mounted emergency light unit to facilitate maintenance and record keeping of the unit. Labels shall be phenolic and comply with the nameplate requirements of the general completion specifications.

3.3 WARRANTY:

A. All fixtures and ballasts shall be warranted for 1 year from the date of substantial completion. During this period, the electrical contractor shall furnish labor and materials necessary to replace failed fixtures.

B. All lamps with a published average rated life in excess of 10,000 hours shall be included in the warranty requirements of section 3.02 A.

END OF SECTION 265100

SECTION 270528 – TELECOMMUNICATIONS INFRASTRUCTURE

PART 1 - GENERAL:

1.1 SCOPE OF WORK:

A. This section of the specifications covers the complete telecommunication and technology system infrastructure indicated on the drawings or as specified herein. Provide all materials, labor, equipment and supervision to install electrical systems.

B. The work shall consist of, but not be limited to, the installation of the following systems:

1. Data communication system.
2. Telephone system.
3. Public Address system.
4. Security cameras
5. Access Control
6. Intrusion
7. Wireless
8. Audio Visual

1.2 CODE COMPLIANCE:

A. All electrical work shall be in accordance with the following codes and agencies:

1. The National Electrical Code (NFPA 70) - Latest Edition.
2. The National Electrical Safety Codes (ANSI C-2) - Latest Edition.
3. ANSI/TIA/EIA-568-B, 569, 606,607.
4. FCC Federal Communications Commission
5. OSHA (Standards 29 CRF) Telecommunications – 1910.268
6. South Carolina Department of Education - Office of School Facilities (OSF) Planning and Construction Guide – Latest edition
7. Technology specifications of the owner.

B. Safety requirements must be met. In the event of conflict between or among such codes/requirements, the more stringent shall apply.

1.3 GUARANTEE:

A. All work and materials shall be guaranteed for a period of one year from date of acceptance by the Owner.

1.4 DRAWINGS:

A. The drawings indicate the arrangement of electrical low voltage equipment. The Contractor shall review architectural drawings and those of other trades to identify the location of any features, which may interfere with the installation of systems covered in this specification.

B. Discrepancies shown on different drawings, between drawings and specifications, or between documents and field conditions shall be promptly brought to the attention of the CCSD IT department.

C. As Built Drawings shall be furnished as required by other sections of this specification. In addition, as built drawing shall conform to the following:

1. Updated drawings shall be clearly marked and be legible.

1.5 SITE INVESTIGATION:

A. Prior to submitting bids of the project, visit the work site to become familiar with existing conditions that may affect the cost of the project.

1.6 SHOP DRAWINGS:

A. The Contractor shall submit for review by the Engineer, a complete schedule with engineering data on materials and equipment to be incorporated in the work. Submittals shall be supported by descriptive materials (i.e., catalog sheets, product data sheets, diagrams, performance curves, and charts published by the manufacturer) to show conformance to specifications and drawing requirements. Complete electrical characteristics shall be provided for all equipment. The Engineer reserves the right to require a sample of any equipment to be submitted for approval.

B. Each submittal item for materials and equipment shall be marked to show specification section and paragraph number that pertains to the item.

C. Prior to submitting shop drawings, review the submittal for compliance with the Contract Documents and place a stamp or other confirmation thereon that states that the submittal complies with Contract requirements. Submittals without such verifications will be returned disapproved without review.

D. Submittals shall be made for each of the following items:

1. Cable Trays (if shown on plans)
2. Conduits
3. Fire Wall Penetrations
4. Grounding and Bonding components
5. Cable Tray Supports

E. All equipment items shall be included in one shop drawing submittal.

1.7 TESTS:

A. At the time of final inspections, all electrical systems shall be tested for compliance with the specifications. The contractor shall provide personnel and equipment required to assist the Engineer or his representative in conducting the tests.

B. Equipment covers shall be removed for internal inspection.

1.8 MATERIALS:

A. Materials or equipment specified by manufacturer's name shall be used unless approval of other manufacturers is listed in addendum to these specifications. Request for approval of substitute materials shall be submitted in writing to the Engineer at least ten days prior to bid opening.

1.9 GENERAL INSTALLATION:

A. Any tiles that are damaged during the installation process must be replaced and installed by the contractor. New tiles must match the type and design of the adjacent areas.

B. Any grid members that are damaged during the installation process must be replaced and installed by the contractor.

C. Any areas of wall surfaces and solid ceilings that may become damaged during the installation process shall be restored to their original finish. (i.e. must match the appearance of the adjacent surfaces)

D. Brick penetrations must be patched with a mortar that matches the color of the brick.

E. Fire stopping products and Silicone type sealants shall not be used to seal masonry penetrations.

F. All work shall be performed in a neat and workman like manner. All methods of construction, details of workmanship that are not specifically described or indicated shall be subject to the approval of the Engineer.

G. Any disruption in service (data. phone, PA, etc.) must be scheduled and coordinated with the owner and the Engineer.

PART 2 – PRODUCTS:

2.1 CABLE TRAY (if shown on plans):

A. Cable Tray size and type shall be as shown on the plans.

B. Approved cable tray manufacturers shall be as shown on the plans.

2.2 CONDUITS:

A. Conduits for technology shall not be smaller than 1” in diameter for new construction and 1 ¼” for connection to surface mounted raceways in existing construction.

B. “LB’s” or other tight 90-degree fittings shall not be used.

C. Conduit used for technology systems shall also conform to the conduit specification.

2.3 FIRE WALL PENETRATIONS:

A. Approved discontinuous fire stopping systems are as follows:

1. Specified Technologies “EZ Path” systems. Install 4” EZ-Path devices in triplex wall plates at each fire wall penetration. Rating of the devices shall match or exceed the rating of the wall.

2. Four 4” sleeves installed as per the appropriate U.L. detail.

B. Approved continuous fire stopping systems are as follows:

1. CSD sealing systems “FSP” unit supplied by Seaco Industries. Utilize one unit for 1 & 2 hour walls and 2 units for 4 hour walls.

2.4 UNDERGROUND PATHWAYS

A. Hand Hole Enclosures, boxes and covers are required to conform to all test provisions of the most current ANSI/SCTE 77 “Specification For Underground Enclosure Integrity” for Tier 22 applications when installed in vehicular traffic areas and tier 15 applications in other areas.

B. The hand holes shall physically accommodate and structurally support compatible covers while possessing the Tier rating. The hand hole covers shall have the Tier level rating embossed on the surface. In no assembly can the cover design load exceed the design load of the box.

C. The hand hole covers shall have a minimum coefficient of friction of 0.05 in accordance with ASTM C1028 and the corresponding Tier level embossed on the top surface.

D. The hand hole components in an assembly (box & cover) shall be manufactured using matched surface tooling.

E. Independent third party verification or test reports stamped by a registered Professional Engineer certifying that all test provisions of this specification have been met are required with each submittal.

F. The hand hole boxes and covers shall be constructed of polymer concrete.

PART 3 - EXECUTION:

3.1 GROUNDING:

A. A Telecommunications Main Grounding Busbar (TMGB) shall be installed in the primary telecommunications room. It shall serve as the dedicated extension of the building grounding electrode system for the telecommunications infrastructure, and serves as the central attachment point for telecommunications bonding backbones (TBB) and equipment. The Telecommunications Main Grounding Busbar (TMGB) shall:

1. Be a pre-drilled copper busbar provided with standard NEMA bolt hole sizing and spacing for the type of connectors to be used and shall have 2” standoff insulators, and stainless steel brackets and fasteners.
2. Have minimum dimensions of ¼” thick x 4” wide and 24” long.
3. Be bonded to the main service entrance equipment (power) ground with a Bonding Conductor sized per the table below for a TBB.
4. Be ASTM B187-C11000 listed for use.

5. Where a panelboard for telecommunications is located in the same room or space as the TMGB, that panelboard's Alternating Current Equipment Ground (ACEG) bus or the enclosure shall be bonded to the TMGB with a No. 6 AWG Bonding Conductor.
6. All equipment racks, housings, messenger cables, and metallic raceways for telecommunications cabling, located within the same room or space as the TMGB shall be bonded to the TMGB with a No. 6 AWG Bonding Conductor.
7. In buildings where the metal frames (structural steel) are effectively grounded, the TMGB shall be bonded to the metal frame using a No. 6 AWG conductor.

B. A Telecommunications Grounding Busbar (TGB) shall be installed in each Telecommunication Room and shall serve as the common central point of connection for telecommunications systems and Equipment. The Telecommunications Grounding Busbar (TGB) shall:

1. Be a pre-drilled copper busbar provided with standard NEMA bolt hole sizing and spacing for the type of connectors to be used and shall have 2" standoff insulators, and stainless steel brackets and fasteners.
2. Have minimum dimensions of ¼" thick x 2" wide and 12" long.
3. Be bonded to the nearest electrical panel with a No. 6 AWG Bonding Conductor.
4. Be ASTM B187-C11000 listed for use.
5. All equipment racks, housings, messenger cables, and metallic raceways for telecommunications cabling, located within the same room or space as the TGB shall be bonded to the TGB with a No. 6 AWG Bonding Conductor.
6. In buildings where the metal frames (structural steel) are effectively grounded, each TGB shall be bonded to the metal frame using a No. 6 AWG conductor.

C. A Telecommunications Bonding Backbone (TBB) shall originate at the TMGB, and extend throughout the building using the telecommunications backbone pathways, and connects to the Telecommunications Grounding Busbar TGB(s) in each Telecommunication Room. The Telecommunications Bonding Backbone (TBB) shall:

1. Be consistent with the design of the telecommunications backbone cabling system.
2. Permit multiple TBB's as dictated by the building size.
3. Be continuous and routed in the shortest possible straight-line path.
4. Be bonded to all cable trays between Telecommunication Rooms.
5. Be an insulated copper conductor sized per the following table:

TBB length (ft)	TBB size AWG
0-13	6
14-20	4
21-26	3
27-33	2
34-41	1
42-52	1/0
53-66	2/0
67+	3/0

D. The connections of the bonding conductors to the TMGB and TGB's shall utilize listed 2-hole compression connectors, exothermic type welded connections, or equivalent. Mechanical lugs shall not be installed.

E. Cable trays (if shown on plans) shall be electrically continuous. A 10 awg bonging jumper shall be connected between trays which are not in physical contact.

3.2 FIREWALL PENETRATION SYSTEMS AND SLEEVES:

A. Openings to accept sleeves or firewall penetration systems in new building construction shall be installed during building construction by the General Contractor.

B. Openings to accept sleeves or firewall penetration systems in existing building construction shall be provided under this division of the Specifications.

C. Use galvanized rigid conduit/ for penetrations through exterior masonry/concrete walls and foundations, concrete floor slabs on grade and above grade, and concrete-filled decks.

D. Use only fire-rated listed assemblies for the type of sleeve or firewall penetration systems being installed through CMU walls or gypsum walls for communications penetrations. Sleeve type shall be galvanized rigid conduit or electrical metallic tubing.

E. Split, fit, and weld sleeves over existing conduits where necessary.

F. Secure sleeves or firewall penetration systems firmly in place using filling and patching materials (mortar) that match with surrounding construction. Fire stop material shall not be used to fill large voids.

G. In floor penetrations, extend sleeve 1” to 3” above finished floor unless noted otherwise.

H. Seal voids between sleeves and building construction with joint sealants. Make allowances for and coordinate the work with installation of fire stopping, conduit insulation, and waterproofing, as applicable.

I. The Contractor shall be fully responsible for final and correct location of sleeves or firewall penetration systems.

J. If Cable trays are installed and utilize discontinuous fire stopping systems, they shall stop a maximum of 12” from firewalls and transition to the approved firewall penetration system. Cable trays shall be electrically continuous. A 10 awg bonging jumper shall be connected between trays which are not in physical contact.

K. Corridor sleeves shall have a diameter of 4” unless directed to change by a licensed structural engineer.

L. A minimum of four (4) 4” sleeves is required into all telecommunication rooms. Additional sleeves shall be installed as needed.

M. All telecommunications sleeves shall be sealed with a re-enterable sealant whenever possible. Caulk may be utilized around the outer surface of the sleeve, but not inside the sleeve. Non-hardening putty is the preferred material to seal the inside of the sleeve.

3.3 ABANDONED CABLES:

A. All unused (abandoned) cables shall be removed from the ceiling and riser areas.

B. Any cables that are identified outside the scope of each project should be reported to the owner. The additional cables may be added as an alternate to the original scope if deemed necessary.

C. The contractor shall remove the cables, and arrange for off-site disposal.

D. All open wall penetrations that result from the removal of abandoned cables shall be properly sealed.

3.4 CONDUITS:

A. Conduits shall be installed from each communication outlet to the cable tray (if shown on plans) or to the nearest telecommunication backboard if cable trays are not used.

B. Conduits shall be directly connected to surface mount fittings using a direct connect method.

C. Flex-conduit shall not be used for telecommunications pathways without the written approval of the CCSD IT department.

D. No more than two 90 degree bends are allowed between pull boxes.

E. Conduit shall used for technology systems shall conform to the conduit specification.

F. All data conduits shall be routed above grade where possible. Where data conduits are indicated on the plans to be routed below grade of where data outlets are shown in locations without overhead access, the electrical contractor shall ensure that all conduits are blown free of water and sealed prior to installation of cables.

3.5 CABLE TRAY (if shown on plans):

A. Tray shall be mounted in the corridor ceiling space to one side as shown on plans. Tray shall not be located in the center of the corridor.

B. Installation of cable tray shall be coordinated with plumbing water lines, light fixtures, HVAC duct work and any architectural features of the building.

C. Turn downs shall be installed in all data and server rooms.

D. A bonding jumper shall be installed to connect any mechanical discontinuities in the cable tray system and any space between the cable tray system and the conductor termination equipment enclosure or its equipment ground bus.

E. The cable tray is for cables and shall not be used by any other trade. The electrical contractor shall provide conduit raceways for all special systems including but not limited to fire alarm, public address, security, CCTV, LVLC etc.

3.6 UNDERGROUND PATHWAYS:

A. It is the responsibility of the contractor to contact a service locator to mark all existing cables and conduits. The contractor assumes all responsibility for damage to underground facilities and services.

B. Manholes / Handholes should be installed where necessary to provide pulling points, and splicing access. All cover must be marked with a “Communications” label. Locate devices out of the normal flow of foot or vehicle traffic.

C. Hand holes and man holes shall be installed such that the top of the cover is flush with the finished grade. Hand holes and man holes shall be installed on a minimum 6” bed of compacted pea gravel.

3.7 BACKBOARDS:

A. Telecommunication backboards shall be located and sized as per the plans. They shall be painted with a fire resistant paint with color to match wall.

END OF SECTION 270528

SECTION 275319 – EMERGENCY RESPONDER RADIO ANTENNA/REPEATER SYSTEM

PART 1 - GENERAL:

1.1 SCOPE OF WORK:

A. Evaluate the facility to determine the emergency responder radio coverage within the building and if necessary, install, and test a complete and operating Emergency Responder Radio Antenna/Repeater System. The system will support the emergency radio system in use by the local first responders at the location of the building and no others. Provisions for supporting other public radio systems; cell phone carriers; the Owners' private security and/or maintenance personnel radio systems, etc. shall not be included.

B. This Section includes the requirements for an Emergency Responder Radio Antenna/Repeater System for the purposes of amplifying Emergency Responder radio signals to achieve minimum signal strength in 95% of all areas on each floor of the building.

C. Final acceptance and approval is required from the local Fire Department in writing prior to contract closeout.

D. Section Includes
1. Bi-directional amplifiers (BDA's)
2. Distributed Antenna System
3. Coaxial cables
4. Splitters and direction couplers
5. UPS
6. All other equipment and components necessary for a complete and functioning Emergency Responder Radio Antenna/Repeater System.

1.2 CODE AND STANDARD COMPLIANCE:

A. All electrical work shall be in accordance with the following codes and agencies:

1. NFPA 1 – The National Fire Code (including Annex O from 2009)
2. NFPA 70 – The National Electrical Code
3. FCC Rules Part 22, Part 90 and Part 101.
4. NFPA 101, Life Safety Code,
5. NFPA 72 National Fire Alarm Code
6. FCC 47 CFR Private Land Mobile Radio
7. 90.219-2007 Services-Use of Signal Boosters
8. IFC International Fire Code, Code and Commentary
9. FCC's OET 65 Standards "Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields".
10. ADA "Americans with Disabilities Act"

1.3 DEFINITIONS:

A. Definitions:

1. Bi-Directional Amplifier BDA: Device used to amplify band-selective or multi-band RF signals in the uplink, to the base station for enhanced signals and improved coverage.

2. Emergency Responder Radio Coverage System: A two-way radio communication system installed to assure the effective operation of radio communications systems for fire, emergency medical services or law enforcement agencies within a building or structure. A system used by firefighters, police, and other emergency services personnel.

3. Delivered Audio Quality Definitions (DAQ): This is a universal standard often cited in system designs and specifications.
   a. DAQ 1: Unusable, speech present but unreadable.
   b. DAQ 2: Understandable with considerable effort. Frequent repetition due to noise/distortion.
   c. DAQ 3: Speech understandable with slight effort. Occasional repetition required due to noise/distortion.
   d. DAQ 3.5: Speech understandable with repetition only rarely required. Some noise/distortion
   e. DAQ 4: Speech easily understood. Occasional noise/distortion.
   f. DAQ 4.5: Speech easily understood. Infrequent noise/distortion.
   g. DAQ 5: Speech easily understood. Coupled Bonding Conductor (CBC) – The term "Coupled Bonding Conductor" shall mean a bonding conductor placed, e.g. strapped, on the outside of any technology cable, used to suppress transient noise.

4. FCC: Federal Communications Commission

5. OET 65 Standards: FCC's Bulletin 65 provides Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.

6. Public Safety/First Responder: Public Safety or First Responder agencies which are charged with the responsibility of responding to emergency situations. These include, but are not limited to: law enforcement departments, fire departments, and emergency medical companies.

1.4 QUALITY ASSURANCE:

A. Installer Qualifications: Engage an experienced factory-authorized installer to perform work of this Section. Installer shall have a valid FCC General Radiotelephone Operator License (GROL).

B. Single-Source Responsibility: Obtain radio system components from a single source who assumes responsibility for compatibility of system components.

C. All equipment shall be UL listed and labeled, and in accordance with applicable NEMA and ANSI Standards. Where copper cabling is routed to an area, either in another building, or with a separate electrical service, the Technology Contractor shall provide primary protective equipment.

D. All racks and enclosures shall be either welded or assembled with paint piercing ground washers, grounding strip and bonding jumper as indicated on the Drawings.

E. Installer shall have a valid FCC issued general radio operator’s license.

F. Installer shall have certification of in-building system training issued by a nationally recognized organization, school or a certificate issued by the manufacturer of the equipment being installed.

1.5 SUBMITTAL REQUIREMENTS:

A. Request for substitutions:

1. Refer to the "Basic Materials and Methods" specification for details and requirements.

B. Product Submittals and shop drawings:

1. Refer to the "Basic Materials and Methods" specification for details and requirements.

2. Submit product data for each type of proposed system component specified, including dimensioned drawings showing minimum clearances and installed features.

3. Provide copies of manufacturer specification sheets of all system components, including:
   a. Amplifiers
   b. Antennas
   c. Coaxial cable, couplers, splitters, combiners, or other passive components
   d. Backup battery and charging system.

4. Pass band curves in for the uplink and downlink portions of the NPSPAC band for any amplifiers, if not included in #3. Amplifiers may NOT amplify portions of other licensed services, including Nextel and Specialized Mobile Radio Licensee band, or Cellular A or B bands.

5. Submit wiring diagrams from manufacturer differentiating clearly between factory and field-installed wiring. Include diagrams for each component of the system with all terminals and interconnections identified. Make all diagrams specific to this Project.

6. Submit product certificates signed by the manufacturer of radio system components certifying that their products comply with specified requirements.

7. Submit written certification from the local fire department indicating the frequency band(s) & channels utilized for emergency responder communication.

C. Coordination drawings:

1. Component specification sheets shall be 8.5 inch x 11 inch or greater, scaled or dimensioned, with dimensions or scale clearly noted.

2. Floor plan drawings shall be 24 inch x 36 inch minimum with drawings scaled to legible size.

3. Floor plan drawings may include elevation detail names for each elevation view. Sheet title shall include site name, address, sheet number, floor plan number and north arrow. Include site plan view of the subject buildings and surrounding property to clearly indicate the

location and orientation of roof mounted outdoor antennas associated with the proposed system.

4. Include a minimum of (1) building elevation depicting the location of any outdoor antennas associated with the proposed system. Include height of antenna centerline above building, orientation, and location of all external grounding connections.

5. Include a detail plan view of all Telecommunications Spaces housing head-end and/or other consolidated equipment, showing the location of the rack(s) and/or enclosure(s) of the Emergency Responder Radio Antenna/Repeater System equipment.

6. Include a separate plan view of each interior floor where indoor antenna systems are proposed. Include antenna numbers, coaxial cable routes, and the locations of any other system components including splitters, couplers, filters, amplifiers, etc. All components shall be named or labeled for reference in power budget calculations tables. Overlay approximated coverage radii indicating –95 dBm downlink (base to mobile) signal strength around each proposed indoor coverage antenna. Include results of any previous coverage testing per grid, if available.

7. Include a minimum of one (1) detail elevation view(s) of all rack(s) and/or enclosure(s) housing the Emergency Responder Radio Antenna/Repeater System equipment. Identify each piece of equipment by brand, model number and equipment type (e.g. Acme BA123 RF amplifier).

8. Specify antenna grounding and surge protection in accordance with NEC Article 810.

9. Specify the backup power source (Life Safety), and include calculations to ensure the backup power requirements as specified in this standard are met.

10. Design Approval: Plans shall be submitted and approved prior to installation. The following information shall be provided to the local Fire Department unit representative by the system designer/Contractor:
    a. A minimum of three (3) copies of detailed drawings showing the location of the amplification equipment and associated antenna systems which includes a view showing building access to the equipment; and
    b. A minimum of three (3) copies of schematic drawings of the electrical system, backup power, antenna system and any other associated equipment relative to the amplification equipment including panel locations and labeling.
    c. A minimum of one (1) copy of the Manufacturer's data sheets on all equipment to be installed.

D. As-Built drawings:

1. Refer to the “Basic Materials and Methods” specification for details and requirements.

1.6 OPERATIONS AND MAINTENANCE REQUIREMENTS:

1. Operation and maintenance data. Record of field tests of the radio system shall be included in the operation and maintenance manuals.

2. Maintenance data for radio system shall be included in the operation and maintenance manual. Include data for each type of product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations that carry stock of repair parts for the system to be furnished.

PART 2 – PRODUCTS:

2.1 MANUFACTURERS:

A. Subject to compliance with requirements, available Integrators offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. CommScope/Andrew
   2. Corning
   3. Times Microwave
   4. G-Wave
   5. CCI (Communication Components Inc.)
   6. Solid Technologies

2.2 STANDARD FEATURES:

A. Compatibility: The equipment, including but not limited to repeaters, transmitters, receivers, signal boosters, cabling, fiber distributed antenna system, etc., shall not interfere with the existing communication systems utilized by the Public Safety and First Responder agencies or other public radio and cellular systems.

B. Power Supplies: At least two (2) independent and reliable power supplies shall be provided, one primary and one secondary. The primary power source shall be supplied from a dedicated 20 ampere branch circuit and comply with NFPA 72. The secondary power source shall be a dedicated battery, capable of operating the in-building radio system for at least 24 hours of 100% system operation. The battery system shall automatically charge in the presence of external power input. The battery system shall be contained in one NEMA 4 or 4X type enclosures. Monitoring the integrity of power supplies shall be in accordance with NFPA 72.

C. Survivability

   1. Physical Protection: All wiring and fiber optics shall be installed in metallic conduit. Refer to the Conduit specification found elsewhere in these contract documents for type, sizing and installation standards.

   2. Fire Performance: All main risers or trunks of the antenna system shall be installed with resistance to attack from a fire using one of the following methods:
      a. A 2-hour fire rated cable or cable system.
      b. Routing the cable through a 2-hour fire rated enclosure(s) or shaft(s).
      c. A system configured in a looped design, routed through 1-hour fire rated enclosure(s) or shaft(s). The circuit shall be capable of transmitting and receiving a signal during a single open or non-simultaneous single ground fault on a circuit conductor.

3. Cabinet: The signal booster and all associated RF filters shall be housed in a single, NEMA 4 certified, painted steel weather tight box. The cabinet shall be large enough to dissipate internal heat without venting the inside of the cabinet to the outside atmosphere. Operating temperatures: –22 degrees F to +120 degrees F (–30 degrees C to +50 degrees C) minimum temperature range, including microprocessors. Equipment installed on the roof of structures shall be rated for the expected extreme temperatures associated with rooftop installations.

4. Passive Equipment: Passband shall be 700-900 MHz, IP rating of 2 GHz.

5. Cable: Passband shall be 700-900 MHz. Cable shall be rated for fire plenum and riser rating.

2.3 MATERIALS AND COMPONENTS:

A. Signal Strength
   1. Downlink: A minimum signal strength of -95 dBm shall be provided throughout the coverage area.

   2. Uplink: Minimum signal strength of -95 dBm received at the local Fire Department Radio System from the coverage area.

   3. A donor antenna must maintain isolation from the distributed antenna system. The donor antenna signal level shall be a minimum of 15 dB above the distributed antenna system under all operating conditions.

B. Permissible Systems

   1. Buildings and structures shall be equipped with an FCC Certificated Class B Bi-Directional (700-800 MHz) Amplifier(s) as needed.
   2. The distributed antenna system may utilize a radiating cable, fixed antennas or a combination of both.

C. Supported Frequencies: The radio system shall support frequencies in the 700 and 800 MHz public safety bands as utilized by the local Fire Department.

D. Reject Filters: Notch filter sections shall be incorporated to minimize adjacent channel cellular and SMR (Nextel) degradation of the signal booster performance. The minimum downlink band adjacent band rejection shall be 35 dB or greater at 865 MHz and 870 MHz.

E. Band Migration Capability: The signal booster shall include re-tunable or replaceable filters to accommodate rapid and economic passband changes in the event of mandatory FCC changes within the NPSPAC band. The use of non-adjustable and non-replaceable RF input and output filters is prohibited.

F. Output Level Control: An automatic output leveling circuit shall be included for both passbands with a minimum dynamic range of 60 dB, less any gain reduction setting, to maintain FCC out of band and spurious emission compliance.

G. Degraded Performance in Emergencies: The system shall be designed to allow degraded performance in adverse conditions, such as abnormally high temperatures resulting from nearby

fires, extreme voltage fluctuations or other abnormal conditions that may occur during an emergency. Circuits that intentionally disable the signal booster in such situations (i.e. under/over voltage, over/under current, over/under temperature, etc.) will not be implemented as the standard mode for public safety applications.

H. Mode of Operation: The system shall be normally powered on and shall continuously provide passing of frequencies within the Public Safety and First Responder bands.

I. All in-building radio systems shall be compatible with both analog and digital communications simultaneously at the time of installation.

2.4 SYSTEM MONITORING:

A. The distributed antenna system shall include a connection to the fire alarm system to monitor the integrity of the circuit of the signal booster(s) and power supplies and annunciate this malfunction on the fire alarm system shall comply with NFPA 72.

B. A sign shall be located at the fire alarm panel with the name and telephone number of the local Fire Department indicating that they shall be notified of any failures that extend past the 2 hour time limit.

PART 3 - EXECUTION:

3.1 APPROVED INSTALLERS & INTEGRATORS:

A. The following installers and integrators are approved to design, install, and test the Emergency Responder Radio Antenna/Repeater System as detailed and required in this specification:

1. Radio Communications of Charleston SC

2. Mount Pleasant Radio of Charleston SC

3. Mobile Communications America.

4.. Other Equals by prior approval.

3.2 INSTALLATION:

A. Distribution System Signal Wires and Cables
1. Wires and cables shall enter each equipment enclosure, console, cabinet or rack in such a manner that all doors or access panels can be opened and closed without removal or disruption of the cables.

2. Routing and Interconnection
   a. Wires or cables routed between consoles, cabinets, racks, and other equipment shall be installed in an approved conduit or cable tray that is secured to building structure.
   b. Completely test all of the cables after installation and replace any that are found to be defective.

3. Install cables without damaging conductors, shield, or jacket.

4. Do not bend cables, while handling or installing, to radii smaller than as recommended by manufacturer.

5. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

B. Product Delivery, Storage, and Handling
1. Delivery: Deliver materials to the job site in OEM's original unopened containers, clearly labeled with the OEM's name and equipment model and serial identification numbers.

2. Store and protect equipment in a conditioned space until installation.

C. System Installation
1. Coaxial antenna cabling shall not be installed in the same conduit used for other systems.

2. All equipment shall be connected according to the OEM's specifications to insure correct installation and system performance.

3. Coordinate all roof penetrations with Owner and/or roofing contractor.

3.3 GROUNDING
A. Ground cable shields and equipment per Manufacturer's requirements.

B. Antenna mast shall be grounded per NFPA 70 NEC requirements, the Grounding specifications found elsewhere in these contract documents and antenna manufacturer's requirements. Provide grounding blocks and surge protection for outside coaxial cabling. Bond the antenna mast to the existing grounding system.

3.4 TESTING:
A. The local Fire Department will review plans and specifications. Upon acceptance, plans will be stamped to indicate approval. Stamped plans are required to be present at the acceptance test. Any field changes that occur during construction shall be incorporated into new As-Built plans, including any manufacturer's data sheets for any equipment changes not submitted in the original submittal. As-Built plans, if required due to system changes, shall be submitted to the local Fire Department for approval.

B. Tests shall be made using frequencies close to the frequencies used by the Fire Department and appropriate emergency services. If testing is done on the actual frequencies, then this testing must be coordinated with the local Fire Department unit. All testing must be done on frequencies authorized by the FCC. A valid FCC license will be required if testing is done on frequencies different from the police, fire or emergency medical frequencies.

C. Testing Procedures
1. Minimum Signal Strength: For testing system signal strength and quality, the testing shall be based on the delivered audio quality (DAQ) system. A DAQ level below 3.0 shall be considered a failed test for a given grid cell.

2. Measurements shall be made with the antenna held in a vertical position at 3 to 4 feet above the floor to simulate a typical portable radio worn on the belt or turnout coat pocket.

D. Preliminary Site Assessment Testing
1. Once building envelope has been completed, the emergency responder radio antenna/repeater System contractor shall evaluate the existing signal strength throughout the facility using the testing procedures outlined elsewhere in these specifications.

2. Results of these tests shall be presented to the Engineer within one week of testing. Installation of an Emergency Responder Radio Antenna/Repeater System shall not commence until authorized by the Engineer.

E. Final Acceptance Testing
1. All acceptance testing shall be done in the presence of a local Fire Department representative or by the local Fire Department unit at no expense to the Owner.

2. Small scale drawings (11 inch x 17 inch maximum) of the structure shall be provided by the Contractor to the Owner. The plans shall show each floor divided into the grids as described above, and the results of the pre-testing. Each grid shall be labeled to indicate the DAQ result from the final acceptance testing.

3. The Contractor shall provide the latest approved plans for the system, including any manufacture's data sheets for any equipment changes not submitted in the original submittal to the Owner.

4. Include testing results of the repeater (output wattage, gain level, etc) and connection to the fire alarm.

3.5 MAINTENANCE AND ANNUAL TESTING:

A. The Installer / Integrator shall include, at no additional cost to the owner, five (5) years of maintenance and annual testing of the Emergency Responder Radio Antenna/Repeater System as outlined below. At the completion of the 5 year Maintenance Contract, the installer / integrator may negotiate additional and ongoing maintenance / testing with the owner.

1. Maintenance contract shall be with a Radio Service Provider, who will provide a 24 hour by 7 day emergency response within two (2) hours after notification. The system shall be maintained in accordance with FCC requirements.

2. All tests shall be conducted, documented, and signed by a person in possession of a current FCC General Radio Operator License (GROL), or a technician certification issued by the Association of Public-Safety Communications Officials International (APCO) or equivalent as determined by the local Fire Department.

3. Maintain a list of contact personnel with phone numbers at the radio repeater system cabinet. The contact personnel shall have knowledge of the building and the repeater system and be available to respond to the building in the case of an emergency.

4. Radio Service Provider maintenance contract shall include but not limited to:

a. Annual Test
   1) All active components of the distributed antenna system, including but not limited to amplifier, power supplies, and back-up batteries, shall be tested a minimum of once every 12 months.

   2) Amplifiers shall be tested to insure that the gain is the same as it was upon initial installation and acceptance. The original gain shall be noted and any change in gain shall be documented.

   3) Back-up batteries and power supplies shall be tested under load for a period of 1 hour to verify that they will operate during an actual power outage.

   4) Active components shall be checked to determine that they are operating within the manufacturer's specifications for their intended purpose.

   5) Documentation of the test shall be maintained on site and a copy forwarded to the local Fire Department Radio Supervisor upon completion of the test.

3.6 WARRANTY:

A. The Installer / Integrator shall make available to the owner a service department of an authorized representative who will provide repair maintenance during normal working hours at no cost to the Owner for parts nor labor for a period of twelve (12) months from the date of beneficial use or occupancy.

3.7 TRAINING:

A. On Site Services:

   1. Owner's representative shall be instructed in the proper use and testing of the system.

END OF SECTION 275319

SECTION 283100 - FIRE ALARM SYSTEM

PART 1 - GENERAL:

1.1 SCOPE OF WORK:

A. This specification provides for the complete installation of an integrated fire detection and alarm system. The system shall include, but not be limited to, control panel, alarm initiating and indicating peripheral devices, conduit, wire and accessories required to provide a complete operational fire alarm system. The fire alarm system will be fully addressable.

B. The fire alarm system shall include but not be limited to the following functions:

1. Alarm sensing, processing and reporting.
2. System supervision and trouble indication.
3. Output signals to audible and visual notification devices.
4. Output signals to shut down HVAC systems, as noted.
5. Output signals to release fire doors, unless noted otherwise on the drawings.
6. Connection to the kitchen hood fire suppression system (if noted on drawings).
7. Communicator with connection to local reporting agency or fire department as directed by the Owner.
8. Connection to the fire suppression system components if provided including but not limited to: water level, temperature, flow, valve position, or pressure switches.
9. Connection to the fire pump controller, if fire pump is provided.
10. Connection to the emergency generator supervisory controls, if generator is provided.
11. Connection to the elevator controller, if elevator is provided.
12. Output signals to sound the sprinkler system alarm bell if present.

C. Monitoring and 3rd party certification: The Contractor shall connect new fire alarm system to a Central Station or a Remote Supervising Station monitor service as indicated on the drawings.

1. Remote Supervising Station monitor service (If indicated on the drawings)::
   a. Unless directed otherwise by the owner, the contractor shall provide one year of monitoring for one (1) year at no additional cost to the Owner.

2. Central Station Monitor Service (If indicated on the drawings):
   a. The Central Station shall comply with all UL and NFPA 72 requirements for central station monitor facilities, and shall have receiving equipment that is compatible for use with the Digital Communicator required by this specification.
   b. The Central Station shall be UL listed and certificated. The Contractor shall submit documentation of UL Certification with the submittal data. All services, including maintenance and runners required by UL will be provided for one (1) year at no cost to the Owner.
   c. The Contractor shall provide UL Certification of the completed satisfactory installation of the fire alarm system. The Contractor shall apply and pay for all UL permits and inspections necessary to obtain satisfactory certification. Final copy of the certification shall be furnished to the Architect/Engineer.

1.2 CODE AND STANDARD COMPLIANCE:

A. All electrical work shall be in accordance with the following codes and agencies:

1. National Electric Code, Article 760
2. National Fire Protection Standards: NFPA 72, National Fire Alarm Code
3. Local and state building codes.
4. All requirements of the local Authorities having jurisdiction.

1.3 LISTING REQUIREMENTS:

A. The system and all components shall be listed by Underwriters Laboratories, Inc. for use in fire protective signaling systems under the following standards as applicable: (All devices shall be by this Contractor.)

1. UL 864, Control Units for Fire Protective Signaling Systems
2. UL 268, Smoke Detectors for Fire Protective Signaling Systems
3. UL 268A, Smoke Detectors for Duct Applications
4. UL 217, Smoke Detectors, Single and Multiple Stations
5. UL 521, Heat Detectors for Fire Protective Signaling Systems
6. UL 228, Door Closers Holders for Fire Protective Signaling Systems
7. UL 464, Audible Signaling Appliances
8. UL 1638, Visual Signaling Appliances
9. UL 38, Manually Actuated Signaling Boxes
10. UL 346, Water flow Indicators for Fire Protective Signaling Systems
11. UL 1481, Power supplies for Fire Protective Signaling Systems
12. UL 1480, Speakers for Fire Alarm, Emergency, and Commercial and Professional Use

1.4 SUBMITTAL REQUIREMENTS:

A. Request for substitutions:

1. Refer to the “Basic Materials and Methods” specification for details and requirements.

B. Product Submittals and shop drawings:

1. Refer to the “Basic Materials and Methods” specification for details and requirements.

2. Bill of Materials: Complete list of all parts needed to fully install selected system components.

3. Submit for approval Drawings to detail all mechanical and electrical equipment, including:
   a. One-line diagrams
   b. Internal wiring
   c. Wire counts
   d. Physical dimensions of each item.

4. Product Data: Product data sheets for all equipment with performance specifications demonstrating compliance with specified requirements.

5. Installation Instructions: Manufacturer’s installation instructions.

6. Complete calculations showing the following:
   a. Battery calculations for all system power supplies and amplifiers with at least 20% spare capacity calculated with all notification devices set to the maximum output levels

b. Voltage drop of notification appliance circuits showing less than 15% voltage drop calculated with all notification devices set to the maximum output levels.
c. Power requirements of all notification and initiation circuits as designed.

7. Provide scaled floor plans, riser diagrams, factory wiring diagrams, and field wiring diagrams indicating the wiring of all devices to include raceway size and routing, junction boxes, and conductor size, type and quantity in each raceway. Show their connections to other systems including but not limited to HVAC systems and fire protection systems. Information to be included on layout plans shall include but shall not be limited to the following:

a. Circuit tags on all circuit legs.
b. Labeling of all initiation devices (to include signaling circuit designation and device address).
c. Labeling of all visual notification appliances with specific device identifier label, notification circuit number, and candela setting.
d. Labeling of all speakers with specific device identifier label, speaker circuit number and wattage tap selection.
e. Connections to HVAC systems.
f. Connections to other fire protection systems.

C. As-Built drawings:

1. Refer to the “Basic Materials and Methods” specification for details and requirements.
2. Operating instructions for FACP.
3. Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.
4. Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.
5. Record of field tests of system.

1.5 COORDINATION WITH OTHER TRADES:

A. Low voltage (24V or less) wiring, conduit, boxes, etc. are included in this section. A complete metallic conduit raceway system shall be furnished and installed by the electrical contractor as per the conduit specification. Conduit routing shall be as per the fire alarm shop drawings furnished by the fire alarm contractor.

B. Water flow switches, tamper switches, OS & Y valves will be provided by Sprinkler Contractor.

C. Door holding magnet locations shall be coordinated with door hardware supplier to ensure optimum magnetic alignment.

D. HVAC Duct Detectors shall be furnished by the fire alarm contractor detectors for installation by the mechanical contractor. Control wiring shall be by the mechanical contractor and fire alarm wiring shall be by fire alarm contractor. Duct detectors shall be powered from the fire alarm system and resettable from the control panel.

E. 120 volt power conductors & raceways to fire alarm panels shall be furnished and installed by the electrical contractor.

PART 2 – PRODUCTS:

2.1 MANUFACTURERS:

A. The equipment manufacturer shall be a nationally recognized company specializing in fire alarm and detection systems. The equipment manufacturer shall have a minimum of 10 years of experience in the fire protective signaling systems industry. The following manufacturers are approved:

1. Edwards

B. The basis of design for the equipment and service described in this specification are those supplied and supported by SimplexGrinnell.

C. Being listed as an acceptable manufacturer in no way relieves obligation to provide all equipment and features in accordance with these specifications.

D. Alternate products must be submitted to the engineer in accordance with the prior approval procedures outlined elsewhere in these specifications.

2.2 GENERAL:

A. All equipment and material shall be new and unused.

B. All equipment and material shall be designed for continuous duty without undue heating or degradation of function or performance.

C. All equipment, materials, accessories, devices, and other facilities covered by this specification or noted on contract drawings and installation specifications shall be the best suited for their intended use.

D. All equipment, materials and devices shall be by one manufacturer.

2.3 SYSTEM FUNCTIONAL OPERATION:

A. Priority of Signals: Fire alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority Two, Supervisory and Trouble events have second, third, and fourth-level priority, respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.

B. Noninterfering: An event on one device does not prevent the receipt of signals from any other device. All devices are manually resettable from the FACP after the initiating device or devices are restored to normal. The activation of an addressable device does not prevent the receipt of signals from subsequent addressable device activations.

C. Transmission to an approved Supervising Station: Automatically route alarm, supervisory, and trouble signals to a central station or a remote supervising station monitor service as indicated on the drawings..

D. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACP and the remote annunciator, indicating the type of device, the operational state of the device (i.e alarm, trouble or supervisory) and shall display the custom label associated with the device.

E. Alarm Condition Detection:

1. When a fire alarm condition is detected by one of the system initiating devices, the following functions shall immediately occur if shown on plans:
   a. Indication of alarm condition at the FACP and the annunciator(s).
   b. Identification of the device type that is the source of the alarm at the FACP and the annunciator(s). For all initiation device activation notifications, the display shall indicate the room name and room number where the device is located. Room numbers shall be matched to the final room numbers used in the facility not the room number shown on the contract documents.
   c. Initiate audible and visible notification appliances until silenced at FACP.
   d. All automatic programs assigned to the alarm point shall be executed and the associated indicating devices and relays activated.
   e. A signal shall be sent through communicator.
   f. Initiate the emergency voice evacuation message broadcast throughout the building.
   g. Fire alarm output modules shall be activated per the notes on the drawings.
   h. Selectively closing doors normally held open by magnetic door holders and motorized oiperators on the fire floor, floor above and floor below.
   i. Unlocking designated doors.
   j. Shutting down supply and return fans serving area where alarm is initiated.
   k. Closing smoke dampers on system serving area where alarm is initiated.
   l. Initiation of smoke control sequence.
   m. Initiation of elevator Phase I functions (recall, shunt trip, illumination of indicator in cab, etc.) in accordance with ANSI/ASME A17.1 / CSA B44, Safety Code for Elevators and Escalators, when specified detectors or sensors are activated, as appropriate.
   o. Initiate a signal to the stage fire curtain controller to lower the curtain.
   p. Initiate a signal to the lighting control system to turn on all the lights.
   q. Initiate a signal to the sound reinforcement and PA systems to mute those systems.
   r. Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.
   s. Record the event in the FACP historical log.

F. Supervisory Condition Detection:

1. Upon activation of a supervisory device, the following functions shall immediately occur:

   a. Activate the system supervisory service audible signal and illuminate the LED at the control unit and the remote annunciator.
   b. Identification of the device type or Air handler designation (if device is a duct smoke detector located at an air handler) that is the source of the supervisory condition at the FACP and the annunciator(s).However, unacknowledged alarm messages shall have

priority over supervisory messages and if such an alarm must also be displayed, the supervisory condition message shall not be displayed on the display. For all supervisory notifications, the display shall indicate the room name and room number where the device is located. Room numbers shall be matched to the final room numbers used in the facility not the room number shown on the contract documents.

c. A signal shall be sent through communicator.
d. Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.
e. Record the event in the FACP historical log.
f. Restoring the condition shall cause the Supervisory LED to clear and restore the system to normal.

G. Trouble Detection:

1. All wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, disarrangement of any components, or any open circuits in the system, shall result in a trouble condition.

2. Constant Supervision Audio: When provided, audio notification appliance circuits shall be supervised during standby by monitoring for DC continuity to end-of-line resistors.

3. When a trouble condition is detected the following functions shall immediately occur:

a. The System alarm LED shall flash.
b. A local sounding device in the panel shall be activated.
c. Identification of the device that is the source of the trouble condition at the FACP and the annunciator(s).However, unacknowledged alarm messages shall have priority over trouble messages and if such an alarm must also be displayed, the trouble condition message shall not be displayed on the display.
d. A signal shall be sent through communicator.
e. Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.
f. Record the event in the FACP historical log.

H. Control switches:

1. Acknowledge Switch: Activation of the control panel Acknowledge switch in response to a single new trouble or alarm condition shall silence the panel sounding device and change the System Alarm or Trouble LEDs from flashing to stead ON. If additional new alarm or trouble conditions exist in the system, activation of this switch shall advance the display to the next alarm or trouble condition that exists, and shall not silence the local audible device or change the LEDs to steady until all new conditions have been so acknowledged. New alarm conditions shall always be displayed before new trouble conditions. Activation of the Acknowledge switch shall also cause a corresponding (time-stamped) message to be displayed. Occurrence of a new alarm or trouble condition shall cause the panel to "resound" and the sequence described herein shall repeat.

2. System Reset Switch: Activation of the System Reset Switch shall cause all electronically latched initiating devices as well as all associated output devices and circuits, to return to the normal state. If alarm conditions exist in the system after the System Reset Switch activation, the system shall then re-sound the alarm conditions as indicated here in. The

"System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-alarming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."

3. System Test Switch: Activation of the System Test Switch shall initiate an automatic test of all addressable detectors in the system. Such test shall activate the electronics in each addressable device, simulating an alarm condition. A report summarizing the results of this test shall be displayed automatically on the front panel.

4. Lamp Test: Activation of the Lamp Test switch shall turn on all LED indicators, display and local sounder and then return to the previous condition.

5. A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.

6. WALKTEST: The system shall have the capacity of 8 programmable passcode protected one person testing groups, such that only a portion of the system need be disabled during testing. The actuation of the "enable one person test" program at the control unit shall activate the "One Person Testing" mode of the system as follows:
   a. The city circuit connection and any suppression release circuits shall be bypassed for the testing group.
   b. Control relay functions associated with one of the 8 testing groups shall be bypassed.
   c. The control unit shall indicate a trouble condition.
   d. The alarm activation of any initiating device in the testing group shall cause the audible notification appliances assigned only to that group to sound a code to identify the device.
   e. The unit shall automatically reset itself after signaling is complete.
   f. Any opening of an initiating device or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.
   g. Install Mode: The system shall provide the capability to group all non-commissioned points and devices into a single "Install Mode" trouble condition allowing an operator to clearly identify event activations from commissioned points and devices in occupied areas.
   h) It shall be possible to individually remove points from Install Mode as required for phased system commissioning.
   i) It shall be possible to retrieve an Install Mode report listing that includes a list of all points assigned to the Install Mode. Panels not having an install mode shall be reprogrammed to remove any non-commissioned points and devices.

I. Module Distribution:

1. The fire alarm control unit shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Style 4 (Class B) supervised serial communications channel (SLC):
   a. Initiating Device Circuits
   b. Notification Appliance Circuits
   c. Auxiliary Control Circuits
   d. Graphic Annunciator LED/Switch Control Modules in systems with two or more Annunciators and/or Command Centers, each Annunciator/Command Center shall be

programmable to allow multiple Annunciators/Command Centers to have equal operation priority or to allow hierarchal priority control to be assigned to individual Annunciator/Command Center locations.

e. Amplifiers, voice and telephone control circuits

J. Service Gateway: A Service Gateway software application shall be provided that allows an authorized service person to remotely query panel status during testing, commissioning, and service without the need to return to the panel using standard email or instant messaging tools.

K. Voice alarm communication system (if shown on drawings). Upon alarm activation of any device which initiates the general evacuation alarm, the following functions shall automatically occur:

1. The following audio messages and actions shall occur simultaneously: An evacuation message shall be sounded on fire floors (zones) immediately above and below (adjacent to) the fire floor (zone) general alarm evacuation. It is the intent of this message to advise occupants hearing this message that they are near danger and should leave the building via the stairs (nearest exit) immediately.

2. An alert message shall be sounded on the remainder of building. It is the intent of this message to advise occupants to prepare for evacuation if necessary.

3. An instructional message shall be sounded in the stairwells instructing occupants to move carefully and quickly down the stairs to exit the building and to exit to a safe floor if you encounter smoke in the stairwell.

4. An instructional message shall be sounded in the elevator cabs. It is the intent of this message to advise elevator occupants that an emergency exists, the elevator has been directed to the ground floor, and that occupants should quickly exit the building.

5. An instructional message shall be sounded in the main entry lobby and in the corridors connected to the building's lobby. It is the intent of this message to advise lobby occupants to leave the lobby and clear the area for arriving firefighters and to prevent new entries into the lobby.

6. Provide selective paging to each individual floor (zone). In addition to the message/channels detailed above, a dedicated page channel shall be capable of simultaneously providing live voice instructions without interrupting any of the messages listed above shall be provided.

7. The LED annunciator shall incorporate the microphone and telephone handset voice communication systems, including all required zone select and manual override control switches and the following LED indicators:

8. The system shall be capable of delivering multi-channel audio messages simultaneously over copper and/or fiber media. All audio messages shall originate at the audio control unit. The audio control unit shall store pre-recorded audio messages digitally. These messages shall be automatically directed to various areas in a facility under program control. The system shall support remote cabinets with zoned amplifiers to receive, amplify and send messages through speakers over supervised circuits.

9. The emergency audio control shall provide control switches to direct paging messages as follows:

    a. "All Call" to direct the page messages to all areas in the facility, overriding all other messages and tones.
    b. "Page to Evacuation Area" to direct the message to the evacuation area(s), overriding all other messages and tones.
    c. "Page to Alert Area" to direct page messages to the area(s) receiving the alert message and tones, overriding all other messages and tones..
    d. "Page to Balance Building" to direct page messages to the areas) in the facility NOT receiving either the evacuation area or alert area messages.
    e. "Page by Phone" switch to select the firefighters telephone system as the source for paging.

10. Voice alarm evacuation messages shall not contain the word fire. In single story buildings, messages shall not refer to elevators nor stairs.

L. Service aids:

1. Automatic Detector Test: The system shall include a special Automatic Detector Test which permits a serviceman to test all addressable detectors from the main control panel.

2. Watch Dog Timers: The system shall include independent "Watch Dog" timers to detect and report failure of any microprocessor circuit, memory or software.

3. History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. A separate alarm and trouble log shall be provided.

4. Recording of Events: The system shall be capable of recording all alarm, supervisory, and trouble events by means of system printer. The printout shall include the type of signal (alarm, supervisory, or trouble) the device identification, date and time of the occurrence. The printout shall differentiate alarm signals from all other printed indications.

2.4 MATERIALS AND COMPONENTS:

A. Fire Alarm Control Panels (FACP):

1. Mechanical Design:

    a. The control panel shall be housed in a cabinet designed for flush mounting directly in a wall or vertical surface. The back box and door shall be constructed with provisions for electrical conduit connections. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators.

    b. The control unit shall be modular in structure for ease of installation, maintenance, and future expansion.

2. System Capacity:

    a. 2,500 point capacity where (1) point equals (1) monitor (input) or (1) control (output).

b. 2000 points of annunciation where one (1) point of annunciation equals 1 LED driver output on a graphic driver or 1 switch input on a graphic switch input module and 1 LED on panel or 1 switch on panel.

c. Three (3) Class B Addressable Notification Appliance Signaling Line Circuits (SLCs). Each Addressable Notification Appliance SLC shall be rated at 3A and capable of supporting at least 63 Notification Appliances per channel.

d. Power Supplies with three (3) additional Class B integral Intelligent Addressable Notification Appliance Signaling Line Circuits (SLCs) for system expansion. Each Addressable Notification Appliance SLC shall be rated at 3A and capable of supporting at least 63 Notification Appliances per channel.

3. Circuit Interface (SLC & NAC):

a. One Circuit Interface Board shall be provided to monitor and control each circuit of addressable detectors and addressable modules.
b. The Circuit Interface Board shall communicate and provide power to all devices on its circuit over a single pair of wires. ("t tap") connections may be made off of the circuit. Circuit wiring shall be twisted pair of up to 10,000 ft. in length.

c. The Circuit Interface Board shall receive analog information from all addressable detectors and shall process this information to determine normal, alarm, or trouble conditions. The analog information may also be used for automatic test and determination of maintenance requirements.

d. A constant voltage under both primary and secondary power conditions shall be maintained at the notification appliance field wiring terminal connections in the FACP to ensure the voltage drop on the circuit is consistent under both primary and secondary power conditions.

4. Central Processing Unit Module (CPU):

a. The CPU shall communicate with, monitor, and control all other modules in the panel. Removal, disconnection or failure of any control panel module shall be detected and reported by the Central Processing Unit.

b. The CPU shall contain and execute all control by event programs for specific action to be taken if a fire situation is detected in the system. Such control by event programs shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.

5. Display Interface:

a. The Display shall provide all controls and indicators used by the system operator and may also be used to program all control panel parameters. The Display shall contain, and display as needed, custom alphanumeric labels for all addressable detectors and addressable modules. Such label information shall be stored in programmable nonvolatile memory.

b. From all battery charging circuits in the system, provide battery voltage and ammeter readouts on the Display.

c. The system shall have an expanded content, multi-line, operator interface display. The expanded content multi-line displays shall be Quarter-VGA (QVGA) or larger and be capable of supporting a minimum of 854 standard ASCII characters to minimize or eliminate the levels of navigation required for access to information when responding to critical emergencies and abnormal system conditions. The QVGA operator interface shall provide operator prompts and six context sensitive soft-keys for intuitive operation. Expanded content, multi-line operator interfaces shall be capable of providing the following functions:

1 Dual language operation with Instant-Switch language selection during runtime.

2 Activity display choices for:
a) First 8 Events, First 5 Events and Most Recent Event (with first and most recent event time and date stamps),

b) First Event and Most Recent Event (with first and most recent event time and date stamps)

c) Scrollable List Display displays a scrollable list of active points for the event category (alarm, priority 2, supervisory, or trouble) selected. The position in this list will be the last acknowledged point (not flashing) at the top followed by the next 7 unacknowledged points (flashing)

d) General Event Status (alarm, priority 2, supervisory, or trouble in system)

e) Site Plan

3 Equal or hierarchal priority assignment. In systems with two or more operator interfaces, each operator interface shall be programmable to allow multiple operator interfaces to have equal operation priority or to allow hierarchal priority control to be assigned to individual operator interfaces (locations).

4 At least 50 custom point detail messages for providing additional point specific information in detailed point status screens.

5 Bitmap file import for operator interface display of site plan and background watermark images. Site plan status icons shall indicate area status for highest priority active events.

6. Communications:

a. 10. Four (4) form "C" Auxiliary Relay Circuits (Form C contacts rated 2A @ 24VDC, resistive), operation is programmable for trouble, alarm, supervisory of other fire response functions. Relays shall be capable of switching at least ½ A @ 120VAC, inductive.

b. The FACP shall support at least (5) RS-232-C ports and one service port. All (5) RS-232 Ports shall be capable of two-way communications.

c. Remote Unit Interface: supervised serial communication channel for control and monitoring of remotely located annunciators and I/O panels.

d. Fire Panel Internet Interface to provide supplemental notification and remote user access to the FACP using Ethernet and TCP/IP communications protocol compatible with IEEE Standard 802.3.

e. One Auxiliary electronically resettable fused 2A @24VDC Output, with programmable disconnect operation for 4-wire detector reset.

f. One Auxiliary Relay, SPDT 2A @32VDC, programmable as a trouble relay, either as normally energized or de-energized, or as an auxiliary control.

g. The primary communications path to the monitoring service shall be single path cellular with 5/60 min check

h. The secondary communications path to the monitoring service shall be non-dial cellular with 24/6 hour self-test.

I. Cellular communications account shall be provided and paid by the fire alarm monitoring company.

j. Cellular communicator shall be equal to Honeywell #HWF2A

k. The supervising station and protected premise had to be notified if communication degrades to less than two towers.

l. Cellular communicator shall be supplied with 24 hour battery backup capacity and remote cellular antenna with necessary adapters and cables.

7. Power Supply:

a. The power supply for the panel and all fire alarm peripherals shall be integral to the control panel. The power supply shall provide all control panel and peripheral power needs as well as 3 amperes of unregulated 24VDC power for external audio visual devices. The audio visual power may be increased as needed by adding additional modular expansion power supplies. All power supplies shall be designed to meet UL and NFPA requirements for power limited operation on all external initiating circuits and indicating circuits.

b. Positive temperature coefficient thermistors, circuit breakers, or other over current protection shall be provided on all power outputs.

c. Input power shall be 120VAC 60Hz. The power supply shall provide internal batteries and charger.

d. The control unit shall receive AC power via a dedicated circuit.

e. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24

hours with 5 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic. Provide Intelligent Remote Battery Charger for charging batteries.

f. All circuits requiring system-operating power shall be 24 VDC nominal voltage and shall be individually fused at the control unit.

g. The incoming power to the system shall be supervised so that any power failure will be indicated at the control unit.

h. The system batteries shall be supervised so that a low battery or a depleted battery condition, or disconnection of the battery shall be indicated at the control unit and displayed for the specific fault type.

i. The system shall support NAC Lockout feature to prevent subsequent activation of Notification Appliance Circuits after a Depleted Battery condition occurs in order to make use of battery reserve for front panel annunciation and control.

j. The system shall support 100% of addressable devices in alarm or operated at the same time, under both primary (AC) and secondary (battery) power conditions.

k. Loss of primary power shall sound a trouble signal at the FACP and a trouble signal shall be transmitted to the supervising station. The FACP shall indicate when the system is operating on an alternate power supply.

8. Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary.

a. The system shall be capable of on-site programming to accommodate system expansion and facilitate changes in operation.

b. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control unit. Loss of primary and secondary power shall not erase the instructions stored in memory.

c. Panels shall be capable of full system operation during new site specific configuration download, master exec downloads, and slave exec downloads.

d. Remote panel site-specific software and executive firmware downloads shall be capable of being performed over proprietary fire alarm network communications and via TCP/IP Ethernet network communications. Ethernet access to any fire alarm panel shall be capable of providing access only to authenticated users through a cryptographically authenticated and secure SSL tunnel.

e. Panels shall automatically store all program changes to the panel's non-volatile memory each time a new program is downloaded. Panels shall be capable of storing the active site-specific configuration program and previous revisions in reserve.

f. Panels shall provide electronic file storage with a means to retrieve a record copy of the site-specific software and previous revisions.

9. Voice Alarm (if shown on plans): Provide an emergency communication system, integral with the FACP, including voice alarm system components, microphones, amplifiers, and tone generators. Features include:

    a. Amplifiers comply with UL 1711, "Amplifiers for Fire Protective Signaling Systems." Amplifiers shall provide an onboard local mode temporal coded horn tone as a default backup tone. Test switches on the amplifier shall be provided to test and observe amplifier backup switchover. Each amplifier shall communicate to the host panel amplifier and NAC circuit voltage and current levels for display on the user interface. Each amplifier shall be capable of performing constant supervision for non-alarm audio functions such as background music and general paging.

    b. Dual alarm channels permit simultaneous transmission of different announcements to different zones or floors automatically or by use of the central control microphone. All announcements are made over dedicated, supervised communication lines. All risers shall support Class B wiring for each audio channel.

    c. Eight channel digitally multiplexed audio for systems that require more than two channels of simultaneous audio. Up to 8 channels of audio shall be multiplexed on either a style 4 or style 7 twisted pair.

    d. Emergency voice communication audio controller module shall provide at least 32 minutes of message memory for digitally stored messages. Provide supervised connections for master microphone and at least 5 remote microphones.

    e. Status annunciator indicating the status of the various voice alarm speaker zones and the status of fire fighter telephone two-way communication zones.

    f. When required, Redundant Voice Command Centers shall be capable of generating voice paging from more than one node in a network audio system

    g. Audio Amplifiers (Multi-Channel): Provide as minimum one audio amplifier per paging zone. The system software shall be capable of selecting the required audio source signal for amplification. To enhance system survivability, each audio amplifier shall automatically provide a local 3-3-3 1000 Hz temporal pattern output upon loss of the audio communications with the one-way audio control unit, during an alarm condition. Audio amplifiers shall be power limited and protected from short circuits conditions on the audio circuit wiring. Each amplifier output shall include a dedicated, selectable 25/70 Vrms output. Provide a standby audio amplifier that will automatically sense the failure of a primary amplifier, and replace the function of the failed amplifier. Amplifier wattage shall be determined based on calculated speaker wattage requirements with at least 20% spare capacity.

    h. The master microphone module and master telephone shall be permanently mounted behind the locked access door, visible through the viewing window in Voice Alarm Control panel and provide firefighters with the means of issuing voice message instructions to specific audio zones, groups of zones or all zones. The microphone, telephone, and the press-to-talk switches shall be supervised. This module shall contain a local speaker with volume control to monitor selected audio channels.

i. 3-Position Switch Provide 3-position switch for each evacuation signaling zone, with "Voice," "Auto" and "Evacuate" positions identified and two LED status indicators for each audio visual evacuation signaling "zone", one red and one yellow. These LED's shall illuminate to indicate respectively: 1) Evacuation signals activated (red), 2) Trouble in audio (speaker) or visual (strobe) circuit(s) (yellow).

j. All Call Switch 3-Position Provide 3-position switch for "All-Call" to activate all the evacuation signaling zones, with "Voice", "Off" and "Auto" positions identified and two LED status indicators for each audio visual evacuation signaling "zone", one red and one yellow. These LED's shall illuminate to indicate respectively: 1) Evacuation signals activated (red), 2) Trouble in audio (speaker) or visual (strobe) circuit(s) (yellow).

k. Fire Fighters Telephone Hand Sets: High-impact plastic handset, heavy-duty coil cord, and hook switch; connected to the FACP by means of dedicated, supervised communication lines. Handsets have a dynamic receiver and a carbon transmitter, operating on 24VDC.

l. A black master telephone handset with a push to talk button and a flexible-coiled self-winding five (5) foot cord shall be provided and recessed within a protective unit-mounted enclosure at the command center.

m. Cabinet: Flush- or surface-mounted as indicated, 18-gage, minimum, painted steel with a latched hinged door with trim labeled "Fire Fighters' Phone." Size to accommodate handset and cord.

B. Addressable Input and Initiation Devices:

1. Addressable Photoelectric Smoke Detectors:

a. The addressable Photoelectric Smoke Detectors shall connect with two wires to one of the control panel circuits. The detectors shall use the photoelectric principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density. The detectors shall be ceiling mount and shall include a twist lock base and shall be white in color.

b. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself, by activating a magnetic switch, or may be activated remotely on command from the control panel.

c. The detectors shall provide address setting means on the detector head. The detectors shall also store an internal identifying code which the control panel shall use to identify the type of detector.

d. The detectors shall provide dual alarm and power LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LEDs may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected.

2. Addressable Ionization Detectors:

a. The addressable Ionization Detectors shall connect with two wires to one of the control panel circuits. The detectors shall use the dual chamber ionization principal to measure products of combustion and shall, on command from the control panel, send data to the panel representing the analog level of products of combustion. The detectors shall be ceiling mount and shall include a twist lock base and shall be white in color.

b. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself, by activating a magnetic switch, or may be activated remotely on command from the control panel.

c. The detectors shall provide address setting means. The detectors shall also store an internal identifying code which the control panel shall use to identify the type of detector.

d. The detectors shall provide dual alarm and power LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LEDs may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected.

3. Addressable Thermal Detectors:

a. The addressable Thermal Detectors shall connect with two wires to one of the control panel circuits. The detectors shall use an electronic sensor to measure temperature levels in its chamber and shall, on command from the control panel, send data to the panel representing the analog temperature level. The detectors shall be ceiling mount and shall include a twist lock base and shall be white in color.

b. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself, by activating a magnetic switch, or may be activated remotely on command from the control panel.

c. The detectors shall provide address setting means on the detector head. The detectors shall also store an internal identifying code which the control panel shall use to identify the type of detector.

d. The detectors shall provide dual alarm and power LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LEDs may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. An output connection shall also be provided in the base to connect an external remote alarm LED.

e. Thermal Sensor: Combination fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp;

f. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag.

g. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and programmable to operate at 135-deg F or 155-deg F. Sensor rate-of-rise temperature detection shall be selectable at the FACP for either 15-deg F or 20-deg F per minute.

h. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.

4. Addressable Manual Stations:

a. Provide white addressable manual station with red letters at the locations shown on the drawings. The addressable manual station shall connect with two wires to one of the control panel circuits. The manual station shall, on command from the control panel, send data to the panel representing the state of the manual switch.

b. The Manual Station shall provide address setting means and shall also store an internal identifying code which the control panel shall use to identify the type of device. An LED shall be provided which shall flash under normal conditions, indicating that the Manual Station is operational and in regular communication with the control panel. The LED may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected.

c. Protective Shield: Provide a tamperproof, clear LEXAN shield and red frame that easily fits over manual pull stations. When shield is lifted to gain access to the station, a battery powered piercing warning horn shall be activated. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.

5. Addressable Monitor Module (FAIM):

a. The monitor module shall be used to connect a supervised conventional initiating device (any n.o. dry contact device, including 4 wire smoke detectors) to an addressable circuit. The Monitor Module shall mount in a 4 inch square deep electrical box.

b. The monitor module shall provide address setting means using rotary decimal switches and shall also store an internal identifying code which the control panel shall use to identify the type of device. An LED shall be provided which shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.

c. The monitor modules used for water valve position monitoring or water flow detection shall be water proof.

6. Isolator Module:

a. The Isolator Module shall be used to isolate wire to wire short circuits on a circuit and to limit the number of other modules or detectors that are incapacitated by the short circuit fault. The Circuit should be wired Style 4, and isolator modules shall be placed between not more than 25 devices. If a wire to wire short occurs, the isolators on either side of the short is corrected, the isolators shall automatically reconnect the isolated section of the circuit.

b. The Isolator Module shall not require any address setting, although each Isolator may electrically reduce the capacity of the circuit by one detector or module address

c. Isolator Module shall be listed to UL 864. The Isolator shall mount directly to a minimum 2 1/8" deep, standard 4" square electrical box, without the use of special adapter or trim rings. Power and communications shall be supplied by the Addressable Controller channel SLC; dual port design shall accept communications and power from either port and shall automatically isolate one port from the other when a short circuit occurs. The Isolator module shall Report faults to the host FACP and have an on-board LED provides module status.

7. Addressable CO Sensor

a. The CO Sensor shall be an addressable carbon monoxide (CO) sensing module providing both CO toxic gas detection and enhanced fire detection, and shall be listed to UL 268, Smoke Detectors for Fire Alarm Signaling Systems and UL 2075, Gas and Vapor Detectors and Sensors; allowing systems to be listed to Standard 2034, Single and Multiple Station Carbon Monoxide Alarms.

b The CO Sensor shall include CO sensor element mounted in the sensor base which can be easily replaced without replacing the complete sensor base assembly.

c. The CO Sensor base shall provide address selection in the base allowing the address to remain with its location when the sensor is removed for service or type change.

d. The CO Sensor base shall include an integral red LED to indicate the power-on, trouble, test mode or alarm status.

e. The CO Sensor base shall report the following CO Sensor troubles: Communication loss, Disabled, Almost Expired 12 Months, Almost Expired 6 Months, Expired (End of Life), and Sensor Missing/Failed.

8. Addressable Combination CO Sounder Base

a. The combination CO Sensor shall be an addressable carbon monoxide (CO) sensing module providing both CO toxic gas detection and enhanced fire detection, and shall be listed to UL 268, Smoke Detectors for Fire Alarm Signaling Systems and UL 2075, Gas and Vapor Detectors and Sensors; allowing systems to be listed to Standard 2034, Single and Multiple Station Carbon Monoxide Alarms.

b. The CO Sensing element shall support operation with a Sounder base; the CO Sounder base shall provide temporal temporal code 4 (TC4) for toxic carbon monoxide alarms.

c. The CO Sounder base shall be listed to UL464, Audible Signal Appliances.

d. The CO Sounder Base shall include CO sensor element mounted in the sounder base which can be easily replaced without replacing the complete sensor base assembly.

e. The CO Sounder base shall provide address selection in the base allowing the address to remain with its location when the sensor is removed for service or type change.

f. The CO Sounder Sensor base shall include an integral red LED to indicate the power-on, trouble, test mode or alarm status.

g. The CO Sensor base shall report the following CO Sensor troubles: Communication loss, Disabled, Almost Expired 12 Months, Almost Expired 6 Months, Expired (End of Life), and Sensor Missing/Failed.

9. HVAC Duct Detector:

a. The fire alarm contractor shall furnish addressable duct detector where indicated on the plans. Installation of duct detector shall be by Mechanical Contractor.

b. The Fire Alarm Contractor shall connect the duct detector to the fire alarm system completely.

c. The mechanical contractor shall be responsible for mounting the detector and wiring terminations to the control system.

d. The duct detector shall be reset-able from the Fire Alarm Control Panel.

e. Power for the duct detector shall be provided from fire alarm system. This power shall be backed up by fire alarm system batteries and shall be supervised for continuity.

f. Duct Smoke Sensor shall be Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Sensor includes relay as required for fan shutdown.

g. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor shall be provided by the FACP.

h. The Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable. Relay shall be mounted within 3 feet of HVAC control circuit.

i. Duct Housing shall provide a relay control trouble indicator LED.

j. Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.

k. Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.

l. Duct Housing shall provide a magnetic test area and sensor status LED.

m. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.

n. Each duct smoke sensor shall have a Remote Test Station with an alarm LED and test switch.

o. Provide a NEMA 4X weatherproof duct housing enclosure that shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.

C. Addressable output and notification devices (if shown on drawings):

1. Speaker-Strobe 4": Provide 4" white speakers/strobes with red "ALERT" letters at the locations shown on the drawings. Speakers shall have a 4" mylar cone, paper cones are not acceptable. The rear of the speakers shall be completely sealed protecting the cone during and after installation. In and out screw terminals shall be provided for wiring. Speakers shall provide 1/4w, 1/2w, 1w, and 2w power taps for use with 25V or 70V systems. At the 2 watt setting, the speaker shall provide a 87 dBA sound output over a frequency range of 400-4000 Hz. when measured in reverberation room per UL-1480. Strobes shall provide synchronized flash. Strobe output shall be determined as required by its specific location and application from a family of 15/75cd, 30cd, & 110cd devices.

2. Speaker-Strobe Ceiling 8": Provide 8" white ceiling mounted speaker/strobes with red "ALERT" letters at the locations shown on the drawings. In and out screw terminals shall be provided for wiring. Speaker baffles shall be round or square, steel with white finish as required. Provide square surface mount boxes with matching white finish as required. Speakers shall provide 1/2w, 1w, 2w, and 4W power taps for use with 25V or 70V systems. At the 4 watt setting, the speaker shall provide a 94 dBA sound output a frequency of 1000 Hz. when measured in an anechoic chamber at 10 ft. Strobes shall provide synchronized flash outputs. Strobe output shall be determined as required by its specific location and application from a family of 15cd, 30cd, 75cd, and 110cd devices.

3. Speaker – Strobe Re-entrant: Provide 4" white surface re-entrant speaker/strobes with red "ALERT" letters at the locations shown on the drawings. Weatherproof boxes shall be provided for outdoor mounting. Speakers shall provide 2w, 4w, 8w, and 15w power taps for use with 25V or 70V systems. The re-entrant speakers shall utilize high efficiency compression drivers. Cone type drivers are not acceptable. At the 15 watt setting, the speaker shall provide a 102 dBA sound output over a frequency range of 400-4000 Hz. when measured in reverberation room per UL-1480. Strobes shall provide synchronized flash. Strobe output shall be determined as required by its specific location and application from a family of 15cd, 30cd, 75cd, & 110cd devices.

4. Horn-Strobes: Provide white horn/strobes with red letters at the locations shown on the drawings. Strobes shall provide synchronized flash. Strobe output shall be determined as required by its specific location and application from a family of 15/75 cd, 30 cd, or 100 cd devices.

5. Strobes: Provide white strobes with red letters at the locations shown on the drawings. Strobes shall provide synchronized flash. Strobe output shall be determined as required by its specific location and application from a family of 15/75 cd, 30 cd, or 100 cd devices.

6. Exterior Sprinkler Horn: Where shown on plans, Provide red weather proof horn for sprinkler system water flow. The horn shall sound a distinctive tone different from the building fire alarm general alarm. The horn shall be provided with 120V power from a generator backed up panel in facilities with emergency generators. In facilities without generators, the horn shall be powered from the fire alarm system.

7. Addressable Control Module (FAOM):

   a. The Control Module shall be used to connect a supervised conventional indicating devices (any 24V polarized audio/visual indicating appliance) to an addressable circuit. The Control Module shall mount in a standard 4 inch deep electrical box. The control module may also be wired as a dry contact (form C) relay. Power for the relay coil shall be provided by the addressable detector circuit to reduce wiring connection requirements. Audio/visual power shall be provided by a separate circuit from the main control panel or from supervised remote power supplies.

   b. The Control Module shall provide address setting means using rotary decimal switches and shall store an internal identifying code which the control panel shall use to identify the type of device. An LED shall be provided which shall flash under normal conditions, indicating that the Monitor Module is operational and in regular communication with the control panel.

8. Addressable Repeater shall supervise channel (SLC) wiring and communicate with and control addressable notification appliances. The Repeater shall be a stand-alone panel capable of powering one (1) NAC SLC. The channel (SLC) shall be rated for 3 amps and support at least 63 addresses. Power and communication for the notification appliances shall be provided on the same pair of wires. It shall be possible to program the High/Low setting of the audible (horn) appliances by channel from the addressable controller.
   a. The Repeater shall provide a constant voltage output to ensure NAC current and voltage do not vary whether the panel is operating on AC or battery. The output voltage during alarm conditions shall be 29 VRMS.
   b. Addressable SLC notification appliance circuits shall be Class B, Style 4.
   c. For Class B circuits, the Repeater shall support at least 4 Class B branches directly at its output terminals for one SLC.
   d. The internal power supply and battery charger shall be capable of charging up two 12.7 Ah batteries internally mounted or 25Ah batteries mounted in an external cabinet.
   e. The Repeater panel can be mounted close to the host fire alarm control unit or remotely.
   f. The Repeater status shall be communicated to the host fire alarm control unit and locally indicated.
   g. A 200mA auxiliary output shall be available
   h. The Repeater shall be listed to UL 864

D. Graphic annunciator (if shown on drawings):

1. The fire alarm contractor shall furnish and install a graphic annunciator panel in the location shown on the plans with the following features:

   a. Flush mounted back box with aluminum frame
   b. Size of annunciator shall be adequate to clearly show all devices.
   c. Field replaceable artwork

d. Super bright, multicolor Led's. Green when device is operating normally, yellow to indicate supervisory alarm, and red to indicate general alarm condition detected.
e. High contrast graphics designed in AutoCAD format printed with non-fading black ink on a transparent .010" polyester slip-sheet.
f. Pushbutton control switches to test status of all LEDs.
g. Key Lock rendering Annunciator tamper-proof.
h. Red 'You Are Here' indicator.
i. Metal Reinforcing Angle attached to perimeter of Graphic to stiffen.
j. 0.250" white P.V.C. backing panel with holes drilled for Led's
k. 0.125" clear Acrylic cover to protect graphic artwork.

E. SMOKE CONTROL SYSTEM (if shown on plans)

1. Smoke Control System: Provide a smoke control system which is UL 864 (UUKL product category) listed for smoke control system service. The system shall provide automatic operation of smoke exhaust fans, makeup air fans, air handling units, and dampers in accordance with the smoke control sequence indicated on the drawings. The smoke control system shall be located in the fire command center.

2. Provide and install smoke control relays within 3 feet of each smoke exhaust fan controller, makeup air fan controller, air handling units controller, and damper controlled by the smoke control system. The building automation/temperature control system contractor shall terminate the relays to the fan controllers, air handling unit controllers, and dampers.

3. Provide and install addressable modules to monitor status/operation of each smoke exhaust fan, makeup air fan, air handling unit, and damper controlled by the smoke control system. The fire alarm contractor shall terminate the modules to status indicators.

4. Enclosure: Finish to match Fire Alarm Control Units. The locking cover/display assembly is hinged on the left. Key and lock shall be common to all secured fire alarm system enclosures.

F. SMOKE CONTROL SYSTEM GRAPHIC ANNUNCIATOR (if shown on plans)

1. Annunciator Unit (zoned system): Provide an LED-indicating light located on the graphic annunciator to indicate the status for all smoke control equipment. In addition, in systems with two or more Smoke Control System Graphic Annunciators, each Annunciator shall be programmable to allow multiple Annunciators to have equal operation priority or to allow hierarchal priority control to be assigned to individual Annunciators (locations).

2. Fans, dampers, and other operating equipment in normal status shall be indicated by a GREEN LED. Fans, dampers, and other operating equipment in off or closed status shall be indicated by a RED LED. Fans, dampers, and other operating equipment in fault status shall be indicated by a YELLOW LED. The annunciator shall graphically depict the building arrangement and smoke control system zones. Fans, major ducts, dampers, and airflow direction shall be indicated.

3. Provide HOA switches labeled "ON-AUTO-OFF" on the annunciator to permit fire-fighters manual control of each individual smoke control fan or air handling unit. HOA switches labeled "OPEN-AUTO-CLOSE" shall be provided on the annunciator for each individual smoke control damper.

4. Provide a toggle or push-button switch to test the LEDs mounted on the unit. The test switch does not require key operation.

5. Provide a HOA switch labeled "OPEN-AUTO-LOCK" on the annunciator for each stairway to permit fire-fighters manual control of stairway door locks in accordance with local codes.

6. In the normal switch position, the fans, air handling units, or dampers operate automatically as controlled by the building automation/temperature control system. Automatic controls can be overridden with the HOA switches provided on the graphic annunciator. The operation of the HOA switches shall permit manual control and override of any conflicting signal from the building automation/temperature control system or any other system.

7. Enclosure: finish to match Fire Alarm Control Units. The locking cover/display assembly is hinged on the left. Key and lock shall be common to all secured fire alarm system enclosures.

G. REMOTE LCD ANNUNCIATOR (if shown on plans)

1. Remote annunciator shall have super-twist LCD display with two lines of 40 characters each. Annunciator shall be provided with four (4) programmable control switches and associated LEDs.

3. Under normal conditions the LCD shall display a "SYSTEM IS NORMAL" message and the current time and date.

4. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.

5. The LCD shall display the following information relative to the abnormal condition of a point in the system:
   a. 40 character custom location label.
   b. Type of device (e.g., smoke, pull station, waterflow).
   c. Point status (e.g., alarm, trouble).

6. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACP.

H. MAGNETIC DOOR HOLDERS

1. Description: Units shall be listed to UL 228. Units are equipped for wall or floor mounting as indicated and are complete with matching door plate. Unit shall operate from a 120VAC, a 24VAC or a 24VDC source, and develop a minimum of 25 lbs. holding force.

2. Material and Finish: Match door hardware.

I. FIRE ALARM DOCUMENTATION CABINET

1. Furnish and install documentation cabinet labeled “SYSTEM RECORD DOCUMENTS” adjacent to fire alarm control panel .

PART 3 - EXECUTION:

3.1 INSTALLER:

A. The entire Fire Alarm System, except raceways and 120v power circuits, shall be installed by a factory trained installer who shall furnish evidence suitable to the Engineer of experience with similar installations which are operating satisfactorily. The installer shall be NICET certified and shall maintain a service organization within 50 miles of this project location. The equipment and service provider shall have a minimum of 10 years of experience in the fire protective signaling systems industry. The following installers are approved:

1. Johnson Controls

B All cabling shall be installed in conduits furnished and installed by the electrical contractor as per the conduit specification. Conduit routing shall be as per the fire alarm shop drawings furnished by the fire alarm contractor. All fire alarm communication cabling and fire alarm devices shall be furnished and installed by the fire alarm contractor. 120v power circuits & raceways to fire alarm panels shall be furnished and installed by the electrical contractor.

3.2 INSTALLATION:

A. Installation shall be in strict compliance with manufacturer’s recommendations. Consult manufacturer for all wiring diagrams, schematics, sizes, outlets, etc. before installing conduits and pulling wire.

B. WIRING/SIGNAL TRANSMISSION:

1. OPEN CABLE: Open cable is not allowed. All wiring shall be installed in conduit.

2. Cable shall be the type "listed for the use" as specified under NEC Article 760 30, (bell wire, intercom or telephone wire are not approved).

3. All cable shall be installed as per NEC Article 760.

4. Leave 8 inch wire tails at each device box and 36 inch wire tails at the Fire Alarm Control Panel.

5. Unless specified otherwise herein, all wire shall be minimum #16 Type TFN (solid) or #14 Type THHN/THWN in separate raceway, maximum 40% fill, or approved fire alarm cable as recommended by manufacturer. Wires larger than #14 shall be used when required to minimize voltage drop as per other sections of this specification. Wiring splices are to be avoided to the extent possible and "transposing or changing colors will not be permitted". All junction boxes shall be labeled as "Fire Alarm System" with decal or approved markings. Comply with all local, state and national codes.

6. Cable for speaker strobes shall be circuited as stated above from the Control Module. An end of line resistor device shall be installed at or after the last device on the circuit. Wire

may be 16 through 12 AWG twisted pair with a shield jacket. Opposing speakers facing each other and located in the same room shall be phased opposite of each other. Speakers facing in the same direction shall be wired to be identically phased.

7. Cable for addressable initiating devices shall be 16 to 12 AWG twisted pair with a shield jacket or installed in conduit. Shield continuity must be maintained and connected to earth ground only at the control panel. Addressable detector wiring must not be routed in the same conduit with 120/240 VAC power wiring or other high current circuits. T taps or branch circuit connections are allowed for all addressable circuits. (Belden 9574, 9575, 9581, 9583 or equivalent).

8. Fire alarm cable shall be held in place at the device box, by means of a two screw connector, (do not use squeeze or crimp type connectors).

9. Cable must be separated, minimum two (2) inches, from any open conductors of light, power, or class 1 circuits, and shall not be placed in any outlet box or raceway containing these conductors, as per NEC Article 760 29.

10. All splices or connections shall be made within approved junction boxes and with approved fittings. Boxes shall be red and/or labeled "FIRE ALARM SYSTEM" by decal or other approved markings.

11. System circuiting shall be as follows:

    a. Initiating device circuits shall be Class B, Style D

    b. Signaling line circuits shall be Class B, Style 4, with isolator modules for every 25 devices.

    c. Notification appliance circuits shall be Class B, Style Y.

12. Circuit Loading: To facilitate future growth, the number of devices on any SLC or NAC circuit shall be limited to 75% of the maximum of devices allowable on the circuit. Wire and battery size calculations for all circuits shall be calculated assuming all notification devices are set to their maximum output levels. Refer to the submittals section of this specification for battery spare capacity and voltage drop limitations.

C. All equipment shall be held firmly in place. Fastening and supports shall be adequate to support the loads with a safety factor of five.

D. Fire Alarm Control Panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes.

1. All 120V branch circuit breaker handles serving fire alarm panels shall be provided with a “lock-out” type accessory per NFPA-72 requirements that allows the circuit breaker to be locked in the “ON” position and allows the circuit breaker to trip in an overload condition.

2. All 120V branch circuit breaker handles serving fire alarm panels shall be permanently marked with red color per NFPA-72 requirements.

3. The 120V panelboard index circuit designations for all 120V branch circuit panelboards serving fire alarm panels shall be identified typically “FIRE ALARM CIRCUIT” per NFPA-72 requirements.

E. Device Box Mounting: Unless otherwise noted on the drawings, plans, specifications or by the Architect or Engineer, the recommended mounting heights, type of boxes required and other specific requirements are as follows:

1. Fire Alarm Control Panels & Remote Annunciators: Control unit displays shall be mounted such the distance to the highest switch, lamp or textural display does not exceed 6 ft aff, and the lowest switch, lamp, or textual display shall not be less than 15” aff. Use only identified conduit entries or request approval for other penetrations in cabinets, (certain areas require clear space for interior components). Cabinet shall be grounded to the power supply circuit equipment grounding conductor as per the manufacturer’s installation instructions.

2. Magnetic Door Holder(s): Wall type require a 4” square box with single gang plaster ring. Floor type require a 1/2 inch threaded conduit up through center of device, threads only to protrude 1/2 inch above finished floor. Note: See individual instruction sheet of particular device being used for the exact location of box or stub.

3. Signaling Horn(s): Standard semi flush horns, bells and chimes require a 4 inch square, 2 1/8 inch deep, device box with a 2 Gang ring (1/2 inch minimum depth). Install 6 inches below finished ceiling or 90 inches above finished floor, whichever is lower.

4. Flush horns, bells, or chimes require a special back box. Install 6 inches below finished ceiling or 90 inches above finished floor, whichever is lower.

5. Watertight horns, bells or chimes shall be flush mounted.

6. Fire alarm notification lights or combination horn/lights:

   a. Signaling horn/ light combination device(s): standard combination devices require a 4 inch square, 2 1/8 deep device box with a 2 gang ring. (1/2 inch minimum depth) Install so that the entire lens is between 80 and 96 inches above the finished floor.

   b. Final locations of all visual notification appliances and combination visual/audible notification appliances shall be adjusted as required to provide unobstructed direct visibility of all visual appliances in the field of view. Review Architectural drawings (where applicable) prior to rough-in phase and report all discrepancies to the Engineer in writing. All devices requiring relocation after installation that were not brought to the attention of the Engineer shall be relocated at the Contractor’s expense.

7. Manual Station(s): Install a 4 inch square device box with a 1 Gang ring (1/2 inch minimum depth) at 48 inches to top, above finished floor. All Manual Stations shall be in unobstructed locations.

8. Heat and Smoke Detector(s): The location of detectors shown on the plans is schematic only. The detectors must be located according to code.

   a. Detectors require a 4 inch square device box with a 3/0 ring. They should be located on the highest part of a smooth ceiling so that the edge of the detector is no closer than

4’ from a sidewall. Ceilings with beams, joists or soffits that exceed 8 inches in depth require special planning and closer spacing. Verify with manufacturer.

b. If it is necessary to mount a detector upon a sidewall, the top of the detector shall be located no closer than 4 inches from the ceiling and no further away than 12 inches.

c. Smoke detectors should be installed to favor the air flow towards return openings and not located within 3 feet of air supply or return diffusers which could dilute smoke before it reaches the detector.

e. Ideally, heat and smoke detectors should be located near the center of the open area which they are protecting, this providing coverage generally for a 15 foot radius for smoke detectors and a 25 foot radius for heat detectors. VERIFY LOCATION WITH ARCHITECT OR ENGINEER.

9. Remote Indicator for Duct Detector(s): Install a 1 Gang device box either above the door or upon the ceiling outside the protected room or other location as specified or shown on plans. Two (2) conductors are required between the indicator and its associated detector.

10. Sprinkler Water flow and Gate Valve Switch(s): Install a 4 inch square device box on a wall accessibly and centrally located near the switch(s) and use 1/2 inch flex to connect each device to the box. Exterior mounted devices on post indicator valves and in pits, etc. require liquid tight flex and weatherproof boxes and fittings for all wiring.

11. Wire guards: Wire guards shall be installed on signaling devices located in gymnasiums.

12. For ceiling device installations in suspended tile ceilings, furnish and install ERICO T-Grid Box Hanger with adjustable T-bars & extra deep boxes to accommodate ceiling type and to provide ample capacity and space for wiring pulling and circuit terminations.

F. Zone schedule:

1. The system shall be fully addressable. Where non addressable, conventional devices must be used, they shall be interfaced to an addressable input or output module to provide device specific identification and monitoring.

2. The voice alarm communication system (if shown on plans) shall be installed and programmed such that separate paging zones are established for the following areas:
   a. Each Floor
   b. Elevators and associated lobbies
   c. Exit Stairways
   d. Main entry or Lobby and connecting corridors.
   e. Assembly spaces with more than 50 occupants such as Gymnasiums, Cafeterias, Media Centers.

G. Field programming:

1. The system shall be programmable, configurable and expandable in the field without the need for special tools or PROM programmers and shall not require replacement of memory ICs. All programming may be accomplished through the standard control panel keyboard. All programs shall be stored in non-volatile memory.

3.3 LABELING:

A. All control panels, power extender panels and annunciator panels shall be permanently labeled with their respective panel designations.

B. All Fire Alarm panels shall be permanently labeled with the Room name/number containing the 120V panelboard feeding the fire alarm and the branch circuit panelboard and branch circuit number designation.

C. All notification and initiating devices shall labeled with adhesive label noting the point number as address as displayed in the program.

3.4 TESTING:

A. Provide initial certification testing of the system in accordance with the procedures outlined in NFPA 72. The minimum required tests are as follows:

1. Where voice alarm communication system are shown on the plans, After all speaker taps have been properly set in accordance with the Construction Documents, test all Acoustically Distinguishable Spaces for intelligibility in accordance with applicable NFPA-72 testing requirements using a certifiable, listed, calibrated intelligibility meter. Test methods shall be one of the following:

   a. STI (Speech Transmission Index).
   b. STIPA (Speech Transmission Index – Public Address).
   c. Ref. IEC 60268-16. The Objective Rating of Speech Intelligibility by Speech transmission Index, 1998.

2. Test each initiating and notification circuit. One connection each should be opened at not less than 10 percent of the initiating and notification devices.

3. Test each initiating and notification device for alarm operation and proper response at the control unit. Test smoke detectors with listed aerosols acceptable to the manufacturer or other such testing methods which are approved by the manufacturer.

4. Test the system for all specified functions in accordance with the manufacturer's operating and maintenance manual.

5. Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the period and in the manner required by NFPA 72.

6. Verify that each alarm notification device functions as specified. Determine that the system is operable under trouble conditions as specified.

7. Coordinate testing with the Engineer and Owner to verify proper wiring of all required interfaces with existing systems.

8. Provide all labor required for making post-installation field adjustments to visual or audible notification appliances candela and or dB levels as directed by the Owner, Engineer, or

Authority Having Jurisdiction (scope of adjustments to be established by the Engineer following acceptance testing).

9. Provide all other testing required by NFPA 72 but not specified herein.

B. Document all testing in accordance with the National Fire Alarm Code. Submitted documentation shall include but shall not be limited to the following items:

1. Fully completed NFPA-72 Record of Completion form

2. Fully completed NFPA-72 Inspection and Testing form

3. Intelligibility test results (with measurements taken and "Pass/fail")

C. On Site Services:

1. Contractor shall provide the onsite services of an authorized technical representative of the fire alarm system, to supervise connections and fully test devices and components of the system as installed.

D. Final Acceptance:

1. Upon completion, the Contractor shall conduct functional tests of the entire system for the Authority Having Jurisdiction, Owner and Engineer as required until the system is demonstrated to be free of unexplained alarms, troubles, faults, or any abnormalities

2. In the event that additional software programming is necessary to complete the tests, the system shall be completely retested as outlined in this section at the contractor's expense.

3. The system will be accepted only after a satisfactory test of the system has been accomplished by the system representative.

4. Systems which are indicated on the drawings to be monitored via central station services shall not be accepted until the final be U.L. certificate(s) have been furnished to the owner.

3.5 SPARE PARTS, CONSUMABLES, & EXTRA MATERIALS

A. General: Furnish extra materials, packaged with protective covering for storage, and identified with labels clearly describing contents as follows:

1. Break Rods for Manual Stations: Furnish quantity equal to 15 percent of the number of manual stations installed; minimum of 6 rods.
2. Notification Appliances: Furnish quantity equal to 10 percent of each type and number of units installed, but not less than one of each type.
3. Smoke Detectors or Sensors, Fire Detectors, and Flame Detectors: Furnish quantity equal to 10 percent of each type and number of units installed but not less than one of each type.
4. Detector or Sensor Bases: Furnish quantity equal to 2 percent of each type and number of units installed but not less than one of each type.

3.6 WARRANTY:

A. Equipment and Wiring:

1. All equipment and wiring furnished and installed under this specification shall be warranted from inherent mechanical or electrical defects for a period of one (1) year from the date of beneficial use or occupancy.

B. Maintenance Request:

1. Guarantee response to a repair request within twenty four (24) hours after receipt of such a call.

2. Make available to the Owner a service department of an authorized representative who will provide repair maintenance during normal working hours at no cost to the Owner for a period of twelve (12) months from the date of beneficial use or occupancy.

3.7 TRAINING:

A. On Site Services:

1. Owner's representative shall be instructed in the proper use and testing of the system.

END OF SECTION 283100

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Protection of existing trees and vegetation to remain.
2. Removal of surface debris.
3. Grubbing.
4. Removal of sod and grassing.
5. Removal of indicated pavements and other above-grade improvements.
6. Removal of indicated below-grade improvements.

1.3 MATERIALS OWNERSHIP

A. Except for materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from the site.

1.4 SUBMITTALS

A. Record drawings according to Division 1 Specification Sections.

1. Identify and accurately locate capped utilities and other subsurface structural, electrical, and mechanical conditions which will remain.

1.5 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Specification Sections.

B. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts that are completely familiar with the specified requirements and methods needed for the proper performance of the Work of this Section.

C. Use equipment adequate in size, capacity and numbers to accomplish the Work in a timely manner.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable regulations relating to environmental requirements, disposal of debris, burning debris on-site, use of herbicides, and City of North Charleston/SCDHEC requirements for sedimentation and erosion control.

B. Coordinate clearing work with utility companies.

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
3. Repair any damage to walks, streets, etc incurred due to rerouting during the construction process at no additional cost to the owner.

B. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.

1. DO NOT BEGIN TRENCH/PIT EXCAVATION BEFORE CALLING ‘PALMETTO UTILITY PROTECTION SERVICE’ AT 811 or (888) 721-7877. Call 72-hours before any planned excavation activities. Utilities within Public Properties or Easements will be located by P.U.P.S. Failure to notify P.U.P.S. will result in the Contractor being liable for any repairs to utilities that are damaged.
2. Protect existing improvements and utilities on adjoining properties and on the Owner’s property.
3. Restore damaged improvements or utilities to their original conditions, as acceptable to the property owner.

C. Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation indicated to remain in place, against unnecessary cutting, breaking or skinning or roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within the drip line, excess foot or vehicular traffic, or parking of vehicles with the drip line or any acts which may be harmful to the continued growth of the trees to be protected. Provide temporary guards to protect trees and vegetation to be left standing. For the purposes of tree protection, the drip line is defined as 1-1/2 times the diameter of the tree measured 4-feet above existing grade.

1. Water trees and other vegetation to remain within the limits of contract work as required to maintain their health during the course of construction operations.

2. Provide protection for roots over 1-1/2 inches in diameter that are cut during construction operations. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible or cut off cleanly below grade.
3. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner acceptable to the Architect/Engineer. Employ a licensed arborist to repair damages to trees and shrubs. All tree work shall be done in accordance with the most recent revision of the International Society of Arboriculture practices.
4. Replace trees that cannot be repaired and restore to full-growth status, as determined by arborist.

    a. If a tree identified to remain is damaged, remove tree and replace with a tree of the same or similar species, 2-inch caliper or larger, from balled and burlapped nursery stock when construction activities in the vicinity are completed.

D. Install tree protection barrier where indicated on the plans using metal tee for posts and orange construction fence, spacing posts no less than 8-feet on center. Height to be a minimum of 3-feet above grade.

    1. Place tree protection fencing in a manner to prevent the approach of equipment within the drip line of trees to remain.

E. Improvements on Adjoining Property: Authority for performing indicated removal and alteration work on property adjoining Owner's property will be obtained by Owner before award of Contract.

F. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.

G. Notify utility locator service for area where Project is located before site clearing. Mark for easy recognition identified objects.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Section 312000 – Earth Moving.

    1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on-site.

2.2 ACCESSORIES

A. Herbicide: Contractor’s choice of legal and appropriate chemical formulation for selective weed control for the specific season of year as approved by applicable regulatory agency.

B. Tree Wound Paint: Bituminous based paint of standard manufacture specifically formulated for tree wounds.

PART 3 - EXECUTION

3.1 PREPARATION

A. Locate and identify utilities to remain.

B. Protect and maintain benchmarks and survey control points from disturbance during construction.

C. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

D. Locate and clearly flag trees and vegetation to remain.

E. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

F. Identify a temporary storage area for placing removed materials.

3.2 UTILITIES

A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.

1. Owner will arrange to shut off indicated utilities when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.

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

1. Notify Architect/Engineer not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect/Engineer's written permission.

3.3 CLEARING AND GRUBBING

A. Remove obstructions, grass, and other vegetation as indicated and to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain.
2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.

3. Completely remove surface rock, stumps, roots, obstructions, and debris extending to a depth of 18-inches below exposed subgrade.

    a. Remove roots 1-1/2 inches or smaller.
    b. Clear undergrowth and deadwood without disturbing topsoil.
    c. Apply herbicide to remaining stumps to inhibit growth.

4. Use only hand methods for grubbing within drip line of remaining trees.
5. Remove existing sod and grassing without disturbing topsoil.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding 6-inch loose depth, and compact each layer to a density equal to adjacent original ground.

C. Selective Clearing:

1. Shall be performed in areas designated by Architect/Engineer.
2. Selective clearing shall consist of remove all vegetation, brush, stumps, etc. within the designated area. Grubbing will not be required within these areas. Grub areas, as directed, using by-hand methods only.
3. Selected trees shall be left standing and care shall be taken not to damage remaining trees.

D. Tree Pruning: Where existing trees are to remain, and branches encroach with the areas of new construction, prune individual trees as necessary.

1. Trim trees designated to remain of dead branches of 1-1/2 inches in diameter or greater.
2. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branch.
3. Paint cuts greater than 1-1/4 inches in diameter with approved tree wound paint.

3.4 TOPSOIL STRIPPING

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1-inch in diameter; and free of weeds, roots, and other deleterious materials. If necessary, topsoil requirements shall be met by offsite sources at no additional cost to project.

B. See Section 312000 – Earth Moving.

3.5 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove portions of slabs, pavements, curbs, gutters, aggregate bases, and other above-grade improvements as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

3.6 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.

B. Burning is NOT permitted on the Owner’s Property.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Any discrepancies between specifications and geotechnical report, strictest shall apply.

1.2 SUMMARY

A. Section Includes:

1. Topsoil stripping, stockpiling, respreading, and removal.
2. Rough Grading and preparing subgrades for slabs-on-grade, walks, pavements, lawns, and plantings.
3. Finish Grading for slabs-on-grade, walks, pavements, lawns, and plantings.
4. Dressing of shoulders and banks.

1.3 Not used.

1.4 REFERENCES

A. ANSI/ASTM D698 – Test Methods for Moisture-Density Relations of Soil and Soil-Aggregate Mixtures, using 5.5 lbs. Rammer and 12-inch drop.

B. ANSI/ASTM D1556 – Test Method for Density of Soil in Place by Sand-Cone Method.

C. SCDOT – Standard Specifications for Highway Construction, South Carolina Department of Transportation; 2000 Edition.

1.5 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Layer placed between the subbase course and asphalt paving.

C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations indicated.

1. Unauthorized Excavations: Removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect/Engineer. Unauthorized excavation, as well as remedial work directed by Architect/Engineer, shall be at the Contractor's expense.
2. Additional Excavations: Excavation below subgrade elevations as directed by the Architect/Engineer.

    a. When excavations have reached required subgrade elevations, notify the Architect/Engineer and Testing Agency, who will make an inspection of conditions. If the Architect/Engineer and Testing Agency determine that bearing materials at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered and replace excavated materials by the Architect/Engineer and Geotechnical Engineer.
    b. The Contract Sum may be adjusted by an appropriate Contract Modification.

        1) Removal of unsuitable material and its replacement, as directed, will be paid on basis of Conditions of Contract relative to changes in Work. Notify the Architect/Engineer prior to removal of any unsuitable materials.

3. Muck: Materials unsuitable of carrying loads due to high organic content or saturation to the extent that it is somewhat fluid and must be removed by dragline, dredge or other special equipment, are designated as Muck.
4. Bulk Excavation: Excavations more than 10-feet in width and pits more than 30-feet in either length or width.

G. Fill: Soil materials used to raise to subgrade elevations indicated.

H. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material exceeding 1-c.y. for bulk excavation or ¾-c.y. for trench and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Excavation of Trenches and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-wide, short-tip-radius rock bucket; rated at not less than 120-hp flywheel power with bucket-curling force of not less than 25,000 lbs. and stick-crowd force of not less than 18,700 lbs.; measured according to SAE J-1179.
2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 45,000-lbs. breakout force; measured according to SAE J-732.

I. Structures: Buildings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.

K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

L. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2-inches in diameter; and free of weeds, roots, and other deleterious materials.

M. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.6 SUBMITTALS

A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D2487 of each on-site or borrow soil material proposed for fill and backfill.
2. Laboratory compaction curves according to ASTM D698 for each on-site or borrow soil material proposed for fill and backfill.
3. Laboratory compaction curves according to ASTM D1557 for each on-site or borrow soil material proposed for fill and backfill.

B. Project Record Documents: Accurately record actual locations and make as as-built drawing of all utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.7 QUALITY ASSURANCE

A. Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.

B. Perform Work in accordance with State of South Carolina Highway Department Standard Specifications.

1. Maintain one copy on site.

C. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.

D. Geotechnical Testing and Inspection Service: The Owner will employ and pay for a qualified independent Geotechnical Testing Agency to perform soil testing and inspection services during earthwork operations. The Contractor shall schedule his work in such a manner to permit a reasonable amount of time for testing to be performed before placing succeeding lifts of fill material and shall keep the Testing Agency informed of all progress.

1. The Owner shall pay for the cost of initial testing, subsequent tests, which are required as a result of a test failure, shall be paid for by the Contractor.

E. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E329 to conduct soil materials and rock-definition testing, as documented according to ASTM D3740 and ASTM E548.

F. Use of Explosives: Use of explosives is NOT permitted on the Owner's property.

G. Pre-Excavation Conference: Conduct conference at Project site to comply with requirements in Division 1 Specification Sections.

1.8 PROJECT CONDITIONS

A. Existing Utilities: Locate existing underground utilities in areas of excavation work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.

1. DO NOT BEGIN ANY TRENCH/PIT EXCAVATION BEFORE CALLING 'PALMETTO UTILITY PROTECTION SERVICE' AT 800 or (888) 721-7877. Call 72-Hours before any planned excavation activities. Utilities within Public Properties and Easements will be located by P.U.P.S. Failure to notify P.U.P.S., will result in the Contractor being liable for any repairs to utilities which are damaged.
2. In the event uncharted, or incorrectly charted, piping or other utilities are encountered during excavation, consult utility owner immediately for directions. Cooperate with the Owner and utility companies in keeping respective services in operations. Repair damaged utilities to the satisfaction of the utility owner.
3. Do not interrupt existing utilities serving facilities occupied by the Owner or others, during occupied hours, except when permitted in writing by the Architect/Engineer and then only after acceptable temporary utilities have been provided.
4. Provide a minimum of 48-hours notice to the Architect/Engineer, and receive written notice to proceed before interrupting any utility.

B. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.

1. Operate warning lights as recommended by authorities having jurisdiction.
2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
3. Perform excavation by hand within drip line of large trees to remain. Protect root systems from damage or dry-out to the greatest extent possible. Maintain moist conditions for root system and cover exposed roots with moistened burlap.

C. Dust Control: Use means necessary to prevent dust from becoming a nuisance to the public, to neighbors, and to others working on or near the site.

D. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.

E. Protect benchmarks, survey control points, existing structures, fences, sidewalks, pavements, curbs, gutters, and other structures from excavation equipment and vehicular traffic.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Soil materials used as fill, backfill, subgrades for structures or pavements, embankments, or grading shall consist of suitable materials as found available on site until such supply of on-site material is depleted.

1. Provide suitable materials free of organic matter and deleterious substances, containing no rocks or lumps over 6-inches in the largest dimension, and with not more than 15% of rocks or lumps larger than 2-1/2 inches in the greatest dimension.
2. Do not permit rocks having a dimension greater than 1-inch in the upper 6-inches of fill or embankment.

B. In the event that the quantity of suitable on-site materials is insufficient to complete the Work, suitable borrow materials, as approved by the Architect/Engineer, shall be provided by the Contractor at no additional expense to the Owner.

C. Satisfactory Fill Materials: Materials used for site grading should meet USCS classification SP, SP-SM, SP-SW, SW, or SM and have less than 35% passing the #200 sieve, and be free of organic matter and other deleterious debris. The near surface soils consist of sand to silty sand and may be used as borrow material for site development. The geotechnical testing agency should be consulted with regarding characterization and treatment of on-site materials for use as structural fill.

D. Unsatisfactory Materials: Unsatisfactory fill materials include materials which do not satisfy the requirements for suitable materials, as well as topsoil and organic materials (OH, OL), elastic Silt (MH), and high plasticity Clay (CH).

E. Subsoil Materials: Excavated material, graded free of lumps larger than 6-inches and rocks larger than 3-inches and debris.

F. Backfill and Fill Materials: Satisfactory soil materials free of clay, rock or gravel larger than 2-inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.

G. Subbase: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; with at least 90-percent passing a 1-1/2-inch sieve and not more than 12-percent passing a No. 200 sieve.

H. Base: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; with at least 95-percent passing a 1-1/2-inch sieve and not more than 8-percent passing a No. 200 sieve.

I. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100-percent passing a 1-inch sieve and not more than 8-percent passing a No. 200 sieve.

J. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100-percent passing a 1-1/2- inch sieve and 0 to 5-percent passing a No. 8 sieve.

K. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100-percent passing a 1-inch sieve and 0 to 5-percent passing a No. 4 sieve.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6-inches wide and 4-mils thick, continuously inscribed with a description of the utility; colored as follows:

B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6-inches wide and 4-mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30-inches deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sanitary and Storm Sewer systems.

C. Filter Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to SCDOT Standard Specifications Section 804.11 (2000), ASTM D4759, and referenced standard test methods:

1. Grab Tensile Strength: 90 lbs.; ASTM D4632.
2. Tear Strength: 40 lbs.; ASTM D4533.
3. Puncture Resistance: 40 lbs.; ASTM D4833.
4. Water Flow Rate: 150 gpm per sq. ft.; ASTM D4491.
5. Apparent Opening Size: No. 50; ASTM D4751.
6. Acceptable Products (or equal):

    a. AMOCO Fabrics and Fibers Co.
    b. Mirafi, Inc.
    c. Reemay Inc., Typar Geotextile Fabric.

D. Separation Fabric: Woven geotextile, specifically manufactured for use as a separation geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to SCDOT Standard Specifications Section 804.11 (2000), ASTM D4759, and referenced standard test methods:

1. Grab Tensile Strength: 200 lbs.; ASTM D4632.
2. Tear Strength: 80 lbs.; ASTM D4533.
3. Puncture Resistance: 80 lbs.; ASTM D4833.
4. Water Flow Rate: 4 gpm per sq. ft.; ASTM D4491.
5. Apparent Opening Size: No. 30; ASTM D4751.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that survey benchmarks, existing grades and contours, and intended elevations for the Work are as indicated.

B. Examine the areas and conditions under which the Work of this Section will be preformed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

C. All site preparation work, topsoil and subsoil excavation, and filling work shall be performed in strict accordance with this specification and in accordance with the subsurface investigation report. The strictest requirements shall apply if discrepancies occur.

3.2 PREPARATION

A. Verify that grubbing operations are completed before commencing the Work of this Section.

B. Complete any demolition and/or removal work as may be required prior to grading operations.

C. Identify required lines, levels, contours, and datum.

D. Stake and flag locations of known utilities.

E. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

F. Protect plant life, lawns, and other features remaining as a portion of final landscaping..

G. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

H. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

I. Establish and maintain the gravel Construction Entrance.

J. Sampling and Preliminary Testing:

1. Prior to beginning any grading operations, the Contractor shall submit to the Architect/Engineer a proposed sequence of excavation operations.
2. Based upon the sequence of excavations, samples of the anticipated fill materials will be obtained as excavations proceed and tested for grain size, permeability, and moisture-density relationships using the Standard Proctor Method (ASTM D698, Method A).
3. Allow sufficient time for completion of laboratory tests of the soils being tested before beginning any fill operations with the soil in question.

3.3 DEWATERING

A. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.4 EXPLOSIVES

A. Explosives: Do not use explosives.

3.5 GENERAL EXCAVATION

A. Excavation is classified.

B. Suitable excavation material shall be transported to and placed in fill areas within the limits of the Work.

C. Unsuitable materials encountered under the building pad must be excavated to the extent as directed by the Architect/Engineer and replaced with suitable materials from on-site or off-site borrow excavations.

D. Unsuitable materials encountered in areas to be paved shall be excavated to a minimum of 2-feet below finish grade and replaced with suitable materials from on-site or off-site borrow excavations.

E. Unsuitable and surplus excavation materials, not required for subsequent fill or backfill, shall be disposed of off-site.

3.6 STABILITY OF EXCAVATIONS

A. General: Comply with all local codes, ordinances, and requirements of agencies having jurisdiction.

B. Slope side of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of materials excavated. Maintain sides and slopes of excavations in safe condition until completion of backfill.

C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross bracing, in good serviceable condition. Maintain shoring and bracing in excavations during the entire time period excavations will be open. Extend shoring and bracing as excavation progresses.

3.7 TOPSOIL EXCAVATION

A. Excavate topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials and stockpile for latter use.

1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable materials.
2. Where existing trees are indicated to remain, leave existing topsoil in-place within the drip line to prevent damage to root systems.

B. Stockpile in areas designated on site.

C. Do not remove topsoil when wet.

D. Stockpile topsoil to height not to exceed 8-feet. Cover to protect from erosion.

E. Do not allow topsoil to be mixed with subsoils.

3.8 SOIL EXCAVATION (CUTS)

A. Perform excavating of every type or material encountered, within the limits of the Work, to the lines, grades, and elevations indicated and specified.

B. Excavate subsoil from areas to be further excavated, re-landscaped, or re-graded.

C. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.

D. When excavating through roots, perform work by hand and cut roots with a sharp axe.

E. Benching Slopes: Horizontally bench existing slopes greater than 4:1 (4-horizontal to 1-vertical) to key fill material to slope for firm bearing.

F. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

G. Rock Excavation:

1. Notify the Architect/Engineer upon encountering rock or similar materials that cannot be removed or excavated by conventional earth moving or ripping equipment.
2. Do not use explosives on the Owner's Property without written permission from the Architect/Engineer.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

B. Stockpile excavated materials acceptable for backfill and fill where directed.

C. Stockpile excavated topsoil to be reused on-site; remove remainder from site.

D. Stockpile excavated subsoil, not placed directly into fill areas and to be reused at a later time, on-site; remove remainder from site.

3.10 BACKFILL AND FILL

A. Use fills consisting of suitable materials placed in loose lifts of 10-inches or less (in use with smooth drum/sheepsfoot rollers) and rolled and/or vibrated with suitable equipment until compacted (limited to 4-inches if using small, hand-operated equipment).

B. Do not place materials containing rocks or clumps that will pass through a 6-inch diameter ring within the top 12-inches of the surface of the completed fill. Do not place materials containing rocks that will not pass through a 1-inch ring within the top 6-inches of the completed fill.

C. Fill materials containing broken concrete or broken asphaltic pavements will not be acceptable.

D. General: Place and compact soil material in layers to required subgrade elevations, for each area classification listed below, using materials specified in Part 2 of this Section.

1. Under grass and planted areas; use satisfactory excavated or borrow soil material.
2. Under walks and pavements; use satisfactory excavated or borrow soil material and appropriate subbase material.
3. Under steps and ramps; use satisfactory excavated or borrow soil material and appropriate subbase material.

4. Under building slabs; use satisfactory excavated or borrow soil material and appropriate granular drainage fill subbase material.
5. Under footings and foundations; use satisfactory excavated or borrow soil material.

3.11 PLACEMENT AND COMPACTION

A. Fill area to contours and elevations with unfrozen, dry materials.

B. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow strip, or break up sloped surfaces steeper than 4-horizontal to 1-vertical (4:1) such that fill materials will bond with existing surface.

C. When existing ground surface has a density less than that specified under "Compaction" for a particular area classification, break up ground surface, pulverize, moisture-condition to within 3-percent of optimum moisture content, and compact to required depth and percentage of maximum density.

D. Place backfill and fill materials in layers not more than 10-inches loose depth for material to be compacted by heavy compaction equipment, and not more than 4-inches loose depth for material to be compacted with hand-operated tampers.

E. Before compaction, moisten or aerate each layer as necessary to within 3-percent of optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

F. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately the same elevation in each lift.

G. Control soil and fill compaction, providing a minimum percentage of density specified for each area classification indicated below. Correct improperly compacted areas or lifts as directed by the Architect/Engineer if soil density tests indicate inadequate compaction.

H. Percentage of Maximum Density Requirements: Compact controlled fill to 95% of the material's maximum Modified Proctor dry density (ASTM D1557). Compact general (onsite) fill to 95% of the material's maximum Standard Proctor dry density (ASTM 698).

I. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantities as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.

1. Remove and replace, or scarify and air dry, soil materials that are wet to permit compaction to specified density.

2. Stockpile or spread soil materials that have been removed because it is too wet to permit compaction. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory level.

J. Slope grades away from buildings a minimum of 3-inches in 10-feet, unless noted otherwise.

K. Make grade changes gradual. Blend slopes into level areas.

3.12 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Remove debris, roots, branches, and stones in excess of 1" inch in size. Remove soil contaminated with petroleum products.

C. Site Grading Outside Building Lines: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Shape surfaces to receive topsoil to within not more than 0.1-foot.
2. Walks: Shape surface of areas under walks to line, grade, and cross-section to within not more than 0.1-foot.
3. Pavements: Shape surface of areas under pavements to line, grade, and cross-section to within not more than 1/2-inch.

D. Grading Inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

E. Compaction: After grading, compact subgrade surfaces to depth and indicated percentage per "Placement and Compaction."

F. Surface Roughening:

1. Where topsoil is to be placed, scarify surface to depth of 4-inches.
2. In areas where vehicles or equipment have compacted soils, scarify surface to a depth of 6-inches.
3. Cuts, Fills, and Graded Areas that will be Mowed:

    a. Make slopes to be mowed no steeper that 3-horizontal to 1-vertical (3:1).
    b. Roughen these areas with shallow grooves by normal tilling, disking, harrowing, or use of cultipacker-seeder. Make the final pass of any such tillage implement on the contour.
    c. Make grooves formed by such implements close together (less than 10-inches and not less than 1-inch deep.
    d. Excessive roughness is undesirable for areas to be mowed.

4. Roughening with Tracked Machinery:

a. Limit roughening with tracked machinery to sandy soils to avoid undue compaction of the soil surface. Tracking is generally not as effective as the other roughening methods described.
b. Operate tracked machinery up and down the slope to leave horizontal depressions in the soil. Do not back-blade during final grading operations.

3.13 FINISH GRADING

A. General: Finish grading consists of preparation of all disturbed areas outside of structures, paving and other surfaces for the establishment of lawn areas.

B. Before Finish Grading:

1. Verify building and trench backfilling has been inspected.
2. Verify subgrade has been contoured and compacted.

C. Degree of finish shall be that ordinarily obtainable from a blade-grader, supplemented with hand raking and finishing.

D. Loosen subgrade of lawn areas to minimum depth of 4-inches. Remove stones measuring over 1” inch in any dimension. Remove sticks, roots, rubbish, and other extraneous matter. Limit preparation to areas that will be planted promptly after preparation.

E. Spread topsoil to minimum depth required to meet lines, grades, and elevations shown, after light rolling and natural settlement.

F. Place topsoil in areas where seeding, sodding, planting, and other landscaped areas are indicated.

G. Place topsoil to the following compacted thickness:

1. Areas to be Seeded with Grass: 6-inches or as otherwise noted on plans.
2. Areas to be Sodded with Grass: 4-inches or as otherwise noted on plans.

H. Place topsoil during dry weather.

I. Remove roots, weeds, rocks, and other foreign material while spreading. Remove foreign material from site.

J. Near existing plants, buildings and other features spread topsoil manually to prevent damage.

K. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contours of subgrade.

3.14 TOLERANCES

A. Top Surface of Subgrade: Plus or minus 0.1-foot from required elevation.

B. Top Surface of Finish Grade: Plus or minus 1/2-inch from required elevation.

3.15 SUBBASE AND BASE COURSES

A. General: Subbase courses consist of placing subbase material, in layers of specified thicknesses, over subgrade surfaces to support a pavement base course.

1. Base courses, subbase courses, and drainage base courses are specified in Section 32 11 23 - Aggregate Base Courses.

B. Excavation for Pavements: Cut surface under pavement to comply with cross-section, elevations, and grades as indicated.

C. Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course.

D. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12-inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer.

3.16 FIELD QUALITY CONTROL

A. Testing Agency: The Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality control testing.

B. Allow Testing Agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Testing Agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2922, and ASTM D2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one (1) test for every 2,000 sq. ft. or less of paved area or building slab, but in no case fewer than three (3) tests.

D. When Testing Agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

E. Proofrolling: The Contractor shall proofroll subgrade areas that will receive paving, structures on fill or impervious lining material.

1. Make at least three (3) passes with a 25 to 50-ton rubber tired vehicle over the entire area.
2. Unstable, soft or otherwise unsuitable materials revealed by the proofrolling shall be removed and replaced with satisfactory materials and compacted as specified.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by the Architect/Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing. This shall include 'late' installation of electrical, telephone or fiber lines.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.18 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.

END OF SECTION 312000

SECTION 312070 – TRENCHING AND BACKFILLING FOR SITE UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Excavating trenches, backfilling and compacting for utilities, 5-feet outside the building, from site utility connections to Utility Main connections.

B. Compacted bedding under fill over utilities to subgrade elevations.

1.3 RELATED SECTIONS

A. Section 02 21 00 – Subsurface Investigation.

B. Section 31 10 00 – Site Clearing.

C. Section 31 20 00 – Earth Moving.

D. Section 02 37 00 – Erosion / Sedimentation Control.

E. Section 22 11 13 – Water Distribution System.

F. Section 33 41 00 – Storm Utility Drainage System.

G. Section 32 92 00 – Landscaping.

1.4 REFERENCES

A. AASHTO T180 – Standard Specification for Moisture-Density Relations of Soils using a 10-lbs. Rammer and an 18-inch drop; American Association of State Highway and Transportation Officials; 1997.

B. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Course Aggregates; 1996a.

C. ASTM D698 – Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort {12,400 ft-lbs/cf}; 1991 (Re-Approved 1998).

D. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in-place by the Sand-Cone Method; 1990 (Re-Approved 1996).

E. ASTM D1557 – Test Method for Laboratory Compaction Characteristics of Soil using Modified Effort {56,000 ft-lbs/cf)}; 1991 (Re-Approved 1998).

F. ASTM D2167 – Standard Test Method for Density and Unit Weight of Soil in-place by the Rubber Balloon Method; 1994.

G. ASTM D2487 – Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System); 1998.

H. ASTM D2922 – Standard Test Methods for Density of Soil and Soil-Aggregate in-place by Nuclear Methods (Shallow Depth); 1996.

I. ASTM D3017 – Standard Test Method for Water Content of Soil and Rock in-place by Nuclear Methods (Shallow Depth); 1996.

J. ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 1998.

K. SCDOT – Standard Specifications for Highway Construction, South Carolina Department of Transportation; 2007 Edition.

1.5 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

C. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

D. Excavation: Removal of material encountered to subgrade elevations indicated and subsequent disposal of materials removed.

E. Unauthorized Excavations: Removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect/Engineer. Unauthorized excavation, as well as remedial work directed by Architect/Engineer, shall be at the Contractor’s expense.

1. Under footings, foundation bases, or retaining walls, correct unauthorized excavations by extending indicated bottom elevation of footing or base to excavated bottom, without altering the required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to the Architect/Engineer.

2. In locations other than those above, backfill and compact unauthorized excavations as specified for authorized excavations for same classification, unless otherwise directed by the Architect/Engineer.

F. Additional Excavations: Removal of materials beyond indicated subgrade elevations as directed by the Architect/Engineer. When excavation has reached required subgrade elevations, notify the Architect/Engineer and Testing Agency, who will make an inspection of conditions.

If the Architect/Engineer and Testing Agency determines that bearing materials at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered and replace excavated materials as directed by the Architect/Engineer. The Contract Sum may be adjusted by an appropriate Contract Modification.

1. Remove of unsuitable material and its replacement, as directed, will be paid on basis of Conditions of Contract relative to changes in Work. Notify the Architect/Engineer prior to removal of any unsuitable materials.

G. Rock Excavation: Removal of any hard, natural substances that requires the use of explosives and/or special impact tools such as jackhammers, sledges, chisels or similar devices specifically designed for use in cutting or breaking rock, but exclusive of trench excavation machinery. To be considered rock, the substance shall be of continuous material; individual boulders or rocks in soil will not be considered to be rock excavation.

H. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material exceeding 1-c.y. for bulk excavation or 3/4-c.y. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:

1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-wide, short-tip-radius rock bucket; rated at not less than 120-hp flywheel power with bucket-curling force of not less than 25,000 lbs. and stick-crowd force of not less than 18,700 lbs.; measured according to SAE J-1179.
2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 45,000-lbs. breakout force; measured according to SAE J-732.

I. Muck: Materials unsuitable of carrying loads due to high organic content or saturation to the extent that the material is somewhat fluid and must be removed by dragline, dredge or other special equipment.

J. Bulk Excavation: Excavations more than 10-feet in width and pits more than 30-feet in either length or width.

K. Fill: Soil materials used to raise existing grades to subgrade elevations indicated.

L. Finish Grade Elevations: Elevations indicated on the Drawings.

M. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

N. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

O. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2-inches in diameter; and free of weeds, roots, and other deleterious materials.

P. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.6 SUBMITTALS

A. Product Data: For the following:

1. Each type of plastic warning tape.
2. Drainage fabric.
3. Separation fabric.

B. Materials Sources: Submit name of imported material source.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D2487 of each on-site or borrow soil material proposed for fill and backfill.
2. Laboratory compaction curves according to ASTM D698 for each on-site or borrow soil material proposed for fill and backfill.
3. Laboratory compaction curves according to ASTM D1557 for each on-site or borrow soil material proposed for fill and backfill.

D. Project Record Documents: Accurately record actual locations and make as as-built drawing of all utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.7 QUALITY ASSURANCE

A. Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.

B. Perform Work in accordance with State of South Carolina Highway Department Standard Specifications.

1. Maintain one copy on site.

C. All work shall be performed in strict accordance with this specification and in accordance with the subsurface investigation referenced in Section 022100. The strictest requirements shall apply if discrepancies occur.

D. Provide sufficient quantities of fill to meet the project schedule and requirements. When necessary, store materials on-site in advance of need.

E. When fill materials need to be stored on-site, locate stockpiles where designated.

1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
2. Prevent contamination.
3. Protect stockpiles from erosion and deterioration of materials.

F. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.

G. Geotechnical Testing and Inspection Service: The Owner will employ and pay for a qualified independent Geotechnical Testing Agency to perform soil testing and inspection services during earthwork operations. The Contractor shall schedule his work in such a manner to permit a reasonable amount of time for testing to be performed before placing succeeding lifts of fill material and shall keep the Testing Agency informed of all progress.

1. The Owner shall pay for the cost of initial testing, subsequent tests, which are required as a result of a test failure, shall be paid for by the Contractor.

H. Pre-Excavation Conference: Conduct conference at Project site to comply with requirements in Division 1 Specification Sections.

1.8 PROJECT CONDITIONS

A. Existing Utilities: Locate existing underground utilities in areas of excavation work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.

1. DO NOT BEGIN ANY TRENCH/PIT EXCAVATION BEFORE CALLING ‘PALMETTO UTILITY PROTECTION SERVICE’ AT 811 or (888) 721-7877. Call 72-Hours before any planned excavation activities. Utilities within Public Properties and Easements will be located by P.U.P.S. Failure to notify P.U.P.S., will result in the Contractor being liable for any repairs to utilities which are damaged.
2. In the event uncharted, or incorrectly charted, piping or other utilities are encountered during excavation, consult utility owner immediately for directions. Cooperate with the Owner and utility companies in keeping respective services in operations. Repair damaged utilities to the satisfaction of the utility owner.
3. Do not interrupt existing utilities serving facilities occupied by the Owner or others, during occupied hours, except when permitted in writing by the Architect/Engineer and then only after acceptable temporary utilities have been provided.
4. Provide a minimum of 48-hours notice to the Architect/Engineer, and receive written notice to proceed before interrupting any utility.

B. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.

1. Operate warning lights as recommended by authorities having jurisdiction.
2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
3. Perform excavation by hand within drip line of large trees to remain. Protect root systems from damage or dry-out to the greatest extent possible. Maintain moist conditions for root system and cover exposed roots with moistened burlap.

C. Dust Control: Use means necessary to prevent dust from becoming a nuisance to the public, to neighbors, and to others working on or near the site.

D. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.

E. Protect benchmarks, survey control points, existing structures, fences, sidewalks, pavements, curbs, gutters, and other structures from excavation equipment and vehicular traffic.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Soil materials used as fill, backfill, and subgrades for structures shall consist of suitable materials as found available on site until such supply of on-site material is depleted.

1. Provide suitable materials free of organic matter and deleterious substances, containing no rocks or lumps over 2-inches in the largest dimension, and with not more than 15% of rocks or lumps larger than 1-inche in the greatest dimension.
2. Do not permit rocks having a dimension greater than 1/2-inch in the upper 6-inches of fill or backfill.

B. If unsuitable soils are encountered and are determined to be unusable on the project site as directed by the third party geotechnical engineer, the contractor will be compensated for removal and replacement with suitable material.

C. Satisfactory Fill Materials: Materials used for site grading should meet USCS classification SP, SP-SM, SP-SW, SW, or SM and have less than 35% passing the #200 sieve, and be free of organic matter and other deleterious debris. The near surface soils consist of sand to silty sand and may be used as borrow material for site development. The geotechnical testing agency should be consulted with regarding characterization and treatment of on-site materials for use as structural fill.

D. Unsatisfactory Materials: Unsatisfactory fill materials include materials which do not satisfy the requirements for suitable materials, as well as topsoil and organic materials (OH, OL), elastic Silt (MH), and high plasticity Clay (CH).

E. Subsoil Materials: Excavated material, graded free of lumps larger than 6-inches and rocks larger than 3-inches and debris.

F. Subbase: See Section 321123 – Aggregate Base Course.

G. Base: See Section 321123 – Aggregate Base Course.

H. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; with at least 90-percent passing a 1-1/2-inch sieve and not more than 12-percent passing a No. 200 sieve.

I. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; except with 100-percent passing a 1-inch sieve and not more than 8-percent passing a No. 200 sieve.

J. Drainage Fill: See Section 321123 – Aggregate Base Course.

K. Filter Material: See Section 321123 – Aggregate Base Course.

L. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6-inches wide and 4-mils thick, continuously inscribed with a description of the utility; colored as follows:

B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6-inches wide and 4-mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30-inche deep; colored as follows:

1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sanitary and Storm Sewer systems.

C. Filter Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to SCDOT Standard Specifications Section 804.11 (2000), ASTM D4759, and referenced standard test methods:

1. Grab Tensile Strength: 90 lbs.; ASTM D4632.
2. Tear Strength: 40 lbs.; ASTM D4533.
3. Puncture Resistance: 40 lbs.; ASTM D4833.
4. Water Flow Rate: 150 gpm per sq. ft.; ASTM D4491.
5. Apparent Opening Size: No. 50; ASTM D4751.

6. Acceptable Products:

   a. AMOCO Fabrics and Fibers Co.
   b. Mirafi, Inc.
   c. Reemay Inc., Typar Geotextile Fabric.

D. Separation Fabric: Woven geotextile, specifically manufactured for use as a separation geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to SCDOT Standard Specifications Section 804.11 (2007), ASTM D4759, and referenced standard test methods:

1. Grab Tensile Strength: 200 lbs.; ASTM D4632.
2. Tear Strength: 80 lbs.; ASTM D4533.
3. Puncture Resistance: 80 lbs.; ASTM D4833.
4. Water Flow Rate: 4 gpm per sq. ft.; ASTM D4491.
5. Apparent Opening Size: No. 30; ASTM D4751.

2.3 SOURCE QUALITY CONTROL

A. See Division 1 Specification Sections, for general requirements for testing and analysis of soil materials.

B. Where fill materials are specified by reference to specific standards, test and analyze samples for compliance before delivery to site.

C. If tests indicate materials do not meet specified requirements, change materials and retest.

D. Provide materials of each type from same source throughout the Work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that survey benchmarks, existing grades and contours, and intended elevations for the Work are as indicated.

B. Examine the areas and conditions under which the Work of this Section will be preformed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

C. All site preparation work, topsoil and subsoil excavation, and filling work shall be performed in strict accordance with these specifications and in accordance with the subsurface investigation report. The strictest requirements shall apply if discrepancies occur.

3.2 PREPARATION

A. Verify that Clearing and Grubbing operations are completed before commencing the Work of this Section.

B. Complete any demolition and/or removal work as may be required prior to trenching operations.

C. Identify required lines, levels, contours, and datum locations.

D. See Section 312000 – Earth Moving for additional requirements.

E. Locate, identify, and protect existing utilities to remain from damage.

F. Notify utility companies, as required, before removing and/or relocating existing utilities.

G. Protect structures, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by trenching operations.

H. Protect plant life, lawns, and other features remaining as a portion of final landscaping.

I. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

J. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 DEWATERING

A. Prevent surface and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area. Maintain the excavations in a dry condition during construction operations.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

C. Maintain the subsurface water level below the excavation subgrade elevations during excavation and construction.

1. Material disturbed below the foundation subgrade elevation due to improper dewatering shall be removed and replaced with crushed stone or lean concrete at no additional cost to the Owner.
2. Use sumps, pumps, drains, trenching, or well point systems as necessary to maintain a dry excavation.
3. Dewatering by trench pumping will not be permitted if migration of fine-grained natural materials (running sand) occurs in the excavation bottom, side walls or bedding material.

4. Dispose of water pumped from excavations in storm drains having adequate capacity, trenches, or other approved locations.

    a. The Contractor is responsible to acquiring all permits necessary to discharge of water and shall protect waterways from turbidity during the operation.
    b. Prevent flooding of adjacent streets, roadways, or private property.
    c. Provide engines driving dewatering pumps with residential type mufflers.

3.4 EXPLOSIVES

A. Explosives: Do not use explosives.

3.5 TRENCHING

A. Notify the Architect/Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.

B. Slope banks of excavations deeper than 2-feet to angle of repose or less until shored.

C. Do not interfere with 45-degree splay of foundations.

D. Cut trenches to uniform width, wide enough to provide ample working room, allow for inspection of installed utilities, and a minimum of 6 to 9-inches of clearance on both sides of pipe or conduit.

E. Excavate trenches to depth indicated or required to establish indicated slopes and invert elevations and to support bottom of pipe or conduit on undisturbed soil. Excavate trenches to allow installation of top of pipe below the frost line.

1. Where rock is encountered, carry excavation below required elevation and backfill with a 6-inch layer of appropriate bedding backfill material.
2. For pipes or conduits less than 6-inches in nominal size, and for flat-bottomed, multiple-duct conduit units, do not excavate beyond indicated depths. Hand excavate bottom cut to accurate elevations and support pipe or conduit on undisturbed soil.
3. For pipes and equipment 6-inches or larger in nominal size, shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 or circumference). Fill depressions with tamped sand backfill. At each pipe joint, dig bell hoes to relieve pipe bell loads. Ensure continuous bearing of pipe barrel on bearing soil.

F. Hand trim excavations. Remove loose matter.

G. Remove lumped subsoil, large stones, and other hard matter that could damage piping or impede consistent backfilling or compaction.

H. Stockpile excavated materials to be re-used in areas designated on site in accordance with Section 312000 – Earth Moving.

I. Remove unsuitable excavated materials and materials not to be re-used from the project site.

3.6 STABILITY OF EXCAVATIONS

A. General: Comply with all local codes, ordinances, and requirements of agencies having jurisdiction.

B. Slope side of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of materials excavated. Maintain sides and slopes of excavations in safe condition until completion of backfill.

C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross bracing, in good serviceable condition. Maintain shoring and bracing in excavations during the entire time period excavations will be open. Extend shoring and bracing as excavation progresses.

3.7 PREPARATION FOR UTILITY PLACEMENT

A. Cut out soft areas of subgrade not capable of compaction in-place. Backfill with suitable materials per Part 2 of this Section.

B. Compact subgrade to density equal to or greater than requirements for subsequent fill materials.

C. Until ready to backfill, maintain excavations and prevent loose soils from falling into excavations.

3.8 APPROVAL OF SUBGRADE

A. Notify Architect/Engineer when excavations have reached required subgrade.

B. If Architect/Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect/Engineer.

3.9 BACKFILL AND FILL

A. General: Place soil materials in layers to required subgrade elevations, for each area classification listed below, using materials specified in Part 2 of this Section.

1. Under grassed areas: use satisfactory excavated or borrow soil materials.
2. Under walks and pavements: use appropriate subbase materials.
3. Under steps-on-grade: use appropriate subbase materials.

4. Under piping and conduit and equipment: use bedding subbase materials where required over rock bearing surfaces and for correction of unauthorized excavations. Shape excavation bottoms to fit bottom 90-degrees of pipe cylinder.
5. Backfill trenches: with lean concrete where trench excavations pass within 18-inches of column or wall footing and that are carried below bottom of such footings or that pass under wall footings. Place lean concrete to level of bottom of adjacent footings.

    a. Do not backfill trenches until tests and inspections have been made and backfilling has been authorized by the Architect/Engineer. Use care in backfilling to avoid damage or displacement of pipe systems.

6. Provide 4-inch thick concrete base slab support of piping or conduit less than 2'-6" below surface of roadways. After installation and testing or piping or conduit, provide minimum 4-inch thick encasement (side and top) of concrete prior to backfilling or placement of roadway subbase.

B. Place and compact backfill in excavations as promptly as work permits, but not before completing the following:

1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
2. Inspection, testing, approval, and recording of locations of underground utilities for record documents.
3. Removal concrete formwork.
4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in a manner to prevent settlement of the structure or utilities, or leave in place if required.
5. Removal of trash and debris from excavations.
6. Installation of permanent or temporary horizontal bracing on horizontally supported walls.

3.10 PLACEMENT AND COMPACTION

A. Fill areas to contours and elevations with unfrozen, dry materials.

B. Employ a placement method that does not disturb or damage other in-place work.

C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen, or spongy subgrade surfaces.

D. Place backfill and fill materials in layers not more than 8-inches loose depth for material to be compacted by heavy compaction equipment, and not more than 4-inches in loose depth for material to be compacted with hand-operated tampers.

E. Correct areas that are over-excavated.

1. Under load-bearing foundation surfaces: fill with lean concrete or engineered fill, flush to required elevation, compacted to 95-percent of maximum dry density.

2. Under other areas: fill with satisfactory fill materials, flush to required elevations, compacted to a minimum 95-percent maximum dry density.

F. Maintain optimum moisture content of fill materials to attain required compaction densities.

G. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill materials on surfaces that are muddy, frozen, or contain frost or ice.

H. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying materials uniformly around structure, piping or conduit to approximately the same elevation in each lift.

I. Control soil and fill compaction, providing minimum percentage of density specified for each area classification indicated below. Correct improperly compacted areas or lifts as directed by the Architect/Engineer if soil density test indicate inadequate compaction.

J. Percentage of Maximum Density Requirements: Compact controlled fill to 95% of the material's maximum Modified Proctor dry density (ASTM D1557). Compact general (onsite) fill to 95% of the material's maximum Standard Proctor dry density (ASTM 698).

K. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on the surface during or subsequent to compaction operations.

1. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
2. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory level.

L. Make grade changes gradual. Blend slopes into level areas.

M. Reshape and re-compact fills subjected to vehicular traffic.

N. Remove surplus fill materials from site.

3.11 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

B. Stockpile excavated materials acceptable for backfill and fill where directed.

C. Stockpile excavated topsoil to be reused on-site; remove remainder from site.

D. Stockpile excavated subsoil, not placed directly into fill areas and to be reused at a later time, on-site; remove remainder from site.

3.12 TOLERANCES

A. Top Surface of Subgrade: Plus or minus 0.1-foot from required elevation.

B. Top Surface of Finish Grade: Plus or minus 1/2-inch from required elevation.

3.13 FIELD QUALITY CONTROL

A. See Section 312000 – Earth Moving for addition compaction density testing requirements.

B. Testing Agency: The Owner will engage a qualified independent Geotechnical Engineering Testing Agency to perform field quality control testing.

C. Allow Testing Agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

D. Testing Agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2922, and ASTM D2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Trench Backfill: At each compacted initial and final backfill layer, at least one (1) test for each 150 feet or less of trench length, but no fewer than two (2) tests.

E. When Testing Agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.14 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Prevent displacement of banks and keep loose soil from falling into excavations; maintain soil stability.

C. Protect bottom of excavation and soil adjacent to and beneath foundations from freezing.

D. Keep footing excavations free from water. Pump out excavations containing water. Do not pour foundations when excavations are wet or not properly compacted.

E. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

F. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.15 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.

B. Leave site clean and raked, ready to receive final surfaces.

END OF SECTION 312070

SECTION 31 2319 - DEWATERING

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 construction dewatering.

1.3 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades. Refer to soils report as to appropriate means and methods to control said ground water. The contractor shall control, through diversion, channelization or other standard means and methods (#3 below), stormwater runoff from entering excavations including footings. The use of pumps, gravel sumps or additional piping to remove stormwater runoff from excavations and footings shall not constitute a change order to the construction documents.

1. Delegated Design: Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
3. Prevent surface water from entering excavations by grading, dikes, swales or other means.
4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
5. Remove dewatering system when no longer required for construction.

1.4 SUBMITTALS

A. Shop Drawings: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.

1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
2. Include a written plan for dewatering operations including control procedures to be adopted if dewatering problems arise.

B. Delegated-Design Submittal: For dewatering system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Qualification Data: For qualified Installer and professional engineer.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that has specialized in design of dewatering systems and dewatering work.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to dewatering including, but not limited to, the following:

a. Inspection and discussion of condition of site to be dewatered including coordination with temporary erosion control measures and temporary controls and protections.
b. Geotechnical report.
c. Proposed site clearing and excavations.
d. Existing utilities and subsurface conditions.
e. Coordination for interruption, shutoff, capping, and continuation of utility services.
f. Construction schedule. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
g. Testing and monitoring of dewatering system.
h. Consider acceptable outfall for diverted or collected water.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility serving 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 no fewer than three days in advance of proposed interruption of utility.

2. Do not proceed with interruption of utility without Construction Manager's written permission.

B. Project-Site Information: A geotechnical report has been prepared for this Project and is in the specification manual. 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. Make additional test borings and conduct other exploratory operations necessary for dewatering.
2. The geotechnical report is included elsewhere in the Project Manual.

C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements, establishing exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During dewatering, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Provide temporary grading to facilitate dewatering and control of surface water.

D. Monitor dewatering systems continuously.

E. Promptly repair damages to adjacent facilities caused by dewatering.

F. Protect and maintain temporary erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing" during dewatering operations.

3.2 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.
2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.

D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.

1. Maintain piezometric water level a minimum of 24 inches below surface of excavation.

E. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

F. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to Owner.

1. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

3.3 FIELD QUALITY CONTROL

A. Observation Wells: Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers indicated; additional observation wells may be required by authorities having jurisdiction.

1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

B. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

END OF SECTION 31 2319

SECTION 313116 - TERMITE CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Chemical Soil Treatment for Subterranean Termite Control and Formosan Termite Control.

1. Below slabs-on-grade.
2. Under, and at the perimeter of, interior and exterior foundations.

1.3 REFERENCES

A. Title 7, United States Code, 136 through 136y – Federal Insecticide, Fungicide and Rodenticide Act; United States Code; 1947 (Revised 1988).

1.4 DEFINITIONS

A. EPA: Environmental Protection Agency.

B. PCO: Pest control operator.

1.5 SUBMITTALS

A. See Division 1 Specification Sections for submittal procedures.

B. Product Data: Treatments and application instructions, including EPA-Registered Label.

1. Indicate toxicants to be used, composition by percentages, dilution schedule, and intended application rates.
2. Indicate caution requirements and include Manufacturer’s labels and seals identifying contents.

C. Product Certificates: Signed by manufacturers of termite control products certifying that treatments furnished comply with requirements.

1. Indicate regulatory agency approval reports when required.
2. Certify that toxicants meet or exceed specified required and all requirements of authorities having jurisdiction.

D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's record information, including the following as applicable:

1. Date and time of application.
2. Moisture content of soil before application.
3. Brand name and manufacturer of termiticide.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes, and rates of application used.
6. Areas of application.
7. Water source for application.

F. Maintenance Data: Indicate re-treatment schedule and warranty period.

G. Warranties: Submit manufacturer’s warranty and ensure that forms have been completed in the Owner’s name and registered with the manufacturer.

1.6 QUALITY ASSURANCE

A. Applicator Qualifications: A PCO who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment in jurisdiction where Project is located and who is experienced and has completed termite control treatment similar to that indicated for this Project and whose work has a record of successful in-service performance.

1. Company specializing in performing the Work of this Section with minimum 3-years documented experienced, approved by manufacturer, and licensed in the State of South Carolina. Company providing the termite bond must be located within a 50 mile radius.
2. All termite pesticides shall be provided in strict accordance to South Carolina Pesticide Control Act (SC Law 46-13 and Amendments) and Federal Regulations.

1.7 REGULATORY REQUIREMENTS

A. All termite pesticides shall be provided in strict accordance to South Carolina Pesticide Control Act (SC Law 46-13 and Amendment(s) and Federal Regulations. The contractor shall notify Clemson University Pesticide Regulation and Controls Program prior to beginning of treatment and application 864.646.2121).

B. Formulate and apply termiticides, and label with a Federal registration number, to comply with EPA regulations and authorities having jurisdiction.

C. Conform to applicable State of South Carolina codes for requirements for application, application licensing, and authority to use toxicant chemicals in accordance with EPA regulations.

D. Provide certificate of compliance from authority having jurisdiction indicating approval of toxicants.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with EPA-Registered Label requirements and requirements of authorities having jurisdiction.

1.9 COORDINATION

A. Coordinate soil treatment application with excavating, filling, and grading and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs, before construction.

1. Apply toxicant a minimum of 12-hours prior to installation of vapor barrier under slabs-on-grade or finish grading work outside foundation walls.

1.10 WARRANTY

A. See Division 1 Specification Sections for additional warranty requirements.

B. General Warranty: Special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

C. Special Warranty: Written warranty, signed by applicator and Contractor certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites and Formosan termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation. Upon notification and inspection, the Contractor will arrange for the necessary repairs or replacement and pay up to $1,000,000 costs of labor and materials for subterranean termites and $1,000,000 costs of labor and materials for Formosan termites.

D. Warranty Period: Contractor will extend protection annually to the Owner for a period of four years for $0.00/year on or before the end of the previous protection period. After the second year and each year thereafter, the Contractor will reserve the right to revise the annual extension charge. At the end of the five-year termite protection plan, the Contractor will extend this contract by at least fifteen years at an annually fixed price. Contract term shall start from date of Substantial Completion.

E. Inspect and report annually to the Owner in writing. Provide inspection services for the entire Warranty Period stipulated from the Date of Substantial Completion.

1.11 MAINTENANCE SERVICE

A. Continuing Service: At the end of the five-year termite protection plan, the Contractor will provide a proposal for continuing service by at least fifteen years at an annually fixed price. This will include monitoring, inspection, and re-treatment for occurrences of termite activity. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 TOXICANTS

A. Termiticide: Provide an EPA-registered termiticide complying with requirements of authorities having jurisdiction, in a soluble or emulsible, concentrated formulation that dilutes with water or foaming agent, and formulated to prevent termite infestation. Use only soil treatment solutions that are not harmful to plants. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to the product's EPA-Registered Label.

B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Chloropyrifos:

    a. Dursban TC, DowElanco.
    b. Cheminova.
    c. Garda.
    d. Or equal.

2. Permathrin:

    a. Dragnet FT, FMC Corp.; Pest Control Specialties.
    b. Torpedo, ICI Americas, Inc.
    c. Surrender.
    d. Or equal.

3. Cypermethrine:

    a. Prevail FT, FMC Corp.; Pest Control Specialties.
    b. Demom, ICI Americas, Inc.
    c. Cynoff.
    d. Or equal.

4. Fenvalerate:

    a. Gold Coast Tribute, DuPont.
    b. AgroEvo.
    c. Tribute.

d. Or equal.

5. Isofenphose:

a. Pryfon, Mobay Corp.
b. Prelude.
c. Prevail.
d. Or equal.

C. Dilutant: As recommended by toxicant manufacturer.

2.2 MIXES

A. Mix toxicant chemical with dilutant in ratios as specified in manufacturer's written instructions for each type of application and as required by governing authorities.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of the soil, interfaces with earthwork, slab and foundation work, landscaping, and other conditions affecting performance of termite control. Proceed with application only after unsatisfactory conditions have been corrected.

B. Verify that soil surfaces are unfrozen, sufficiently dry to absorb toxicant, and ready to receive treatment.

C. Verify that final grading is complete.

3.2 PREPARATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparing substrate. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended by termiticide manufacturer.

C. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLICATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

B. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute the treatment evenly.

1. Slabs-on-Grade: Treat under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Foundations: Treat adjacent soils including soil along entire inside perimeter of foundation walls, along both sides of interior partition walls, around plumbing pipes and electrical conduit penetrating slab, and around interior column footings, piers, and chimney bases; and along entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
3. Masonry: Treat voids in masonry foundation walls.
4. Penetrations: Treat at expansion joints, control joints, and areas where slabs will be penetrated.

C. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

D. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

E. Post warning signs in areas of application.

F. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

G. If inspection or testing identifies the presence of termites, re-treat soil and re-test.

3.4 PROTECTION OF FINISHED WORK

A. Do not permit soil grading over treated work.

END OF SECTION 313116

SECTION 321123 - AGGREGATE BASE COURSE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Aggregate Base Course under Pavements.

1.3 REFERENCES

A. SCDOT – South Carolina State Highway Department Standard Specifications for Highway Construction, latest Edition.

B. AASHTO M 147 – Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses; American Association of State Highway and Transportation Officials; 1965 (1996).

C. AASHTO T 180 – Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10 lbs) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 1997.

D. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Course Aggregates; 1996a.

E. ASTM D698 – Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbs/ft3); 1991 (Re-Approved 1998).

F. ASTM D1556 – Standard Test Method for Density and Unit Weight of Soil in-Place by the Sand-Cone Method; 1990 (Re-Approved 1996).

G. ASTM D1557 – Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbs/ft3); 1991 (Re-Approved 1998).

H. ASTM D2167 – Standard Test Method for Density and Unit Weight of Soil in-Place by the Rubber Balloon Method; 1994.

I. ASTM D2487 – Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System); 1998.

J. ASTM D2922 - Standard Test Method for Density and Unit Weight of Soil in-Place by Nuclear Methods (Shallow Depth); 1994.

K. ASTM D3017 – Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 1996.

L. ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 1998.

1.4 DEFINITIONS

A. Base Course: Layer placed between the subbase course and asphalt paving.

B. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.

C. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

D. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.

E. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

1.5 SUBMITTALS

A. See Division 1 Specification Sections for submittal procedures.

B. See Section 312000 Earth Moving for additional requirements.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D2487 of each proposed type of aggregate material.
2. Laboratory compaction curves according to ASTM D698 for each proposed type of aggregate material.
3. Laboratory compaction curves according to ASTM D1557 for each proposed type of aggregate material.
4. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

D. Materials Sources: Submit name of imported materials sources if import material is required.

1.6 QUALITY ASSURANCE

A. Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.

B. Perform Work in accordance with State of South Carolina Highway Department Standard Specifications.

1. Maintain one copy on site.

C. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.

D. Geotechnical Testing and Inspection Service: The Owner will employ and pay for a qualified independent Geotechnical Testing Agency to perform soil testing and inspection services during earthwork operations. The Contractor shall schedule his work in such a manner to permit a reasonable amount of time for testing to be performed before placing succeeding lifts of fill material and shall keep the Testing Agency informed of all progress.

1. The Owner shall pay for the cost of initial testing, subsequent tests, which are required as a result of a test failure, shall be paid for by the Contractor.

E. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E329 to conduct soil materials and rock-definition testing, as documented according to ASTM D3740 and ASTM E548.

F. Use of Explosives: Use of explosives is NOT permitted on the Owner's property.

G. Pre-Excavation Conference: Conduct conference at Project site to comply with requirements in Division 1 Specification Sections.

1.7 PROJECT CONDITIONS

A. Provide sufficient quantities of aggregate to meet project schedule and requirements. When necessary, store materials on-site in advance of need.

B. When aggregate materials need to be stored on-site, locate stockpiles as directed by the Architect/Engineer and or Construction Manager.

1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
2. Prevent contamination.
3. Protect stockpiles from erosion and deterioration of materials.

C. Verify that survey benchmarks and intended elevations of Work are as indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use locally available materials and gradations which exhibit a satisfactory record of previous installations.

B. Subbase: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; with at least 90-percent passing a 1-1/2-inch sieve and not more than 12-percent passing a No. 200 sieve.

C. Base: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940; with at least 95-percent passing a 1-1/2-inch sieve and not more than 8-percent passing a No. 200 sieve.

D. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse-aggregate grading Size 57; with 100-percent passing a 1-1/2- inch sieve and 0 to 5-percent passing a No. 8 sieve.

E. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100-percent passing a 1-inch sieve and 0 to 5-percent passing a No. 4 sieve.

F. Macadamized Aggregate Base Course for Pavements:

1. In accordance with SCDOT Standard Specifications, Section 305.

2.2 SOURCE QUALITY CONTROL

A. See Division 1 Specification Sections for general requirements for testing and analysis of aggregate materials.

B. Where aggregate materials are specified using ASTM D2487 classification, test and analyze samples for compliance before delivery to project site.

C. Where aggregate materials are specified using ASTM D2487 classification, testing and analysis of samples for compliance will be provided before delivery to project site.

D. If tests indicate materials do not meet specified requirements, change material and retest.

E. Provide materials of each type from same source throughout the Work.

2.3 ACCESSORIES

A. Separation Fabric: Woven geotextile, specifically manufactured for use as a separation geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to SCDOT Standard Specifications Section 804.11 (2000), ASTM D4759, and referenced standard test methods:

1. Grab Tensile Strength: 200 lbs.; ASTM D4632.
2. Tear Strength: 80 lbs.; ASTM D4533.
3. Puncture Resistance: 80 lbs.; ASTM D4833.
4. Water Flow Rate: 4 gpm per sq. ft.; ASTM D4491.
5. Apparent Opening Size: No. 30; ASTM D4751.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that substrate has been inspected, gradients and elevations are correct, and is dry.

3.2 PREPARATION

A. The subgrade shall be brought to the line and grade necessary to accommodate the base and pavement at the required finish grades. All subgrade shall be proof-rolled before base course is placed on the subgrade. Proof-rolling should be performed with a loaded tandem dump truck (15-cuyd heaped) or as specified in SCDOT Standard Specifications. Test rolling shall be performed parallel to the centerline at speeds between 2 and 5-miles per hour.

B. The surface of the base course will be inspected by the Architect/Engineer for adequate compaction and surface tolerances. Any ruts or soft yielding spots that may appear in the base course, any areas having inadequate compaction, and any deviations of the surface from the requirements specified for the base course shall be corrected by loosening the affected areas, removing unsatisfactory materials, adding approved materials where required, and by reshaping and re-compacting to line and grade to the specified density requirements.

C. Compaction of the base course materials shall be performed by conventional means using a 30,000 to 40,000 lbs vibratory roller or other means of obtaining the required compaction.

D. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.

E. Do not place aggregate on soft, muddy, or frozen surfaces.

3.3 INSTALLATION

A. Spread aggregate base course over prepared subgrade to a total compacted thickness as indicated in the Construction Details, per pavement section type, of the Drawings.

B. The aggregate shall be spread on the subgrade with a mechanical spreader capable of placing the material to uniform loose depth and without segregation of aggregate, except for areas inaccessible to a mechanical spreader. The aggregate material may be placed by other methods approved by the Architect/Engineer.

C. Place aggregate base course in the following layer thicknesses and roller compact.

1. If total thickness is 8-inches or less, place aggregate in one (1) layer.
2. If total thickness is greater than 8-inches, place aggregate in two lifts of approximately equal thickness.

D. No base course material shall be placed on frozen or wet subgrade or base. Hauling equipment shall not be operated on subgrade.

E. Utilize methods of handing, hauling, and placing aggregate which will minimize segregation and contamination of aggregate materials.

F. Aggregate which is contaminated with foreign materials to the extent that the base course will not adequately serve its intended use shall be removed and replaced with acceptable materials by the Contractor at no additional cost to the Owner.

G. Level and contour surfaces to elevations and gradients indicated.

H. Add small quantities of fine aggregates to coarse aggregates as appropriate to assist in compaction.

I. Compact placed aggregate materials to achieve compaction as specified in Section 312000 Earth Moving.

J. Add water to assist in compaction, if necessary. If excess water is apparent, remove aggregate and aerate to reduce moisture.

K. Use manual tamping equipment in areas inaccessible to roller compaction equipment.

L. Apply primer coat to finished surfaces under roads and parking areas in conformance with SCDOT Standard Specifications Sections 401.28. See Section 32 12 16 – Asphalt Paving to addition requirements.

3.4 TOLERANCES:

A. Flatness: Maximum variation of 1/4-inch measured with a 10-foot straight edge.

B. Scheduled Compacted Thickness: Plus or minus 1/4-inch from required thickness.

C. Variation from Design Elevation: Plus or minus 1/2-inch from required elevation.

3.5 FIELD QUALITY CONTROL

A. See Division 1 Specification Sections for general requirements for field inspection and testing.

B. Testing Agency: The Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality control testing.

C. Allow Testing Agency to inspect and test subgrades. Proceed with aggregate base course placement only after test results for previously completed work comply with requirements.

D. Testing Agency will test compaction of aggregate base course in place according to ASTM D1556, ASTM D2167, ASTM D2922, and ASTM D2937, as applicable and to the current edition of SCDOT Standard Specifications. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted aggregate base course layer, at least one (1) test for every 2,000 sq. ft. or less of paved area or building slab, but in no case fewer than three (3) tests.

E. Testing Agency will test compaction of aggregate base course in place according to the current edition of SCDOT Standard Specifications. Tests will be performed at the following locations and frequencies:

1. Roadway Areas: At subgrade and at each compacted aggregate base course layer, at least one (1) test for every 3,600 sq. ft. or less of paved area, but in no case fewer than two (2) tests.

F. If test indicate Work does not meet specified requirements, remove Work, replace and retest at no additional cost to the Owner.

G. Proof roll compacted aggregate base courses at surfaces that will be under slabs-on-grade, pavers, and pavements.

3.6 CLEAN-UP

A. Remove unused stockpiled materials; leave area in a clean and neat condition. Grade stockpile area to prevent standing water.

END OF SECTION 321123

SECTION 32 1216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 GENERAL

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 SUMMARY

A. Section Includes:

1. Hot-mix Asphalt Concrete Paving.
2. Hot-mix Asphalt Concrete Patching.
3. Hot-mix Asphalt Concrete Paving Overlayment.
4. Pavement-marking Paint.

1.4 REFERENCES

A. South Carolina State Department of Transportation (SCDOT) Standard Specification for Highway Construction, latest Edition.

B. AI MS-2 – Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types; The Asphalt Institute; 1994, Sixth Edition.

C. AI MS-19 – A Basic Asphalt Emulsion Manual; The Asphalt Institute; Second Edition.

D. ASTM D946 – Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction; 1982 (Re-Approved 1993).

1.5 DEFINITIONS

A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

B. DOT: Department of Transportation.

1.6 SYSTEM DESCRIPTION

A. Provide hot-mix asphalt paving according to materials, workmanship, and other applicable requirements of standard specifications of SCDOT.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.7 PERFORMANCE REQUIREMENTS

A. Design thicknesses of pavements, bases, and subbases are shown in the Details of the Construction Drawings.

1.8 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

B. Job Mix Formula:

1. Meet SCDOT Standard Specification Sections 401 and 403 for Type C Hot Laid Asphalt Concrete Surface Course.

C. Job-Mix Designs: Certification, by authorities having jurisdiction and SCDOT, of approval of each job mix proposed for the Work.

D. Qualification Data: For manufacturer.

E. Material Test Reports: For each paving material.

F. Material Certificates: Provide copies of material certificates signed by material producer and Contractor certifying that each material item complies with, or exceeds, specified requirements.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.

1. Manufacturer shall be a paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of the state in which Project is located.

B. Obtain materials from same source throughout Work.

C. Testing Agency Qualifications: Qualified according to ASTM D3666 for testing indicated, as documented according to ASTM E 548.

D. Regulatory Requirements: Comply with Standard Specifications of SCDOT and local authorities having jurisdiction for asphalt paving work.

E. Asphalt-Paving Publication: Comply with AI MS-22, "Construction of Hot Mix Asphalt Pavements," unless more stringent requirements are indicated.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Specification Sections. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

1. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
2. Review condition of subgrade and preparatory work.
3. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.11 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp or if the following conditions are not met:

1. Prime and Tack Coats: Minimum surface temperature of 60 deg F.

    a. Apply in conformance with SCDOT Standard Specifications Sections 401.28.

2. Slurry Coat: Comply with weather limitations of ASTM D 3910.
3. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
4. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

    a. Install in conformance with SCDOT Standard Specifications Section 401.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 50 deg F for water-based materials, and not exceeding 95 deg F.

C. Place bituminous mixture only when temperature of mixture is not more than 15 deg F below bitumen supplier’s bill of lading and not more than maximum specified temperature.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use locally available materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D692, sound; angular crushed stone, crushed gravel, or properly cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, properly cured blast-furnace slag, or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 20-percent by weight of the total aggregate mass.

D. Mineral Filler: ASTM D242 or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO MP 1.

B. Asphalt Cement: ASTM D3381 for viscosity-graded material, ASTM D946 for penetration-graded material.

C. Prime Coat: ASTM D2027, medium-curing cutback asphalt, MC-30 or MC-70.

D. Prime Coat: Asphalt emulsion prime complying with SCDOT requirements.

E. Tack Coat: ASTM D977 or AASHTO M 140, emulsified asphalt or ASTM D2397 or AASHTO M 208, cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

F. Water: Potable.

G. Undersealing Asphalt: ASTM D3141 or AASHTO M 238, pumping consistency.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Sand: ASTM D1073 or AASHTO M 29, Grade Nos. 2 or 3.

C. Paving Geotextile: AASHTO M 288, nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.

D. Joint Sealant: ASTM D3405 or AASHTO M 301, hot-applied, single-component, polymer-modified bituminous sealant.

E. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with FS TT-P-115, Type II or AASHTO M 248, Type F. Used for public road traffic markings.

1. Colors: White, Yellow, and Blue, as indicated.
2. Color of paint is white unless indicated otherwise.
3. All handicapped pavement markings shall be blue.

F. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, with drying time of less than 45 minutes. Used for parking lot and non-public road traffic markings.

1. Colors: White, Yellow, and Blue as indicated.
2. Color of paint is white unless indicated otherwise.
3. All handicapped pavement markings shall be blue.

G. Glass Beads: AASHTO M 247, Type 1.

H. Handicapped Parking Signs: Provide handicapped parking signs at locations shown on the Drawings. Type of signs and methods of mounting are shown on the Drawings.

2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by SCDOT and local authorities having jurisdiction; designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types"; and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Provide mixes complying with composition, grading, and tolerance requirements in ASTM D3515.
3. Surface Course: Per SCDOT Standard Specifications Sections 401 and 403, Type C.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade and aggregate base course is dry and in suitable condition to support paving and imposed loads.

B. Verify gradients and elevations of aggregate base are correct.

C. Proof-roll prepared aggregate base course using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

D. Notify Architect/Engineer of unsatisfactory conditions. Do not begin paving work until deficient base course areas have been corrected and are ready to receive paving.

3.2 AGGREGATE BASE COURSE

A. See Section 32 11 23 – Aggregate Base Course for the base construction for work of this section.

3.3 PATCHING

A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12-inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Re-compact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.

1. Pump hot undersealing asphalt under rocking slabs until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Patching: Fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.

3.4 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.

1. Clean cracks and joints in existing hot-mix asphalt pavement.

2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.5 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure for 72-hours minimum.

1. If prime coat is not entirely absorbed within 24-hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
3. Apply tack coat to contract surfaces of curbs, gutters, and other paved contact surfaces.
4. Coat surfaces of manhole covers, catch basin grates, and other grates and frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.6 PLACING ASPHALT PAVEMENT – SINGLE COURSE

A. Install Work in accordance with SCDOT Standard Specifications and requirements of local authorities having jurisdiction.

B. Place asphalt with 24-hours of applying primer or tack coat.

C. Place to compacted thickness as shown on the Construction Details of the Drawings per pavement type.

D. Verify that the installation of storm drainage grates and frames, manhole covers and frames, and other grates and frames are in correct position and elevation.

E. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt surface course in single lift.
2. Spread mix at minimum temperature of 250 deg F.
3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

F. Place paving in consecutive strips not less than 10-feet wide unless infill edge strips of a lesser width are required, unless otherwise acceptable to the Architect/Engineer.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips.

G. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.7 PLACING ASPHALT PAVEMENT – DOUBLE COURSE

A. Install Work in accordance with SCDOT Standard Specifications and requirements of local authorities having jurisdiction.

B. Place asphalt with 24-hours of applying primer or tack coat.

C. Place base course to compacted thickness as shown on the Construction Details of the Drawings per pavement type.

D. Place surface wearing course to compacted thickness as shown on the Construction Details of the Drawings per pavement type.

E. Verify that the installation of storm drainage grates and frames, manhole covers and frames, and other grates and frames are in correct position and elevation.

F. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at minimum temperature of 250 deg F.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.

5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

G. Place paving in consecutive strips not less than 10-feet wide unless infill edge strips of a lesser width are required, unless otherwise acceptable to the Architect/Engineer.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips.
2. Complete a section of asphalt base course before placing asphalt surface course.

H. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

I. Remove excess asphalt from all manhole, cleanout and valve lids. Lids shall be operable and clean.

3.8 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6-inches.
3. Offset transverse joints, in successive courses, a minimum of 24-inches.
4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2-percent of specified course density.

3.9 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96-percent of reference laboratory density according to AASHTO T 245, but not less than 94-percent nor greater than 100-percent.
2. Average Density: 92-percent of reference maximum theoretical density according to ASTM D2041, but not less than 90-percent nor greater than 96-percent.

D. Finish Rolling: Finish rolling paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.10 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Wearing Course: Plus 1/4 inch, no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Wearing Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.11 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect/Engineer.

B. Allow paving to age for 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

E. Public Roadway Traffic Striping: Use chlorinated rubber base traffic lane marking paint, factory-mixed, quick-drying and non-bleeding.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: The Owner will engage a qualified independent Testing and Inspecting Agency to perform field tests and inspections and to prepare test reports.

1. The Testing Agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.

B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D3549.

D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D979 or AASHTO T 168.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D1188 or ASTM D2726.

a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D2950 and correlated with ASTM D1188 or ASTM D2726.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.13 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow excavated materials to accumulate on-site.

END OF SECTION 321216

SECTION 32 1313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes exterior Portland Cement Concrete Pavement for the following:

1. Service Area.
2. Curbs and Gutters.
3. Sidewalks and Outside Pads with integral turndowns.
4. Miscellaneous Concrete.

1.3 REFERENCES

A. See Division 3 Specification Sections for applicable references.

B. ACI 211.1 – Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991.

C. ACI 301 – Specifications for Structural Concrete for Buildings; American Concrete Institute International; 1996.

D. ACI 304R – Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 1989.

E. ACI 305R – Hot Weather Concreting; American Concrete Institute International; 1991.

F. ACI 306R – Cold Weather Concreting; American Concrete Institute International; 1988.

G. ASTM A185 – Standard Specification for Welded Steel Wire Fabric, Plain, for Concrete Reinforcement; 1994.

H. ASTM A497 – Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement; 1995.

I. ASTM A615/A615M – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 1996a.

J. ASTM C33 – Standard Specification for Concrete Aggregates; 1993.

K. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 1996.

L. ASTM C94 – Standard Specification for Ready-Mixed Concrete; 1996.

M. ASTM C150 – Standard Specification for Portland Cement; 1996.

N. ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 1994a.

O. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete; 1995.

P. ASTM C309 – Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 1997.

Q. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete; 1992.

R. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete; 1996a.

S. ASTM C685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 1995a.

T. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete; 1995.

U. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction; 1984 (Re-Approved 1996).

1.4 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.5 SUBMITTALS

A. See Division 1 Specification Sections for submittal procedures.

B. Quality Control Submittals: Submit the following information related to quality assurance requirements.

1. Design Date: Submit proposed mix designs and test data before concrete operations begin. Identify for each mix submitted, the method by which proportions have been selected.

    a. For mix designs based on field experience, include individual strength test results no older than six (6) months from time of submission, standard deviations, and required average compressive strength calculations.
    b. Indicate quantities of each ingredient per cubic yard of concrete.

c. Indicate type and quantity of admixtures proposed to be required.

2. Test Reports: Submit laboratory test reports for all testing specified.
3. Certifications: Submit affidavits from an independent test agency certifying that all materials furnished under this section conform to these specifications.
4. Certifications: Provide certification from manufacturers of concrete admixtures that chloride content complies with specified requirements.
5. Certifications: Submit mill test certificates for all reinforcing steel furnished under this section, showing physical and chemical analysis.
6. Placement Schedule: Submit concrete placement schedule prior to start of any concrete placement operations. Include locations of all joints indicated on the Drawings, plus anticipated construction joints.
7. Submit batch tickets complying with ASTM C685 or delivery tickets complying with ASTM C94, as applicable, for each concrete batch used in the Work.

   a. Include on ticket the additional information specified in the ASTM document.

8. Hot Weather Concrete Placement: Submit description of planned protective measures.

C. Product Data: For each type of manufactured material and product indicated.

D. Design Mixes: For each concrete pavement mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

E. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

F. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

1. Cementitious materials and aggregates.
2. Steel reinforcement and reinforcement accessories.
3. Fiber reinforcement.
4. Admixtures.
5. Curing compounds.
6. Applied finish materials.
7. Bonding agent or adhesive.
8. Joint fillers.

G. Design Data: Indicate pavement thickness, designed concrete strength, reinforcement, and typical details.

H. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301, SCDOT Standard Specifications, and local governing authority standards.

B. Installer Qualifications: An experienced installer who has completed concrete pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment.

1. Manufacturer must be certified according to the National Ready Mix Concrete Association's Plant Certification Program.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.

E. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by the requirements of the Contract Documents.

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

G. Pre-Installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Specification Sections.

1. Before submitting design mixes, review concrete pavement mix design and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with concrete pavement to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixes.
c. Ready-mix concrete producer.
d. Concrete subcontractor.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Follow recommendations of ACI 305R when placing concrete during hot weather.

B. Follow recommendations of ACI 306R when placing concrete during cold weather.

C. Do not place concrete when base surface temperature is less than 40 deg F.

1.8 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces complying with ACI 301. See Division 3 Specifications for additional information.

1. Use flexible or curved forms for curves of a radius 100-feet or less.

B. Form-Release Agent: Commercially formulated form-release agent with a maximum of 350-mg/l volatile organic compounds (VOCs) that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Reinforcing Steel and Wire Fabric: See Division 3 Specification Sections for additional information.

B. Plain-Steel Welded Wire Fabric: ASTM A185, fabricated from as-drawn steel wire into flat sheets.

C. Deformed-Steel Welded Wire Fabric: ASTM A497, flat sheet.

D. Epoxy-Coated Welded Wire Fabric: ASTM A884, Class A, plain steel.

E. Reinforcement Bars: ASTM A615, Grade 60, deformed.

F. Epoxy-Coated Reinforcement Bars: ASTM A775; with ASTM A615, Grade 60, deformed bars.

G. Steel Bar Mats: ASTM A184; with ASTM A615, Grade 60, deformed bars; assembled with clips.

H. Plain Steel Wire: ASTM A82, as drawn.

I. Epoxy-Coated Wire: ASTM A884, Class A coated, plain steel.

J. Joint Dowel Bars: Plain steel bars, ASTM A615, Grade 60. Cut bars true to length with ends square and free of burrs.

K. Epoxy-Coated Joint Dowel Bars: ASTM A775; with ASTM A615, Grade 60, plain steel bars.

L. Tie Bars: ASTM A615, Grade 60, deformed.

M. Hook Bolts: ASTM A307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

N. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer coated wire bar supports.

O. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.

2.3 CONCRETE MATERIALS

A. General: Use the same brand and type of cementitious material from the same manufacturer throughout the Project.

B. Concrete Materials: See Division 3 Specification Sections for additional information.

C. Portland Cement: ASTM C150, Type I or II.

1. Fly Ash: ASTM C618, Class F or C.
2. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.

D. Blended Hydraulic Cement: ASTM C595M, Type IS, portland blast-furnace slag cement.

E. Blended Hydraulic Cement: ASTM C595M, Type IP portland pozzolan cement.

F. Blended Hydraulic Cement: ASTM C595M, Type I (PM) pozzolan-modified portland cement.

G. Blended Hydraulic Cement: ASTM C595M, Type I (SM) slag-modified portland cement.

H. Aggregate: ASTM C33, uniformly graded, from a single source, with coarse aggregate as follows:

1. Class: 4M.*
2. Maximum Aggregate Size: 1-inch nominal.*
3. Do not use fine or coarse aggregates containing substances that cause spalling.

I. Water: ASTM C94.

2.4 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1-percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.

B. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.

C. Water-Reducing Admixture: ASTM C494, Type A.

D. High-Range, Water-Reducing Admixture: ASTM C494, Type F or Type G.

E. Water-Reducing and Accelerating Admixture: ASTM C494, Type E.

F. Water-Reducing and Retarding Admixture: ASTM C494, Type D.

2.5 CURING MATERIALS

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

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

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

E. Clear Solvent-Borne Liquid-Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B.

1. Provide material that has a maximum volatile organic compound (VOCs) rating of 350-mg pr liter.

F. Clear Waterborne Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B.

G. White Waterborne Membrane-Forming Curing Compound: ASTM C309, Type 2, Class B.

H. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Evaporation Retarder:

a. Cimfilm; Axim Concrete Technologies.
b. Finishing Aid Concentrate; Burke Group, LLC (The).
c. Spray-Film; ChemMasters.
d. Aquafilm; Conspec Marketing & Manufacturing Co., Inc.
e. Sure Film; Dayton Superior Corporation.
f. Eucobar; Euclid Chemical Co.
g. Vapor Aid; Kaufman Products, Inc.
h. Lambco Skin; Lambert Corporation.
i. E-Con; L&M Construction Chemicals, Inc.
j. Confilm; Master Builders, Inc.
k. Waterhold; Metalcrete Industries.
l. Rich Film; Richmond Screw Anchor Co.
m. SikaFilm; Sika Corporation.
n. Finishing Aid; Symons Corporation.
o. Certi-Vex EnvioAssist; Vexcon Chemicals, Inc.

2. Clear Solvent-Borne Liquid-Membrane-Forming Curing Compound:

a. AH Curing Compound #2 DR; Anti-Hydro International, Inc.
b. Res-X Cure All Resin; Burke Group, LLC (The).
c. RX Cure; Conspec Marketing & Manufacturing Co., Inc.
d. Day-Chem Rez Cure; Dayton Superior Corporation.
e. Kurez DR; Euclid Chemical Co.
f. Nitocure S; Fosroc.
g. #64 Resin Cure; Lambert Corporation.
h. L&M Cure DR; L&M Construction Chemicals, Inc.
i. 3100-Clear; W. R. Meadows, Inc.
j. Seal N Kure FDR; Metalcrete Industries.
k. Rich Cure; Richmond Screw Anchor Co.
l. Resi-Chem C309; Symons Corporation.
m. Horncure 30; Tamms Industries Co., Div. of LaPorte Construction Chemicals North America, Inc.
n. Uni Res 150; Unitex.
o. Certi-Vex RC; Vexcon Chemicals, Inc.

3. Clear Waterborne Membrane-Forming Curing Compound:

a. AH Curing Compound #2 DR WB; Anti-Hydro International, Inc.
b. Aqua Resin Cure; Burke Group, LLC (The).
c. Safe-Cure Clear; ChemMasters.
d. W.B. Resin Cure; Conspec Marketing & Manufacturing Co., Inc.
e. Day Chem Rez Cure (J-11-W); Dayton Superior Corporation.
f. Nitocure S; Fosroc.
g. Aqua Kure-Clear; Lambert Corporation.
h. L&M Cure R; L&M Construction Chemicals, Inc.
i. 1100 Clear; W. R. Meadows, Inc.
j. Resin Cure E; Nox-Crete Products Group, Kinsman Corporation.
k. Rich Cure E; Richmond Screw Anchor Co.
l. Resi-Chem Clear Cure; Symons Corporation.
m. Horncure 100; Tamms Industries Co., Div. of LaPorte Construction Chemicals North America, Inc.
n. Hydro Cure; Unitex.
o. Certi-Vex Enviocure; Vexcon Chemicals, Inc.

4. White Waterborne Membrane-Forming Curing Compound:

a. AH Curing Compound #2 WB WP; Anti-Hydro International, Inc.
b. Aqua Resin Cure; Burke Group, LLC (The).
c. W.B. Resin Cure; Conspec Marketing & Manufacturing Co., Inc.
d. Thinfilm 450; Kaufman Products, Inc.
e. Aqua Kure-White; Lambert Corporation.
f. L&M Cure R-2; L&M Construction Chemicals, Inc.
g. 1200-White; W. R. Meadows, Inc.
h. White Pigmented Resin Cure E; Nox-Crete Products Group, Kinsman Corporation.
i. Rich Cure White E; Richmond Screw Anchor Co.
j. Resi-Chem High Cure; Symons Corporation.
k. Horncure 200-W; Tamms Industries Co., Div. of LaPorte Construction Chemicals North America, Inc.

l. Hydro White 309; Unitex.

2.6 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: Recycled Rubber Equal to ASTM D1752.

B. Pavement-Marking Paint: Latex, water-base emulsion; ready mixed; complying with FS TT-P-1952.

1. Color: As indicated.
2. Color: Blue for handicapped requirements, white elsewhere.
3. Color: Blue for handicapped requirements, yellow for fire lanes, white elsewhere.

C. Wheel Stops: Precast, air-entrained concrete; 2500-psi minimum compressive strength; approximately 6 inches high, 9 inches wide, and 72 inches long. Provide chamfered corners and drainage slots on underside, and provide holes for dowel-anchoring to substrate. See Section 02843 – Parking Bumpers for additional information.

1. Dowels: Galvanized steel, diameter of 3/4 inch, minimum length 12 inches.

D. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate containing not less than 50-percent aluminum oxide and not less than 25-percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

E. Bonding Agent: ASTM C1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

F. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:

1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.
2. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
3. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

G. Chemical Surface Retarder: Water-soluble, liquid set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.

H. Available Surface Retarder Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Chemical Surface Retarder:

a. True Etch Surface Retarder; Burke Group, LLC (The).
b. Exposee; ChemMasters.
c. Delay S; Conspec Marketing & Manufacturing Co., Inc.

d. Concrete Surface Retarders; Euclid Chemical Co.
e. Expose; Kaufman Products, Inc.
f. Surftard; Metalcrete Industries.
g. Crete-Nox TA; Nox-Crete Products Group, Kinsman Corporation.
h. Lithotex; L. M. Scofield Co.
i. Rugasol-S; Sika Corporation.
j. Certi-Vex Envioset; Vexcon Chemicals, Inc.

2.7 CONCRETE MIXES

A. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience methods. For the trial batch method, use a qualified independent testing agency for preparing and reporting proposed mix designs.

1. Do not use the Owner's field quality-control testing agency as the independent testing agency.
2. Limit use of fly ash to 25-percent of cement content by weight.

B. Proportion mixes according to ACI 211.1 and ACI 301 to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 3,000 psi, typical unless otherwise specified or indicated.
2. Compressive Strength (28 Days): 4,000 psi, where indicated.
3. Maximum Water-Cementitious Materials Ratio: 0.45.
4. Slump Limit at Point of Placement: 3-inches.

a. Slump Limit for Concrete containing High-Range Water-Reducing Admixture (Superplasticizers): Not more than 8-inches after adding admixture to site-verified 2 to 3-inch slump concrete.

C. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals.

D. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25-percent.
2. Combined Fly Ash and Pozzolan: 25-percent.
3. Ground Granulated Blast-Furnace Slag: 50-percent.
4. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50-percent portland cement minimum, with fly ash or pozzolan not exceeding 25-percent.

E. Admixtures: Add acceptable admixtures as recommended by ACI A211.1 and at rates recommended by manufacturer.

F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of plus or minus 1½ -percent:

1. Air Content: 6.0-percent for 1-inch maximum aggregate.*

G. Adjustment to Concrete Mixes: Mix design adjustments may be requested by the Contractor when characteristics of materials, project conditions, weather, test results, or other circumstances warrant.

H. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd..

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements and with ASTM C94 and ASTM C1116.

1. When air temperature is between 85 deg F 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.

B. Project-Site Mixing: Comply with requirements and measure, batch, and mix concrete materials and concrete according to ASTM C94. Mix concrete materials in appropriate drum-type batch machine mixer, complying with ASTM C685.

1. For mixers of 1 cu. yd. or smaller capacity, continue mixing at least one and one-half minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
2. For mixers of capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added.

C. Transit Mixers: Comply with ASTM C94.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify compacted subgrade, granular subbase, and or aggregate base course is acceptable and ready to support paving and imposed loads.

B. Verify gradients and elevations of subgrade, granular subbase, and or aggregate base course are correct.

C. Proof-roll prepared subbase and aggregate base course using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

D. Notify Architect/Engineer of unsatisfactory conditions. Do not begin paving work until deficient base course areas have been corrected and are ready to receive paving.

3.2 PREPARATION

A. General: Immediately before placing concrete, remove loose and deleterious material from compacted substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

3.3 AGGREGATE BASE COURSE

A. See Section 321123 – Aggregate Base Course for the base construction for work of this section.

3.4 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24-hours after concrete placement.

B. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.

3.5 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.

1. Apply epoxy repair coating to uncoated or damaged surfaces of epoxy-coated reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one (1) full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap to adjacent mats.

F. Place reinforcement as indicated in the Drawings.

G. Interrupt reinforcement at contraction and expansion joints.

H. Place dowels and/or reinforcement to achieve pavement and curb alignments as detailed.

I. Provide doweled joints at 12-inches on center at interruptions of concrete with one (1) end of dowel set in capped sleeve to allow longitudinal movement.

3.6 JOINTS

A. General: Construct construction, isolation, and contraction joints and tooled edgings true to line with faces, perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Align curb, gutter, and sidewalk joints.

C. Construction Joints: Set construction joints at side and end terminations of pavements and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.

1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
2. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip paving, unless otherwise indicated.
3. Provide tie bars at sides of paving strips where indicated.
4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
5. Use epoxy bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

D. Isolation/Expansion Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Place ½-inch wide joints at intervals indicated on the Drawings and to separate paving from vertical surfaces and other components.
2. Locate expansion joints where and in pattern indicated.
3. Locate expansion joints at maximum intervals of 20 feet, unless otherwise indicated.
4. Form joints with joint filler extending from bottom of pavement.
5. Extend joint fillers full width and depth of joint.

    a. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
    b. Place top of filler flush with finished concrete surface when no joint sealant is indicated.

6. Furnish joint fillers in one-piece lengths for full width being placed whenever possible.

    a. Where more than one length is required, lace or clip joint-filler sections together.

7. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
8. Secure joint filler to resist movement by wet concrete.

E. Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

F. Contraction Joints: Provide weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Tooled Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with a radiused jointer tool of the following radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate tool marks on concrete surfaces.

a. Radius: 1/4 inch.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into hardened concrete when cutting action will not tear, abrade, or otherwise damage surface and before development of random contraction cracks.

a. Cut 1/3 into depth of pavement.

G. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool of the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

1. Radius: 1/4 inch.

3.7 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from substrate surface and reinforcing before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten substrate to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes, grilles or frames, or other structures until they are at the required finish elevation and alignment.

D. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery, at Project site, or during placement.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

1. When concrete placement is interrupted for more than ½-hour, place a construction joint.
2. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

G. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

H. Screed paved surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form an open-textured and uniform, smooth surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations.

I. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85-percent of its 28-day compressive strength.

J. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

K. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, reinforcement steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.8 CONCRETE FINISHING

A. General: Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes within a tolerance of ¼-inch in 10-feet as determined by a 10-foot-long straightedge placed anywhere on the surface in any direction. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

C. Final Tooling: Tool edges of paving, curbs, gutters, and joints formed in fresh concrete with a jointing tool of the following radius. Repeat tooling of edges and joints after applying surface finishes. Eliminate tool marks on concrete surfaces.

1. Radius: ¼-inch.

D. Finishing Schedule:

1. Area Paving: Light Broom Finish and tool edges.
2. Sidewalk Paving: Light Broom Finish, radius exposed raised edges to ½-inch radius, and tool edges.
3. Curbs and Gutters: Light Broom Finish and tool edges.
4. Inclined Vehicular Ramps: Course Broomed perpendicular to slope.
5. Inclined Handicapped Ramps: Course Broomed perpendicular to slope or V-Jointed perpendicular to slope. Install ADA detectable warning tactile surface, truncated dome, size/location per plan.
6. Exterior Steps-on-Grade: Course Broom Finish or Slip-Resistant Aggregate Finish.

E. Place curing compound or sealer on exposed surfaces immediately after finishing. Apply in accordance with manufacturer’s instructions.

3.9 CONCRETE PROTECTION 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 follow recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to 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. Curing: Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than 7-days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

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. 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 3-hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.10 REMOVAL OF FORMS AND SUPPORTS

A. Provided that concrete has hardened sufficiently that it will not be damaged, forms may be removed after concrete has cured at not less than 50 deg F for 8-hours. Maintain curing and protection operations after form removal.

B. Perform structural repairs with prior approval of the Architect/Engineer for method and procedure, using epoxy-bonding systems. The Architect/Engineer’s approval is required for repair methods using materials other than those specified.

3.11 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch.
3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.12 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect/Engineer.

B. Allow concrete pavement to cure for 28-days and be dry before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Broadcast glass spheres uniformly into wet pavement markings at a rate of 6 lb/gal..

E. Should project be phased to allow parking in certain areas prior to project completion, allow for second application of pavement marking in base bid price to include roadways, service areas and parking spaces.

3.13 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests as specified in Division 1 Specification Sections and this Section. The Contractor shall coordinate with testing agency and perform the following:

1. Provide free access to concrete operations at project site and cooperate with appointed firm.
2. Submit proposed mix design of each class of concrete to testing firm for review prior to commencement of concrete operations.
3. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.

B. Testing Agency: The Owner will engage a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.

C. Testing Services: Testing shall be performed according to the following requirements:

1. Sampling Fresh Concrete: Representative samples of fresh concrete shall be obtained according to ASTM C172, except modified for slump to comply with ASTM C94.
2. Slump: ASTM C 143; one (1) test at point of placement for each compressive-strength test, but not less than one (1) test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
3. Air Content: ASTM C231, pressure method; one (1) test for each compressive-strength test, but not less than one (1) test for each day's pour of each type of air-entrained concrete.
4. Concrete Temperature: ASTM C1064; one (1) test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one (1) test for each set of compressive-strength specimens.

5. Compression Test Specimens: ASTM C31; one (1) set of four standard cylinders for each compressive-strength test, unless otherwise indicated. Cylinders shall be molded and stored for laboratory-cured test specimens unless field-cured test specimens are required.
6. Compressive-Strength Tests: ASTM C39; one (1) set for each day's pour of each concrete class exceeding 5-cu. yd., but less than 25-cu. yd., plus one (1) set for each additional 50-cu. yd.. One (1) specimen shall be tested at 7-days and two (2) specimens at 28-days; one (1) specimen shall be retained in reserve for later testing if required.
7. When frequency of testing will provide fewer than five (5) compressive-strength tests for a given class of concrete, testing shall be conducted from at least five (5) randomly selected batches or from each batch if fewer than five (5) are used.
8. When total quantity of a given class of concrete is less than 50-cu. yd., Architect/Engineer may waive compressive-strength testing if adequate evidence of satisfactory strength is provided.
9. When strength of field-cured cylinders is less than 85-percent of companion laboratory-cured cylinders, current operations shall be evaluated and corrective procedures shall be provided for protecting and curing in-place concrete.
10. Strength level of concrete will be considered satisfactory if averages of sets of three (3) consecutive compressive-strength test results equal or exceed specified compressive strength and no individual compressive-strength test result falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to the Architect/Engineer, concrete manufacturer, and Contractor within 24-hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in pavement, design compressive strength at 28-days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by the Architect/Engineer but will not be used as the sole basis for approval or rejection.

F. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by the Architect/Engineer. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed.

3.14 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement, curb, wheelstop or gutter that is broken, damaged, or defective, or does not meet requirements in this Section.

B. Drill test cores where directed by the Architect/Engineer when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from pavement for at least 14-days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Expansion and contraction joints within cement concrete pavement.
2. Joints between cement concrete and asphalt pavement.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for sealants.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing of current sealant products within a 36-month period preceding the commencement of the Work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.4 deg C).
3. When joint substrates are wet or covered with frost.
4. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
5. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 COLD-APPLIED JOINT SEALANTS

A. Multicomponent Jet-Fuel-Resistant Sealant for Concrete: Pourable, chemically curing elastomeric formulation complying with the following requirements for formulation and with ASTM C 920 for type, grade, class, and uses indicated:

1. Urethane Formulation: Type M; Grade P; Class 12-1/2; Uses T, M, and, as applicable to joint substrates indicated, O.
2. Coal-Tar-Modified Polymer Formulation: Type M; Grade P; Class 25; Uses T and, as applicable to joint substrates indicated, O.
3. Bitumen-Modified Urethane Formulation: Type M; Grade P; Class 25; Uses T, M, and, as applicable to joint substrates indicated, O.

B. Single-Component Jet-Fuel-Resistant Urethane Sealant for Concrete: Single-component, pourable, coal-tar-modified, urethane formulation complying with ASTM C 920 for Type S; Grade P; Class 25; Uses T, M, and, as applicable to joint substrates indicated, O.

C. Type NS Silicone Sealant for Concrete: Single-component, low-modulus, neutral-curing, nonsag silicone sealant complying with ASTM D 5893 for Type NS.

D. Type SL Silicone Sealant for Concrete and Asphalt: Single-component, low-modulus, neutral-curing, self-leveling silicone sealant complying with ASTM D 5893 for Type SL.

E. Multicomponent Low-Modulus Sealant for Concrete and Asphalt: Proprietary formulation consisting of reactive petropolymer and activator components producing a pourable, self-leveling sealant.

2.4 HOT-APPLIED JOINT SEALANTS

A. Not used.

B. Not used.

C. Elastomeric Sealant for Concrete: Single-component formulation complying with ASTM D 3406.

D. Sealant for Concrete and Asphalt: Single-component formulation complying with ASTM D 3405.

2.5 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold- and Hot-Applied Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold- and Hot-Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

D. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

2.6 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of backer materials.
2. Do not stretch, twist, puncture, or tear backer materials.
3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses provided for each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealants from surfaces adjacent to joint.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.

G. Provide recessed joint configuration for silicone sealants of recess depth and at locations indicated.

3.4 CLEANING

A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 321373

SECTION 323119 - DECORATIVE METAL FENCES AND GATES

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. Decorative composite wood and steel fences.
2. Decorative aluminum fences.
3. Swing gates.
4. Upward-acting gates.

B. Related Requirements:

1. Section 087100 "Door Hardware" for exit devices and locksets.
2. Section 099113 “Exterior Painting” for field finishing of composite wood trim.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fencing and gates.

1. Include plans, elevations, sections, gate locations, post spacing, and mounting details.

C. Samples: For each fence material and for each color specified.

1. Provide Samples 12 inches in length for linear materials.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

PART 2 - PRODUCTS

2.1 DECORATIVE COMPOSITE WOOD AND STEEL FENCES

A. Provide composite wood and steel fences and gates as shown on the Drawings and selected by Owner under an Allowance.

B. Gate operators, if used, and gate hardware are included in the Allowance, unless noted otherwise.

2.2 DECORATIVE ALUMINUM FENCES

A. Provide aluminum fences and gates as shown on the Drawings and selected by Owner under an Allowance.

B. Gate operators, if used, and gate hardware are included in the Allowance, unless noted otherwise.

2.3 MISCELLANEOUS MATERIALS

A. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 033000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 3000 psi, 3-inch slump, and 1-inch maximum aggregate size or dry, packaged, normal-weight concrete mix complying with ASTM C387/C387M mixed with potable water according to manufacturer's written instructions.

B. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M and specifically recommended by manufacturer for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.

B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

1. Construction layout and field engineering are specified in Section 017300 "Execution."

3.3 DECORATIVE FENCE INSTALLATION

A. Install fences according to manufacturer's written instructions.

B. Post Excavation: Drill or hand-excavate holes for posts in firm, undisturbed soil. Excavate holes to a diameter of not less than 4 times post size and a depth of not less than 24 inches plus 3 inches for each foot or fraction of a foot that fence height exceeds 4 feet.

C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.

2. Posts Set in Concrete: Extend post to within 6 inches of specified excavation depth, but not closer than 3 inches to bottom of concrete.

3.4 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.5 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

END OF SECTION 323119

SECTION 328400 - PLANTING IRRIGATION

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. Underground irrigation system with pipe and fittings, valves, sprinkler heads emitters bubblers and accessories as indicated on the drawings.
   2. Control system.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Piping: On a lump sum basis. Includes trenching, placing pipe and fittings, valves, control box, conduit and wiring, and accessories.

B. Sprinkler Heads: By the unit. Includes sprinkler head and fittings.

1.4 PERFORMANCE REQUIREMENTS

A. Irrigation zone control shall be electric solenoid controlled underground irrigation system, with [low point self] [pressure blow-out] drain.

B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated.

C. Source Power: 120 volt, single phase.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
   1. Wiring Diagrams: For power, signal, and control wiring.

B. Shop Drawings: Indicate piping layout to water source, location of sleeves under pavement, location and coverage of sprinkler heads, components, plant and landscaping features, site structures, schedule of fittings to be used.

C. Certificates of Compliance: For each product in system, signed by supplier.

D. Closeout Submittals: Indicate timing settings for each automatic controller zone.
   1. Record actual locations of all concealed components, piping system, conduit and valves. (As-built drawings).
   2. Provide schedule indicating length of time each valve is required to be open to provide a determined amount of water.
   3. Operation and Maintenance Data: Provide instructions for operation and maintenance of system and controls, seasonal activation and shutdown, and parts catalog.

1.6 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years experience.

B. Installer: Company specializing in performing the work of this section with minimum three years experience and/or approved by manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Regulatory Requirements: Comply with applicable code and requirements of authorities having jurisdiction regarding piping and components.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to irrigation. Conduct conference one week before starting work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
   1. Notify Landscape Architect no fewer than two days in advance of proposed interruption of water service.
   2. Do not proceed with interruption of water service without Landscape Architect's written permission.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Heads: 2 units of each type and size.
2. Valve Keys for Manual Valves: 2 units.
3. Valve Box Keys: 2 units.
4. Keys for Valve Markers: 2 units.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

B. Copper Tube: ASTM B 88, Type K, water tube, annealed temper.

C. PE Pipe with Controlled ID: ASTM F 771, PE 3408 compound; SIDR 11.5 and SIDR 15.
   1. Insert Fittings for PE Pipe: ASTM D 2609, nylon or propylene plastic with barbed ends. Include bands or other fasteners.

D. PVC Pipe: ASTM D 1785, PVC 1120 compound, 200 psi pressure rated upstream from controls, 200 psi downstream; solvent welded sockets.
   1. PVC Sleeves: ASTM D 2466, Schedule 40.

2.2 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.3 SPRINKLERS

A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.

B. Plastic, Pop-up, Gear-Drive Rotary Sprinklers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hunter Industries Incorporated.
      b. Rain Bird Corporation.
   2. Description: Fixed and/or pop-up type with screens; fully adjustable for flow and pressure; size as indicated; with letter or symbol designating degree of arc and arrow indicating center of spray pattern.

C. Plastic, Pop-up Spray Sprinklers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hunter Industries Incorporated.
b. Rain Bird Corporation.

2. Description: Fixed surface head Pop-Up head with full circle, half circle, third circle, and quarter circle triangular pattern.

D. Emitter: Fixed outlet, non-clogging, with two trickle tubes.

E. Bubbler: Fixed outlet.

F. Quick Coupler.

2.4 VALVES

A. Plastic Ball Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Hunter Industries Incorporated.
b. Rain Bird Corporation.
2. Description: Plastic construction, non-rising stem, inside screw with threaded ends.

2.5 CONTROLLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Toro Sentinel series

B. Description: Automatic Manual controller, motor driven timer with relay switches, with automatic start and shutdown.
1. Exterior Control Enclosures: NEMA 250, Type 4, weatherproof, with locking cover and two matching keys; include provision for grounding.
2. Wiring: UL 493, Type UF multiconductor, with solid-copper conductors; insulated cable; suitable for direct burial; color coded.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."
1. Minimum Trench Width: 12 inches.
2. Trench and backfill to match finish grade and compaction.
3. Trench to accommodate grade changes [and slope to drains].
4. Maintain trenches free of debris, material, or obstructions that may damage pipe.

B. Install warning tape directly above pressure piping, 12 inches below finished grades, except 6 inches below subgrade under pavement and slabs.

C. Provide minimum cover over top of underground piping according to the following:

1. Supply Piping: 24 inches.
2. Branch Piping: 24 inches.
3. Outlet Piping: 24 inches.
4. Control Wiring: 24 inches.

3.2 PREPARATION

A. Piping layout indicated is diagrammatic only. Route piping to avoid plants, ground cover, and structures.

B. Set stakes to identify locations of proposed irrigation system. Obtain Landscape Architect's approval before excavation.

C. Review layout requirements with other affected work. Coordinate locations of sleeves [under paving] to accommodate system.

3.3 INSTALLATION

A. Install pipe, valves, controls, and outlets in accordance with manufacturer's instructions.

B. Connect to utilities.

C. Set outlets and box covers at finish grade elevations.

D. Provide for thermal movement of components in system.

E. Use threaded nipples for risers to each outlet.

F. Install control wiring in accordance with applicable codes. Provide 10 inch expansion coil at each valve to which controls are connected, and at 100 ft intervals. Bury wire beside pipe. Mark valves with neoprene valve markers containing locking device. Set valve markers in 160 psi PVC risers exiting from top of valve to finish grade.

G. After piping is installed, but before outlets are installed and backfilling commences, open valves and flush system with full head of water.

3.4 BACKFILLING

A. Backfilling is specified in Division 31 Section "Earth Moving."

B. Provide 3 inch sand cover over piping. Backfill trench and compact to subgrade elevation. Protect piping from displacement.

C. Coordinate the work with site backfilling, landscape grading and delivery of plant life.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Leak Test: After installation and prior to backfilling, charge system to 100 psi for one hour and test for leaks. Repair leaks and retest until no leaks exist.

B. System is acceptable if no leakage or loss of pressure occurs and system self drains during test period.

C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Provide one complete spring start-up and a fall shutdown.
   1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Adjust control system to achieve time cycles required.

B. Change/Adjust head types for full water coverage as directed.

3.8 CLEANING

A. Flush dirt and debris from piping before installing sprinklers and other devices.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain system, including controllers and adjusting of sprinkler heads. Use operation and maintenance material as basis for demonstration.

3.10 SCHEDULE

A. Perimeter of Grassed Areas: Pop-Up half circle heads.

B. Corners of Grassed Areas: Pop-Up quarter circle heads.

C. Within Grassed Areas: Pop-Up full circle heads.

D. Planters: Fixed square pattern head, and one emitter per 4 sq. ft of planter area.

END OF SECTION 328400

SECTION 329200 - TURF AND GRASSES

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. Sodding.
   2. Erosion-control material(s).

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
   1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.

C. Qualification Data: For qualified landscape Installer.

D. Product Certificates: For soil amendments and fertilizers, from manufacturer.

E. Material Test Reports: For existing in-place surface soil and imported topsoil.

F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required initial maintenance periods.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.
   1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
   2. Experience: Five years' experience in turf installation in addition to requirements in Division 01 Section "Quality Requirements."

3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
   a. Certified Landscape Technician - Exterior, with installation specialty area(s), designated CLT-Exterior.
   b. Certified Turfgrass Professional, designated CTP.
   c. Certified Turfgrass Professional of Cool Season Lawns, designated CTP-CSL.
5. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
6. Pesticide Applicator: State licensed, commercial.

B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.
1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Landscape Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
3. Report suitability of tested soil for turf growth.
   a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
   b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

D. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

C. Bulk Materials:
1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

1.6 PROJECT CONDITIONS

A. Planting Restrictions: Plant during the following period. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.
1. Planting Period: March 15 through October 15.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.7 MAINTENANCE SERVICE

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until Final Completion of project.

B. Initial Meadow Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until Final Completion of project.

C. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

A. Turfgrass Sod: Certified, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

B. Turfgrass Species:
1. Tif-Blair Centipede grass (*Eremochloa ophiuroides var. Tif-Blair*).

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent.

B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.

G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
   1. Organic Matter Content: 50 to 60 percent of dry weight.
   2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture, with a pH range of 3.4 to 4.8.

C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.

D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
   1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. of loose sawdust or ground bark.

E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.4 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 4 percent nitrogen and 20 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.5 PLANTING SOILS

A. Planting Soil: Existing, native surface topsoil formed under natural conditions with the duff layer retained during excavation process and stockpiled on-site. Verify suitability of native surface topsoil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
1. Supplement with another specified planting soil when quantities are insufficient.
2. Mix existing, native surface topsoil with soil amendments and fertilizers in the quantities recommended in the soil analysis report to produce planting soil.

B. Subsoil Type S1:
1. Excavated and re-used material.
2. Graded.
3. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
4. Conforming to ASTM D2487.

C. Topsoil Type S2:
1. Imported borrow.
2. Friable loam.
3. Reasonably free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds, and foreign matter.
4. Acidity range (pH) of 5.5 to 7.5.

5. Containing a minimum of 4 percent and a maximum of 25 percent inorganic matter.
6. Limit decaying matter to 10 percent of total content by volume.
7. Conforming to ASTM D2487.

2.6 MULCHES

A. Double Shredded Hardwood Mulch: Provide air-dry, clean, mildew- and seed-free, double shredded hardwood mulch 4" depth.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
   1. Organic Matter Content: 50 to 60 percent of dry weight.
   2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

2.7 PESTICIDES

A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.8 EROSION-CONTROL MATERIALS

A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.

B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd., with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.

C. Erosion-Control Mats: Cellular, non-biodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface, of [3-inch] [4-inch] [6-inch] nominal mat thickness. Include manufacturer's recommended anchorage system for slope conditions.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Invisible Structures, Inc.; Slopetame 2.
      b. Presto Products Company, a business of Alcoa; Geoweb.
      c. Tenax Corporation - USA; Tenweb.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
   2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
   3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
   4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Landscape Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
   1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
   2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. Limit turf subgrade preparation to areas to be planted.

B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
   1. Apply superphosphate fertilizer directly to subgrade before loosening.
   2. Thoroughly blend planting soil off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
      a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
      b. Mix lime with dry soil before mixing fertilizer.
   3. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
      a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.

b. Reduce elevation of planting soil to allow for soil thickness of sod.

C. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
2. Loosen surface soil to a depth of at least 6 inches. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.
   a. Apply superphosphate fertilizer directly to surface soil before loosening.
3. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, trash, and other extraneous matter.
4. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.

D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

F. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

A. Prepare area as specified in "Turf Area Preparation" Article.

B. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.

C. Fill cells of erosion-control mat with planting soil and compact before planting.

D. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade,

eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across angle of slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.6 TURF MAINTENANCE

A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow bermudagrass to a height of 1/2 to 1 inch.
2. Mow st. augustinegrass to a height of 1 to 1½ inch.

D. Turf Postfertilization: Apply fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.7 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Landscape Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
3. Satisfactory Plugged Turf: At end of maintenance period, the required number of plugs has been established as well-rooted, viable patches of grass, and areas between plugs are free of weeds and other undesirable vegetation.
4. Satisfactory Sprigged Turf: At end of maintenance period, the required number of sprigs has been established as well-rooted, viable plants, and areas between sprigs are free of weeds and other undesirable vegetation.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.8 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.9 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

C. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 329200

SECTION 329300 - PLANTS

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. Plants.
2. Planting soils.
3. Tree stabilization.
4. Landscape edgings.

1.3 ALLOWANCES

A. Allowances for plants are specified in Division 01 Section "Allowances."
1. Perform planting work under quantity allowances and only as authorized. Authorized work includes work required by Drawings and the Specifications and work authorized in writing by Landscape Architect.
2. Notify Landscape Architect weekly of extent of work performed that is attributable to quantity allowances.
3. Perform work that exceeds quantity allowances only as authorized by Change Orders.

1.4 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Division 01 Section "Unit Prices."
1. Unit prices apply to authorized work covered by quantity allowances.
2. Unit prices apply to additions to and deletions from Work as authorized by Change Orders.

1.5 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

G. Finish Grade: Elevation of finished surface of planting soil.

H. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

I. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

J. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

K. Planting Area: Areas to be planted.

L. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

M. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

N. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

O. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

P. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

Q. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

R. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated, including soils.
   1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
   2. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the Project.
   3. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:
   1. Trees and Shrubs: One sample of each variety and size. Maintain approved samples on-site as a standard for comparison.
   2. Organic/Compost Mulch: 1-quart volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
   3. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.
   4. Tree Grates and Accessories: Manufacturer's standard size, to verify design and color selected.

C. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

D. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
   1. Manufacturer's certified analysis of standard products.
   2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

E. Material Test Reports: For standardized ASTM D 5268 topsoil.

F. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

G. Warranty: Sample of special warranty.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.
   1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.

2. Experience: Three years' experience in landscape installation in addition to requirements in Division 01 Section "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:
   a. Certified Landscape Technician - Exterior, with installation, maintenance and irrigation specialty area(s), designated CLT-Exterior.
   b. Certified Landscape Technician - Interior, designated CLT-Interior.
   c. Certified Ornamental Landscape Professional, designated COLP.
5. Pesticide Applicator: State licensed, commercial.

B. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; [sodium absorption ratio;]deleterious material; pH; and mineral and plant-nutrient content of the soil.
1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Landscape Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
3. Report suitability of tested soil for plant growth.
   a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
   b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

D. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
1. Selection of plants purchased under allowances will be made by Landscape Architect, who will tag plants at their place of growth before they are prepared for transplanting.

E. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

F. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
   1. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site.

G. Preinstallation Conference: Conduct conference at Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.

B. Bulk Materials:
   1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
   2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
   3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

C. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.

D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Handle planting stock by root ball.

F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.

G. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than eight hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist. **All plant materials shall be planted within 48 hours of delivery to job site.**
   1. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.
   2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
   3. Do not remove container-grown stock from containers before time of planting.

4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:
   1. Notify Landscape Architect no fewer than two days in advance of proposed interruption of each service or utility.
   2. Do not proceed with interruption of services or utilities without Landscape Architect's written permission.

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

D. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
   1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.10 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
      b. Structural failures including plantings falling or blowing over.
      c. Faulty performance of tree stabilization, edgings, tree grates.
      d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Warranty Periods from Date of Substantial Completion:
      a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
      b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
      c. Annuals: Two months.
   3. Include the following remedial actions as a minimum:
      a. Immediately remove damaged, dead or diseased plants and replace with same unless required to plant in the succeeding planting season.
      b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.

c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

1.11 MAINTENANCE SERVICE

A. Initial Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.
   1. Maintenance Period: From date of completion of planting punch list items to date of final acceptance by Owner and issuance of Certificate of Completion.

B. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
   1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots will be rejected.
   2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.

E. If formal arrangements or consecutive order of plants is shown on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

F. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
1. Class: T, with a minimum of 99 percent passing through No. 8 sieve and a minimum of 75 percent passing through No. 60 sieve.
2. Class: O, with a minimum of 95 percent passing through No. 8 sieve and a minimum of 55 percent passing through No. 60 sieve.
3. Provide lime in form of ground dolomitic limestone.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 sieve and a maximum of 10 percent passing through No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 sieve.

G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or granular texture, with a pH range of 3.4 to 4.8.

C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.

D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. of loose sawdust or ground bark.

E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 3 percent nitrogen and 10 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

E. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

2.5 PLANTING SOILS

A. Imported Planting Soil: Imported topsoil or manufactured topsoil from off-site sources. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from [agricultural land,]bogs, or marshes.

1. Additional Properties of Imported Topsoil or Manufactured Topsoil: Screened and free of stones 1 inch or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth; free of obnoxious weeds and invasive plants including quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass; not infested with nematodes; grubs; or other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens; friable and with sufficient structure to give good tilth and aeration. Continuous, air-filled pore space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent on a dry weight basis.
2. Mix imported topsoil or manufactured topsoil with the following soil amendments and fertilizers in the following quantities to produce planting soil:
    a. Ratio of Loose Compost to Topsoil by Volume: 1:3.

2.6 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
1. Type: Double shredded hardwood mulch to a depth of 3”. Mulch sample shall be approved by Landscape Architect prior to installation.
2. Size Range: 3 inches maximum, 1/2 inch minimum.
3. Color: Natural.

2.7 PESTICIDES

A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.8 TREE STABILIZATION MATERIALS

A. Stakes and Guys:
1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
2. Wood Deadmen: Timbers measuring 8 inches in diameter and 48 inches long, treated with specified wood pressure-preservative treatment.
3. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or turnbuckles.

4. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch in diameter.
5. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
6. Guy Cables: Five-strand, 3/16-inch- diameter, galvanized-steel cable, with zinc-coated turnbuckles a minimum of 3 inches long, with two 3/8-inch galvanized eyebolts.
7. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.
8. Proprietary Staking-and-Guying Devices: Proprietary stake and adjustable tie systems to secure each new planting by plant stem; sized as indicated and per manufacturer's written recommendations.
    a. Products: Subject to compliance with requirements, provide one of the following:
        1) Arborbrace; ArborBrace Tree Guying System.
        2) Decorations for Generations, Inc.; Mega Stake System.

B. Root-Ball Stabilization Materials:
1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated; stakes pointed at one end.
2. Wood Screws: ASME B18.6.1.
3. Proprietary Root-Ball Stabilization Devices: Proprietary at- or below-grade stabilization systems to secure each new planting by root ball; sized per manufacturer's written recommendations unless otherwise indicated.
    a. Products: Subject to compliance with requirements, provide one of the following:
        1) Border Concepts, Inc.; Tomahawk Tree Stabilizers.
        2) Foresight Products, LLC; Duckbill Rootball Fixing System.
        3) Tree Staple, Inc.; Tree Staples.

2.9 MISCELLANEOUS PRODUCTS

A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

B. Burlap: Non-synthetic, biodegradable.

C. Planter Drainage Gravel: Washed, sound crushed stone or gravel complying with ASTM D 448 for Size No. 8.

D. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Landscape Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Lay out plants at locations directed by Landscape Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

E. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

F. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.3 PLANTING AREA ESTABLISHMENT

A. Loosen subgrade of planting areas to a minimum depth of 12 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
1. Apply superphosphate fertilizer directly to subgrade before loosening.
2. Thoroughly spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
    a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
    b. Mix lime with dry soil before mixing fertilizer.

3. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
   a. Spread approximately one-half the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.

B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

C. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

D. Application of Mycorrhizal Fungi: At time directed by Landscape Architect, broadcast dry product uniformly over prepared soil at application rate indicated on Drawings.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
   1. Excavate approximately three times as wide as ball diameter for balled and burlapped, container-grown stock.
   2. Excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
   3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
   4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
   5. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
   6. Maintain supervision of excavations during working hours.
   7. Keep excavations covered or otherwise protected after working hours and when unattended by Installer's personnel.
   8. If drain tile is shown on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Subsoil and topsoil removed from excavations may not be used as planting soil.

C. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
   1. Hardpan Layer: Drill 6-inch- diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

D. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
   1. Use planting soil for backfill.
   2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
   3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
   4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
   5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Set container-grown stock plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
   1. Use planting soil for backfill.
   2. Carefully remove root ball from container without damaging root ball or plant.
   3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
   4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.
   5. Continue backfilling process. Water again after placing and tamping final layer of soil.

E. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines as directed by Landscape Architect.

C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.7 TREE STABILIZATION

A. Staking and Guying: Trees shall not be staked upon installation. If Trees are adversely affected by wind or are unable to maintain a vertical orientation after installation then contractor shall stake and guy trees more than 14 feet in height and more than 3 inches in caliper unless otherwise indicated at no additional cost to owner. Securely attach no fewer than three guys to stakes 30 inches long, driven to grade.
   1. Site-Fabricated Staking-and-Guying Method:
      a. For trees more than 6 inches in caliper, anchor guys to wood deadmen buried at least 36 inches below grade. Provide turnbuckle for each guy wire and tighten securely.
      b. Support trees with bands of flexible ties at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
      c. Support trees with strands of cable or multiple strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
      d. Attach flags to each guy wire, 30 inches above finish grade.
      e. Paint turnbuckles with luminescent white paint.
   2. Proprietary Staking and Guying Device: Install staking and guying system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

B. Root-Ball Stabilization: Install at- or below-grade stabilization system to secure each new planting by the root ball unless otherwise indicated.
   1. Wood Hold-Down Method: Place vertical stakes against side of root ball and drive them into subsoil; place horizontal wood hold-down stake across top of root ball and screw at each end to one of the vertical stakes.
      a. Install stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation. Saw stakes off at horizontal stake.
      b. Install screws through horizontal hold-down and penetrating at least 1 inch into stakes. Predrill holes if necessary to prevent splitting wood.
      c. Install second set of stakes on other side of root trunk for larger trees as indicated.
   2. Proprietary Root-Ball Stabilization Device: Install root-ball stabilization system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

3.8 PLANTING IN PLANTERS

A. Place a layer of drainage gravel at least 4 inches thick in bottom of planter. Fill remaining planter with Topsoil as specified. Place soil in lightly compacted layers to an elevation of 1-1/2 inches below top of planter, allowing natural settlement.

3.9 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated in even rows with triangular spacing.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.10 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.
   1. Trees and Tree-like Shrubs in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with 24-inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
   2. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.11 EDGING INSTALLATION

A. Steel Edging: Install steel edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches apart, driven below top elevation of edging.

3.12 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

B. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated past management practices whenever possible to minimize

the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.13 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Non-Selective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.14 CLEANUP AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

C. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.15 DISPOSAL

A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION 329300

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Storm drainage culvert, collections, and main system piping, fittings, and accessories
2. Connection of Storm Drainage Collector System to building storm drainage systems, building downspout drains, and Storm Drainage Main System.

1.3 REFERENCES

A. AASHTO M 252 (latest edition).

B. AASHTO M 294 (latest edition).

C. ASTM A74 – Standard Specification for Cast-Iron Soil Pipe and Fittings; 1998.

D. ASTM C14 – Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe ; 1999.

E. ASTM C76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe ; 1999a.

F. ASTM C443 – Standard Specification for Joints in Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets ; 1998.

G. ASTM C564 – Standard Specification for Rubber Gaskets for Cast-Iron Soil Pipe and Fittings; 1997.

H. ASTM C990 – Specification for Joints for Concrete Pipe Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants.

I. ASTM D1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120; 1999.

J. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 1989 (Re-Approved 1995).

K. ASTM D2412 (latest edition).

L. ASTM D2729 – Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 1996a.

M. ASTM D2751 – Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings; 1996a.

N. ASTM D3034 – Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 1998.

O. ASTM F447 (latest edition).

1.4 DEFINITIONS

A. Bedding: Fill placed under, beside, and directly over pipe, prior to subsequent backfill operations.

B. ABS: Acrylonitrile-butadiene-styrene plastic.

C. EPDM: Ethylene-propylene-diene-monomer rubber.

D. PE: Polyethylene plastic.

E. PVC: Polyvinyl chloride plastic.

1.5 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

1.6 SUBMITTALS

A. See Division 1 Specification Sections for submittal procedures.

B. Product Data: For the following:

1. Piping, Pipe Fittings, and Accessories.
2. Stormwater cleanouts.

C. Manufacturer’s Installation Instructions: Indicate special procedures required to install Products specified.

D. Manufacturer’s Certificate: Certify that products meet or exceed specified requirements.

E. Coordination Drawings: Show basins and other structures, pipe sizes, locations, and elevations. Include details of underground structures and connections. Show other piping in same trench and clearances from sanitary sewerage system piping. Indicate interface and spatial relationship between piping and proximate structures.

F. Design Mix Reports and Calculations: For each class of cast-in-place concrete.

G. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

H. Project Record Documents: Survey location of pipe runs, catch basins, junction boxes, outlet structures and corresponding invert elevations

1. The Contractor shall submit to the Architect/Engineer, prior to substantial completion, a record survey in digital DWG format.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.8 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify the Architect/Engineer not less than two (2) days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect/Engineer's written permission.

D. Verify existing pipe sizes and invert elevations at tie-in points before commencing installation of pipe. Notify the Architect/Engineer immediately upon discovering any discrepancies from inverts shown on the Drawings.

Coordinate the Work with termination of storm sewer connections outside building, trenching, connection to building downspout drains, connection to foundation drainage system and connection to existing site storm drainage system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Gray-Iron Cleanouts:

a. Josam Co.
b. McWane, Inc.; Tyler Pipe; Wade Div.
c. MIFAB.

d. Smith: Jay R. Smith Mfg. Co.
e. Watts Industries, Inc.; Ancon Drain Div.
f. Watts Industries, Inc.; Enpoco, Inc. Div.
g. Zurn Industries, Inc.; Hydromechanics Div.
h. Or equal.

2. PVC Cleanouts:

a. Canplas, Inc.
b. IPS Corp.
c. NDS, Inc.
d. Plastic Oddities, Inc.
e. Sioux Chief Manufacturing Co., Inc.
f. Or equal.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 PIPES AND FITTINGS – CULVERTS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C76, Class III, Wall Type B.

1. Joint Devices: ASTM C990, Preformed Flexible Joint Sealant.
2. Acceptable Nominal Pipe Sizes: 12” to 144”.
3. Watertight joints.

2.4 PIPES AND FITTINGS

A. Ductile-Iron Sewer Pipe: ASTM A746, for push-on joints.

1. Standard-Pattern, Ductile-Iron Fittings: AWWA C110, ductile or gray iron, for push-on joints.
2. Compact-Pattern, Ductile-Iron Fittings: AWWA C153, for push-on joints.
3. Gaskets: AWWA C111, rubber.
4. Acceptable Nominal Pipe Sizes: 4” to 12”.

B. HP Storm (12”-60”) by ADS (or approved equal)

1. Joint Performance: Pipe shall be joined using a bell and spigot joint meeting the requirements of ASTM F2881 ro AASHTO M330. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Gasket shall be installed by pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.
2. Fittings: Fittings shall conform to ASTM F2881 or AASHTO M330. Bell and spigot connections shall utilize a welded or integral bell and valley or inline gaskets meeting the watertight joint performance requirements of ASTM D3212.

3. Field Pipe and Joint Performance: To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F1417 or ASTM F2487.
4. Material Properties: Polypropylene compound for pipe and fitting production shall be impact modified copolymer meeting the material requirements of ASTM F2881, Section 5 and AASHTO M330, Section 6.1.

C. N-12 WT IB Pipe (4”-60”) by ADS (or approved equal)

1. Joint Performance: Pipe shall be joined using a bell and spigot joint meeting the requirements of AASHTO M252, AASHTO M294 or ASTM F2306. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. Gasket shall be installed by pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.
2. Fittings: Fittings shall conform to AASHTO M252, AASHTO M294, or ASTM F2306. Bell and spigot connections shall utilize a welded bell and valley or saddle gaskets meeting the watertight joint performance requirements of AASHTO M252, AASHTO M294, or ASTM F2306.
3. Field Pipe and Joint Performance: To assure watertightness, field performance verification may be accomplished by testing in accordance with ASTM F2487 or ASTM F2487.
4. Material Properties: Material for pipe and fitting production shall be high-density polyethylene conforming with the minimum requirements of cell classification 424420C for 4- through 10-inch diameters, and 435400C for 12- through 60-inch diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The 12-through 60-inch pipe material shall comply with the notched constant ligament-stress (NCLS) test as specified in Sections 9.5 and 5.1 of AASHTO M294 and ASTM F2306 respectively.

2.5 MANHOLES (JUNCTION BOXES)

A. Normal-Traffic Precast Concrete Manholes: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.

1. Diameter: 48-inches minimum, unless otherwise indicated.
2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
3. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
4. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
5. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Gaskets: ASTM C443, rubber.
7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and cover.
8. Steps: Fiberglass, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor

into base, riser, and top section sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 60-inches deep.

9. Steps: Manufactured from deformed, 1/2-inch steel reinforcement rod complying with ASTM A615 and encased in polypropylene complying with ASTM D4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 60-inches deep.
10. Steps: ASTM C478, individual steps or ladder. Omit steps for manholes less than 60-inches deep.
11. Pipe Connectors: ASTM C923, resilient, of size required, for each pipe connecting to base section.

B. Heavy-Traffic Precast Concrete Manholes: ASTM C913; designed according to ASTM C890 for A-16, heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for rubber gasketed joints.

1. Ballast: Increase thickness of one or more precast concrete sections or add concrete to structure, as required to prevent flotation.
2. Gaskets: Rubber.
3. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch diameter frame and cover.
4. Steps: Fiberglass, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast or anchor into base, riser, and top section sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 60-inches deep.
5. Steps: Manufactured from deformed, 1/2-inch steel reinforcement rod complying with ASTM A615 and encased in polypropylene complying with ASTM D4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 60-inches deep.
6. Steps: ASTM C478, individual steps or ladder. Omit steps for manholes less than 60-inches deep.
7. Pipe Connectors: ASTM C923, resilient, of size required, for each pipe connecting to base section.

C. Manhole Frames and Covers: ASTM A536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter cover. Include indented top design with lettering "STORM SEWER" cast into cover.

D. Manholes are to be sized such that the clearance between the outside wall of pipe and the adjacent interior walls of structure is a minimum of 9-inches.

E. Cut-off pipes at manholes flush with interior face of manhole wall to match the shape of the manhole wall. Use watertight seal at all penetrations.

2.6 CATCH BASINS

A. Normal-Traffic, Precast Concrete Catch Basins: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.

1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
2. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
3. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
4. Gaskets: ASTM C443, rubber.
5. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match frame and grate.
6. Steps: Fiberglass, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast steps or anchor ladder into base, riser, and top section sidewalls at 12- to 16-inch intervals. Omit steps for catch basins less than 60-inches deep.
7. Steps: Manufactured from deformed, 1/2-inch steel reinforcement rod complying with ASTM A615 and encased in polypropylene complying with ASTM D4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 60-inches deep.
8. Steps: ASTM C478, individual steps or ladder. Omit steps for catch basins less than 60-inches deep.
9. Pipe Connectors: ASTM C923, resilient, of size required, for each pipe connecting to base section.

B. Heavy-Traffic, Precast Concrete Catch Basins: ASTM C913, precast, reinforced concrete; designed according to ASTM C890 for A-16, heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for rubber gasketed joints.

1. Gaskets: Rubber.
2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match frame and grate.
3. Steps: Fiberglass, individual steps or ladder. Include width that allows worker to place both feet on one step and is designed to prevent lateral slippage off step. Cast steps or anchor ladder into base, riser, and top section sidewalls at 12- to 16-inch intervals. Omit steps for catch basins less than 60-inches deep.
4. Steps: Manufactured from deformed, 1/2-inch steel reinforcement rod complying with ASTM A615 and encased in polypropylene complying with ASTM D4101. Include pattern designed to prevent lateral slippage off step. Cast or anchor into sidewalls with steps at 12- to 16-inch intervals. Omit steps for manholes less than 60-inche deep.
5. Steps: ASTM C478, individual steps or ladder. Omit steps for catch basins less than 60-inches deep.
6. Pipe Connectors: ASTM C923, resilient, of size required, for each pipe connecting to base section.

C. Pipe Connectors: ASTM C923, resilient, of size required, for each pipe connecting to base section.

D. Frames and Grates: ASTM A536, Grade 60-40-18, ductile iron designed for heavy-duty service. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 x 24-inches minimum, unless otherwise indicated.

2. Grate Free Area: Approximately 50-percent, unless otherwise indicated.

E. Frames and Grates: ASTM A536, Grade 60-40-18, ductile iron designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter flat grate with small square or short-slotted drainage openings.

1. Grate Free Area: Approximately 50-percent, unless otherwise indicated.

F. Catch basins are to be sized such that the clearance between the outside wall of pipe and the adjacent interior walls of structure is a minimum of 6 inches.

G. Cut-off pipes at catch basins flush with interior face of manhole wall to match the shape of the manhole wall. Use watertight seal at all penetrations.

2.7 STORMWATER INLETS

A. Drop Inlets: Horizontal gutter opening, of materials and dimensions indicated. Include heavy-duty frames and grates.

B. Combination Curb Inlets: Vertical curb and horizontal gutter openings, of materials and dimensions indicated. Include heavy-duty frames and grates.

C. Frames and Grates: Dimensions, opening pattern, free area, and other attributes indicated.

1. Material: ASTM A536, Grade 60-40-18 minimum, ductile-iron casting.
2. Material: ASTM A48, Class 30 minimum, gray-iron casting.
3. Grate Free Area: Approximately 50-percent, unless otherwise indicated.

2.8 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:

1. Cement: ASTM C150, Type II.
2. Fine Aggregate: ASTM C33, sand.
3. Coarse Aggregate: ASTM C33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4,000 psi minimum, with 0.45 maximum water-cementitious ratio.

C. Reinforcement Fabric: ASTM A185, steel, welded wire fabric, plain.

D. Reinforcement Bars: ASTM A615, Grade 60, deformed steel.

E. Structure Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4,000 psi minimum, with 0.45 maximum water-cementitious ratio.

F. Ballast and Pipe Supports: Portland cement design mix, 3,000 psi minimum, with 0.58 maximum water-cementitious ratio.

1. Reinforcement Fabric: ASTM A185, steel, welded wire fabric, plain.
2. Reinforcement Bars: ASTM A615, Grade 60, deformed steel.

2.9 PROTECTIVE COATINGS

A. Description: One- or two-coat, coal-tar epoxy; 15-mil minimum thickness, unless otherwise indicated; factory or field applied to the following surfaces:

1. Manhole Frames and Covers: On entire surfaces.
2. Catch Basin Frames and Grates: On entire surfaces.
3. Stormwater Inlet Frames and Grates: On entire surfaces.

2.10 CLEANOUTS

A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug. Use units with top-loading classifications according to the following applications:

1. Light Duty: In earth or grass foot-traffic areas.
2. Medium Duty: In paved foot-traffic areas.
3. Heavy Duty: In vehicle-traffic service areas.
4. Extra-Heavy Duty: In roads.
5. Sewer Pipe Fitting and Riser to Cleanout: ASTM A74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping. Not used in paved areas.

2.11 TRENCH DRAINS

A. Channels shall have dimensions as indicated on drawings. Trench system bodies shall be manufactured from polymer concrete. Pre-cast units shall be manufactured with either an invert slope of 0.5% or with neutral invert. Each unit will feature a partial radius in the trench bottom and a male to female interconnecting end profile. Units shall have horizontal cast in anchoring keys on the outside wall to ensure maximum mechanical bond to the surrounding bedding material and pavement surface. The trench drain system shall be installed in accordance with the manufacturer’s installation instructions and recommendations. Grates (including top elevations) shall be as indicated on drawings. Outlet size shall be as indicated on drawings.

B. Along with product information, contractor shall submit detailed layout of channels, that show depth and outlet location/size, for approval, prior to construction.

PART 3 - EXECUTION

3.1 TRENCHING

A. See Section 312000 – Earth Moving and Section 312070 – Trenching and Backfilling for Site Utilities.

B. Hand trim excavations for accurate placement of pipe to elevations indicated.

C. Backfill around sides and to top of pipe with cover material, tamp in-pace and compact, then complete backfilling.

3.2 IDENTIFICATION

A. Install continuous underground warning tape during backfilling of trench for all underground storm drainage piping. Locate below finished grade, directly over piping.

1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

B. Install warning tape a minimum of 12-inches below finish grade and directly above line of pipe.

3.3 PIPING APPLICATIONS

A. General: Include watertight joints.

B. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products. Use pipe, fittings, and joining methods according to applications indicated.

3.4 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS

A. Special Pipe Couplings: Use where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.

1. Use the following pipe couplings for nonpressure applications:

a. Sleeve type to join piping, of same size, or with small difference in OD.
b. Increaser/reducer-pattern, sleeve type to join piping of different sizes.
c. Bushing type to join piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

B. Special Pipe Fittings: Use where indicated. Include PE film, pipe encasement.

3.5 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Verify existing pipe sizes and invert elevations at tie-in points before commencing installation of pipe. Notify the Architect/Engineer immediately upon discovering any discrepancies from inverts or sizes shown on the Drawings.

C. Verify that trench is ready to receive Work and excavations, dimensions, and elevations are as indicated on the Drawings.

D. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.

E. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.

F. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

G. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

H. Install gravity-flow piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.

1. Install piping pitched down in direction of flow, at minimum slope of 1/2-percent, unless otherwise indicated.

I. Extend storm drainage piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.

J. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or a combination of both.

3.6 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. General: Join and install pipe and fittings according to installations indicated.

B. Ductile-Iron Sewer Pipe with Ductile-Iron Fittings: According to AWWA C600.

1. Install PE film, pipe encasement over ductile-iron sewer pipe and ductile-iron fittings according to ASTM A 674 or AWWA C105.

C. HDPE Pipe and Fittings: As follows:

1. Join pipe, tubing, and fittings with couplings for watertight joints according to manufacturer's written instructions.
2. Install according to ASTM D 2321 and manufacturer's written instructions.
3. Install corrugated piping according to the Corrugated Polyethylene Pipe Association's "Recommended Installation Practices for Corrugated Polyethylene Pipe and Fittings."

D. Concrete Pipe and Fittings: Install according to ACPA's "Concrete Pipe Installation Manual." Use the following seals:

1. Round Pipe and Fittings: ASTM C 990 Preformed Flexible Joint Sealant.

E. System Piping Joints: Make joints using system manufacturer's couplings, unless otherwise indicated.

3.7 MANHOLE (JUNCTION BOX) INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 1-inch above finished surface elsewhere, unless otherwise indicated.

C. Install precast concrete manhole sections with gaskets according to ASTM C891. Provide rubber joint gaskets complying with ASTM C443 at joints of sections.

1. Form bottom of excavation clean and smooth to correct elevation.
2. Place manhole sections plumb and level, trim to correct elevations.
3. Apply bituminous mastic coating at joints of sections.
4. Set cover frames and covers level without tipping, to correct elevations.

D. Construct cast-in-place manholes as indicated.

1. Form bottom of excavation clean and smooth to correct elevations.
2. Place concrete base pad, trowel top surface level.
3. Form and place manhole cylinder plumb and level, to correct dimensions and elevations. As work progresses, build in fabricated items and appurtenances.
4. Set cover frames and covers level without tipping, to correct elevations.

E. Masonry Work:

1. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
2. Lay cement brick masonry units in running bond. Course three (3) units to equal 8-inches.
3. Form flush mortar joints.
4. Lay masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
5. Install joint reinforcement at 16-inches on center.
6. Place joint reinforcement in first and second horizontal joints above base and below lid frame opening.

3.8 CATCH-BASIN INSTALLATION

A. General: Install catch basins to sizes and shapes indicated, complete with appurtenances and accessories indicated.

B. Set frames and grates to elevations indicated.

C. Install precast concrete catch basin sections with gaskets according to ASTM C891. Provide rubber joint gaskets complying with ASTM C443 at joints of sections.

1. Form bottom of excavation clean and smooth to correct elevation.
2. Place catch basin sections plumb and level, trim to correct elevations.
3. Apply bituminous mastic coating at joints of sections.

D. Construct cast-in-place catch basins as indicated.

1. Form bottom of excavation clean and smooth to correct elevations.
2. Place concrete base pad, trowel top surface level.
3. Form and place catch basin cylinder plumb and level, to correct dimensions and elevations. As work progresses, build in fabricated items and appurtenances. Bottom shall not hold water but allow for continuous flow between inverts.

E. Masonry Work:

1. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
2. Lay cement brick masonry units in running bond. Course three (3) units to equal 8-inches.
3. Form flush mortar joints.
4. Lay masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
5. Install joint reinforcement at 16-inches on center.
6. Place joint reinforcement in first and second horizontal joints above base and below lid frame opening.

3.9 CONCRETE PLACEMENT

Place cast-in-place concrete according to ACI 318 and ACI 350R.

3.10 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1-inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.11 TAP CONNECTIONS

A. Make connections to existing piping and underground structures so finished Work complies as nearly as practical with requirements specified for new Work.

B. Make connections into existing underground structures by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

1. Use concrete that will attain minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.
2. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

C. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.12 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.

1. In large, accessible piping, brushes and brooms may be used for cleaning.
2. Place plug in end of incomplete piping at end of day and when work stops.
3. Flush piping between manholes, catch basins, and other structures to remove collected debris.

B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24-inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 95-percent of piping diameter.
    c. Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping.
    e. Exfiltration: Water leakage from or around piping.

3. After 30 days, Contractor shall video all storm drainage piping (with the exception of roof drainage) and provide the Engineer with a copy of the CD/DVD for review. Engineer shall review and provide comments on any discrepancies/defective installation.
4. Contractor shall replace defective piping using new materials, and repeat inspections until defects are within specified requirements.
5. Reinspect and repeat procedure until results are satisfactory.

3.13 PROTECTION

A. Protect pipe, structures, and bedding cover from damage or displacement until backfill operations are completed.

END OF SECTION 334100

Appendix ‘A’

Charleston County School District Requirements

Charleston County SCHOOL DISTRICT
excellence is our standard

DESIGN REQUIREMENTS

For New Construction and Major Renovations of CCSD Facilities

NOTE: These Design Requirements, published in October 2020, do not provide specific guidance on requirements related to the Covid-19 pandemic. Owner and Program Management will provide direction for any requirements for Covid-19 in separate communications as they are developed.

Rev: 07 – October 2020 Release

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PART I: OVERVIEW & REQUIREMENTS BY PROJECT PHASE

1 EXECUTIVE SUMMARY

CCSD Design Requirements provide direction to design professionals (architects and engineers, "AE") providing design services for new construction and major renovations for the Charleston County School District. The District's intent is to construct high performance school facilities with superior indoor environmental quality that are energy efficient and cost effective to operate and maintain. These Design Requirements include specific requirements for the Key Stakeholders and Project Team Members that inform Design, Performance, Process, Systems Integration, Construction and Post Occupancy activities.

The Design Requirements provide direction to the AEs for inclusion in contract documents so that Project delivery is consistent and meets CCSD standards. They are intended to improve communication and project planning so that Capital Programs and Facilities Maintenance & Asset Management deliver the highest quality facilities possible. The Requirements do not supersede any specific contractual agreement for an individual Project between CCSD referred to herein as "Owner", the AE, Contractor and/or other participants. Should an AE wish to deviate from these requirements, or the requirements call for a request for approval, the AE shall submit a written request to the CCSD Associate of Facilities Maintenance or Designee with appropriate supporting backup documentation. AE shall obtain written approval to proceed with the request. Conflicts between the Requirements themselves or between the Requirements and the Owner/Architect Agreement during the course of an individual Project shall be brought to the attention of Program Management and then documented in the Owner Project Requirements for that specific Project. Updates to these Design Requirements are at the discretion of the District. Substantive revisions to the text from the previous version are underlined herein and logged in Appendix J: Design Requirements Change Log.

1.1 Guiding Principles

- CCSD strives to provide aesthetically pleasing and structurally functional schools that are comfortable, healthy, safe, secure and meet the needs of students, teachers and staff.
- CCSD strives to build facilities that are cost efficient to construct and operate and are easy to maintain.
- CCSD strives to build sustainable, high performance facilities that provide superior indoor environmental quality. CCSD Board of Trustees Policy states "School projects are designed to be sustainable using LEED (Leadership in Energy and Environmental Design) criteria for the credits and points that the Owner would like every project to attain." See Appendix B: LEED v4 Scorecard.
- CCSD expects school facilities to be designed and constructed so that they are able to be operated for a minimum of 50 years prior to major renovation activities (excluding mechanical systems).
- CCSD strives to provide consistent and informed direction on building requirements and performance requirements to improve Project delivery and reduce lifecycle costs.

- CCSD strives to continually improve performance through incorporating learning into its processes and thus encourages transparency, open communication and thorough documentation among all Stakeholders and Project Team Members.
- CCSD believes clear communication and collaboration among Stakeholders, Project Team Members and other participants in the building/renovation process is critical to a Project's success and requires all participants to make decisions based on the best outcome for the Project.

1.2 Regulatory Requirements

1.2.1 Codes

The South Carolina School Facilities Planning and Construction Guide (SC P&C Guide) issued by the South Carolina Department of Education Office of School Facilities (OSF), shall provide the minimum requirements for school construction. The SC P&C Guide may be obtained by writing or calling the OSF at 1429 Senate Street, Suite 1114, Columbia SC 29204, (803) 734-4839 FAX (803) 734-4857. It may also be downloaded for free at the followinghttps://ed.sc.gov/districts-schools/school-planning-building/south-carolina-school-facilities-planning-construction-guides-forms/. In the event there are discrepancies between the SC P&C Guide and this document, Program Management shall be notified for clarification or resolution.

Building design shall comply with the currently adopted building codes, statutes, regulations and referenced standards specified in the SC P&C Guide applicable to the Project and all other applicable codes, statutes and regulations. Adopted building codes in SC may be viewed for free by going to https://codes.iccsafe.org/category/South%20Carolina?year[]=Current+Adoption&page=1 on the South Carolina Building Codes council website. The version of the SC P&C Guide used shall be shown on the code analysis drawing for the project.

1.2.2 Building Permits

In accordance with South Carolina Bill 236, Section 6-9-110, local building permits are not required.

1.2.3 Zoning Requirements

All projects shall comply with local zoning ordinances. If it is determined during the course of design that a variance is desired or necessary, the AE shall coordinate the effort to obtain it. The process to obtain rights-of-way and encroachment permits shall also be coordinated by the AE. When Projects are located in historic districts or work is being done on a historic building, the Project shall comply with local, state and federal historic preservation laws and policies.

1.2.4 Project Review

The South Carolina Department of Education, Office of School Facilities (OSF), South Carolina Department of Transportation (SCDOT), South Carolina Educational Television and the South Carolina Department of Health and Environmental Control (DHEC) shall review projects. The State Fire Marshal shall review the life safety aspects of the Project as part of the OSF review. The AE shall review documents as they are developed with local fire code officials who perform the construction phase inspections on behalf of the State. The local fire district shall review and approve the drawings to verify site access for firefighting apparatus.

1.3 Special Inspections

Refer to the South Carolina School Facilities Planning and Construction Guide (SC P&C Guide).

1.4 Performance Requirements

CCSD uses the following criteria to evaluate project performance, including but not limited to:

- Compliance with CCSD Design Requirements (this document)
- Compliance with CCSD Standard Drawing Requirements
- Budget and Cost Control
- Program
- Function
- Durability
- Construction Cost Per Square Foot
- Facilities Management (FM) & Asset Management (AM) cost per square foot
- Energy and Sustainability goals

1.5 Project Participants

- **Owner**: Charleston County School District (CCSD)
  - Associate of Facilities Maintenance
  - Executive Director for Capital Programs
  - Executive Directive of Food Services
  - Director of Security
- **Key Stakeholders:** Defined as the Owner (CCSD) and Principals/Senior Management of firms working on the Project (Program Management, AE, Contractors, CxA, etc.)
- **Project Team Members:** Defined as employees of CCSD and firms working on the Project
- **Program Management**: Program Management - firm(s) hired by the CCSD
- **AE**: Primary Architect/Engineer- Design Professionals of Record
- **Contractor**: Prime General Contractor – firm hired by Program Management
- **Subcontractors**: Firms hired by the Contractor
- **CxA**: Commissioning Authority – firm hired by CCSD or Program Management
- **SI**: Special Inspectors, employees of firms providing Special Inspections

2 PROJECT PHASES

The scope of services for each phase is enumerated in detail in the Agreement between CCSD and AE, and as modified in the Supplementary Conditions of Agreement between CCSD and AE, issued by the Charleston County School District. This section outlines the process for each phase of design. CCSD has adopted the United State National CAD Standard-V6 for execution of drawings. The standard format shall be "F" size for all projects. The title sheet will include the schools 4-digit building number on it. The project title must be approved by the CCSD FM Engineer in Charge or Capital Projects. The title shall describe the project scope succinctly and should be less than 40 letters including spaces. The PDF and DWG base line files can be pulled from the CCSD web site.

2.1 Project Feasibility and Conceptual Design (FCD)

2.1.1 FCD Overview

FCD is the Project phase that establishes the financial, time, and CCSD Program requirements. During the FCD phase, the scope of the Project is defined and includes, but is not limited to, site selection and expansion feasibility, programming, schematic space planning diagrams, and existing facility surveys. These Design Requirements shall be distributed to Key Stakeholders during the FCD Phase for review. An Owner's Project Requirements Workshop shall be held with the Key Stakeholders and Project Team Members to review all Owner provided documentation, to define roles and responsibilities of Project Team members and to establish a communication protocol. A Project Specific Owner's Project Requirements document shall be produced by Owner or designee that includes Project Specific information on Performance Metrics, Roles and Responsibilities and tracks any deviations to these Design Requirements.

2.1.2 FCD Submittals

1. **Project Schedule, Budget and Owner Requirements**: Owner and Program Management shall provide facility completion deadline, budget, and Design Requirements to Project Team.
2. **Design Phase Schedule and Review Plans:** The AE shall submit a Schedule and Review Plan to Program Management for approval. The schedule shall contain anticipated dates and major milestones for this Phase of the Work, to include deliverable due dates, zoning and Board of Architectural Review meetings and deadlines, interdisciplinary coordination reviews, quality assurance reviews, OSF reviews and approvals, and other agency and AHJ reviews and approvals as identified herein and in the Agreement between Owner and AE. The Review Plan shall outline the steps to be taken by the AE to review for technical accuracy, errors, omissions, discrepancies and constructability. AE shall state which tool (Redi-Check, AIA D200, or equivalent methodology) will be used.
3. **Project Feasibility and Conceptual Design Documents:** The FCD Submittal is required to obtain the Office of School Facilities' (OSF) approval allowing the Project to proceed. This submittal focuses on several site considerations outlined in Division 3 of the South Carolina School Facilities Planning and Construction Guide (SC P&C Guide). SCDOT submittals for applicable schools shall be started in this phase to attain timely SCDOT approval. AE shall perform an evaluation of applicable code issues and coordinate the review effort with code and regulatory officials.
4. **Owner's Project Requirements (OPR)** Submittal is required by Owner to document any deviations to the Design Requirements, agreement on performance requirements and

measurement criteria, identification of project specific team members' roles/responsibilities/communication, technology parameters (CAD, BIM) and data. See Appendix I for a sample OPR form.

5. **Cost Estimates:** Cost estimates are provided by Program Management. Submittal shall be for all building systems and benchmarked to market rates. The cost estimation process shall include identifying and planning for long lead time items.

6. **Sustainability: AE** shall complete a LEEDv4 scorecard for new schools. Scorecard shall demonstrate compliance with a minimum of 50 points. A CCSD LEEDv4 Scorecard is included in Appendix B that records the credits and points that Owner would like every Project to attain. AE to revise and submit based on specific Project parameters.

2.1.3 FCD Review Process

1. The AE shall submit written responses to all FCD Review Comments within 10 business days of receipt to ensure the comments were understood. After the comments are resolved and the resolution is accepted by the Key Stakeholders, comments shall be incorporated into the Construction Documents.

2. Owner shall review and comment on all submittals from FCD Phase including cost estimate from Program Management, Design Phase Schedule and Review Plan from AE and Owner's Project Requirements within 10 business days of receipt. The Owner shall approve submittals upon resolution of comments.

3. All Key Stakeholders and Project Team Members shall review the OPR and provide written comments back to Owner or Designee. The Owner shall resolve all comments and update the OPR as necessary.

2.2 Schematic Design (SD)

2.2.1 SD Overview

The AE shall perform an evaluation of and finalize the scope, form, adjacencies and spatial relationships. Major systems selection shall be finalized, and more detailed cost estimates shall be produced. Any changes to the schedule or budget during the SD phase shall be reviewed and agreed upon by the Owner and Program Project Manager. The changes shall be documented in the OPR. The AE shall produce the Basis of Design (BOD) (based on ASHRAE Guideline 0 and Guideline 1 current edition) and Program Management Project Manager shall update the OPR on a biweekly basis to include any additional deviations from the Design Requirements and submit to Owner. Owner and Program Management shall review and approve the Basis of Design (BOD) and the OPR. AE shall submit a letter stating that the Project has been reviewed and approved by OSF and SCDOT and other AHJs as necessary. Owner or Program Management retains services of CxA.

2.2.2 Schematic Design Documents

1. SD Basis of Design (BOD) shall be provided by AE. The BOD shall include a written scope that demonstrates the AE's understanding of the requested facility based on the Design Requirements, including any variances documented in the OPR. AE shall outline materials and systems from Appendix A – Basis of Design Manufacturers such that manufacturers of products, systems, and equipment shall bid the project using their standard processes.

2. Program Manager or Owner shall provide changes tracked in OPR from Conceptual Design.

3. The Program Manager shall provide the updated Construction Cost Estimate.

4. The AE shall provide code analysis reports and drawings required by OSF.
5. The AE shall provide an updated Design Schedule.
6. Site Plans: Shall be submitted at appropriate scale, showing:
    - The footprint of all structures (existing and new, including those to be demolished) with finished floor elevations
    - Proposed finish floor elevations, proposed storm piping routes, and proposed general drainage patterns
    - Site boundary (showing adjoining roadways with rights-of-way indicated)
    - Site acreage
    - Site orientation
    - Site location map
    - All setbacks
    - Easements and any other site utilization restrictions
    - Site master plan
    - All utilities
    - Curb cuts
    - Drives
    - Walks and parking areas (existing and proposed denoting the separation of buses and cars)
    - The building service entrance/area
    - Proposed storm water detention
    - Wooded areas with proposed tree save areas indicated
    - Playfields
    - Fire hydrants
    - Fire Department access around the building perimeter
7. Reasonable efforts shall be made to balance earthwork cut and fill on site. These efforts shall be demonstrated as a cut and fill summary chart on the grading plan. When site conditions or projects require phasing, a phasing plan shall be developed depicting how school and construction activities shall be conducted during the construction process. This shall include, but not limited to, lay down space, construction material storage, construction vehicle parking, building access for student drop-off and pick-up, deliveries of supplies, trash removal, emergency vehicle access to the building equivalent to pre-construction conditions, (re-) location of staff, faculty and visitor parking, (re-) location of portable classrooms, and (re-) location of play areas and equipment.
8. Floor Plans: Provide an overall plan for each level at a minimum scale of 1/16” = 1’-0’ showing overall dimensions, building code analysis information and all program spaces labeled including the square footage for each shown. Group restroom layout shall be Male on the right and Female on the left, if side by side. The scheme shall be the same on both floors of the building. Elementary classrooms shall also show the grade designation. Additionally, indicate all proposed built-in casework, fixtures, equipment, furnishings and floor finishes noting the items to be provided outside of the construction contract.

9. Roof Plan: Provide an overall Roof Plan indicating the proposed roofing systems, slopes, firewall or other area separations and points of access. Show locations proposed for major mechanical equipment and rooftop classroom spaces. Equipment location shall take into account roof overhangs near roof unit fan discharge and access for repair and removal.

10. Exterior Elevations: Provide Exterior Elevations at 1/16" = 1'-0' (minimum scale) of at least two major facades, describing all wall systems, other materials, and the size and nature of all openings. Show the proposed Floor Elevation (or elevations, for multi-level schemes).

11. Building Sections: Provide at least two (2) major building sections indicating and describing proposed structural elements, proposed distribution of MEP (Mechanical, Electrical and Plumbing) and fire protection systems, ceiling heights, areas of exposed structure, changes in the roof plane, etc. The building sections shall include all information necessary to describe the spatial nature of the program spaces depicted. Indicate all fire separation walls.

12. Structural Plan and Narrative: Provide a conceptual structural framing plan (or plans, for multi-level schemes) indicating the relationship of major members to the program spaces. A thorough narrative shall be provided describing the proposed structural system(s) including foundations. Also provide a copy of the geotechnical report with recommendations.

13. MEP and Fire Protection Systems Narrative: The narrative of all proposed HVAC (Heating, Ventilation and Air Conditioning), BAS (Building Automation Systems), electrical, plumbing and fire protection systems shall include distribution, projected loads (block and peak loads), projected cooling and indicate locations of major equipment. Electrical systems shall include, but not necessarily be limited to, power, BAS, lighting, data, public address / telephone, fire alarm, security, and surveillance. Provide a draft sequence of operations for HVAC systems based on these requirements and the Schedules and other information documented in the Project Specific OPR.

14. Program Space Analysis Chart: Provide a chart comparing all program space requirements indicated in the Project education specifications and those proposed by the schematic plans.

15. Sustainability: Update the LEEDv4 scorecard.

16. Security Plan: Provide a series of plans that address classroom security, camera locations, access control and site fencing.

2.2.3 SD Review Process

AE shall submit written responses to all SD Review Comments within 10 business days of receipt to ensure the comments were understood. After the comments are resolved and the resolution is accepted by the Key Stakeholders, comments shall be incorporated into the Construction Documents.

Third Party Review of HVAC System: The Commissioning Authority (CxA) shall review the design documents for achieving the Owner's Project Requirements and Basis of Design, and coordination of the systems to be commissioned and shall provide comments to Program Management and the AE for incorporation into the Design Development phase. Submit written report of the third-party review to Program Management within 10 business days of receipt of documents.

Note: This submittal corresponds to the Schematic Design package required by the OSF as outlined in SC P&C Guide. However, the requirements stated above exceed those required by the OSF for an SD submittal. AE shall make submission to the OSF separately as soon as documents meet the requirements of OSF and the approval of Owner. Submission to the OSF shall not occur until after Owner has approved design for submission.

2.3 Design Development Phase (DD)

2.3.1 DD Overview

The primary purpose of Design Development is to define, describe, and coordinate the aspects of the Project so that what remains after approval of the DD submittal is the formal documentation step of Construction Documents. Major issues that could cause delay and restudy during the Construction Documents phase shall be resolved at the conclusion of the DD phase. The AE shall produce a Whole Building Energy Simulation to inform and demonstrate compliance with OPR energy performance metrics and system diversity targets. The AE shall update the BOD to include any changes to the building envelope or mechanical and electrical systems based on the energy model(s) produced with the intention of providing an integrated, energy efficient and sustainable design. AE shall produce detailed drawings and specifications for review and approval.

2.3.2 DD Submittals - Documents

1. **Annotated set of SD documents or written report** shall indicate that all OSF, Owner and Program Management review comments from all reviews have been addressed and/or incorporated into the Design Development Documents.
2. **Specifications** using ARCOM MasterSpec, BSD Speclink, and eSpecs or prior approved equal. Specifications shall be in the CSI Masterformat 2014 format and numbering system and shall be tailored specifically to the Project.
3. **Updated OPR** to include any additional deviations from the Design Requirements or any changes from Schematic Design Phase based on the Whole Building Energy Simulation and more detailed drawings and specifications produced in the Design Development Phase.
4. **Updated BOD** provided by AE shall include changes based on the Whole Building Energy Simulation.
5. **Updated Construction Cost Estimate** Provided by Program Management.
6. The Architect shall have a meeting with the Owner to define the door hardware to be used on the project. The hardware schedules will be prepared by the Architect in conjunction with the Owner's AHC consultant. The Architect shall be responsible that it meets the requirements of this document.
7. **Design Phase Review Checklist** Shall be provided using Owner approved checklists. AE may use their own checklist unless one is specifically provided by Owner.

2.3.3 DD Submittals – Drawings

1. **Site Plan**: All elements of the site plan described by the SD documents shall be fixed for this submittal including detailed topography and any earth retaining structures which may be required. Additionally, a proposed landscape plan, typical site sections and site details shall be provided. All site utility requirements shall be determined for the current construction and the planned future construction, permanent and portable classrooms, and load profile.
2. **Floor Plans:** The overall plan (or plans if multi-level) shall be fixed including dimensions and building code analysis information at 1/16" = 1'-0' scale. All program space information from the SD documents shall be included on these plans. The plans shall include room numbers using the approved room numbering scheme found in Division 10 and Appendix C, and coordinated with the interior signage. Partial floor plans at 1/8" = 1'-0' scale shall be developed for each area of the building, constituting the whole. These plans shall show the final configuration of all built-in

casework, fixtures, equipment, furnishings, and floor finishes, noting the items to be provided outside of the construction contract. If the program includes new or renovated kitchen facilities, provide an enlarged plan of the kitchen at ¼" = 1'-0" scale with an itemized legend and manufacturer's literature for each unit of equipment. At the DD submittal, it is expected that floor plans shall be in their final configuration and shall include all electrical and mechanical spaces. Enlarged plans (1/4' = 1'-0" minimum) of the primary mechanical room, electrical room and the MTR shall be provided, indicating all required equipment including associated service clearances.

3. **Roof Plan**: The overall Roof Plan shall be fixed indicating all roofing systems, slopes (including all required crickets), firewall or other area separation penetrations, parapets, gutters and downspouts, roof drains, overflow scuppers/drains, roof top HVAC equipment, plumbing vents, roof hatches, access ladders and walk pads. Equipment location shall take into account roof overhangs near roof unit fan discharge and access for repair and removal.

4. **Reflected Ceiling Plan(s**): The overall Ceiling Plans, including reflected ceiling plans at 1/16" = 1'-0" (minimum scale) indicating all ceiling materials and systems, changes in the ceiling plane, fire separation walls ceiling mounted fixtures and equipment, and all HVAC, electrical and fire protection fixtures and devices.

5. **Interstitial Plans** (if necessary): These are above ceiling plans and shall provide a plan or details that clearly show all walls and partitions that terminate just above the ceiling and that terminate at the floor deck above or roof deck. This information may be shown on Reflected Ceiling Plans if a separate interstitial plan is not necessary.

6. **Interior Elevations**: Provide interior elevations sufficient to depict the location and number of all wall mounted devices and fixtures including but not limited to power, data, public address / telephone, BAS equipment, HVAC supply and return grills, Flat Screen Electronic Devices, fire extinguishers, and fire alarm within the major instructional and main administrative spaces.

7. **Door and Finish Schedules**: Provide door and finish schedules establishing the numbering systems and indicating materials, sizes, and fire ratings.

8. **Exterior Elevations**: Provide Exterior Elevations at 1/16" = 1'- 0" (minimum scale) of all facades, fixing the finished floor elevations(s), all materials and the size and nature of all openings. Enlarged partial elevations (1/8" = 1'-0" minimum) shall be provided depicting and describing any special detailing.

9. **Building Sections**: Full building sections shall show all floor levels, mezzanines and major changes in the roof plane and shall show and describe all slab, floor/ceiling and roof/ceiling assemblies. Drawings shall indicate roof slopes, structural members, major mechanical equipment and ductwork, ceiling heights, floor/roof elevations and all fire separation walls.

10. **Wall Sections**: Provide wall sections to describe all typical exterior wall systems including the foundation and slab, windows, any intermediate floor system, and the roof at ¾" = 1'-0" indicating the same level of information and detail required for the exterior section(s).

11. **Interior Room Numbers**: Prepare and issue to Program Management for approval a list of room names and room numbers (see Appendix C), to allow coordination with schedules and electrical and equipment panel boards.

12. **Structura**l: Provide the overall foundation, floor and roof framing plans with the size and location of all major members fixed and indicated. Shall provide detailed sections of typical conditions coordinated with, and at the same scale, as Architectural drawings depicted the same or a similar condition.

13. **MEP&FP (Mechanical, Electrical and Plumbing and Fire Protection)**: Provide overall plans with the size and location of all major equipment and distribution system elements fixed and indicated. Provide enlarged plans (1/8" = 1'-0" minimum) of the major instructional and main administrative spaces indicating the location and number or system devices including power, data, BAS, public address / telephone and fire alarm. Provide distribution and riser diagrams, equipment schedules and key details sufficient to describe the full scope of every building system. Provide final Sequence of Operations for HVAC system. The systems to be addressed include, but are not limited to, HVAC / BAS, plumbing and fire protection, power, lighting, data, public address / telephone, fire alarm, security and surveillance. The use of the public address (PA) system being separate from the fire alarm/emergency communication system, silencing the public address system is not required. However, the fire alarm requirements of NFPA 72 regarding intelligibility shall still be met when the fire alarm system alarms throughout the building. All utility requirements shall be determined, and loads indicated. Short Circuit and Ground Fault Analysis of the power distribution system shall be provided with this submittal.

14. **Updated Program Analysis Space Chart**: Provide an updated chart comparing all program space requirements indicated in the Education Specifications (if provided) and/or those proposed by the Design Development plans.

15. **Sustainability**: Provide updated LEEDv4 scorecard and write a brief statement outlining any changes in the LEED principles that will be applied from SD.

16. Security: Provide a series of plans that address classroom security, camera locations, access control and site fencing.

2.3.4 DD Review Process

1. The AE shall submit written responses to all DD Review Comments within 10 business days of receipt to ensure the comments were understood. After the comments are resolved and the resolution is accepted by the Key Stakeholders, comments shall be incorporated into the Construction Documents.

2. Third Party Review of HVAC System: The CxA shall review the design documents for achieving Owner's Project Requirements and the Basis of Design. The CxA shall review the design documents to determine the necessary coordination of system installation required for commissioning. The CxA shall provide comments to the Program Manager and for incorporation into the 95% Construction Documents within 10 business days of receipt.

3. This submittal corresponds to the Design Development package required by the OSF P&C Guide. However, the requirements stated above exceed those required by the OSF for DD. The AE shall make submission to the OSF separately as soon as documents meet the requirements of OSF. Owner's review of the submittal shall conclude with a special session/meeting with the AE and Program Management to discuss the design and detailing of all aspects of the building within 10 business days of receipt.

4. Program Management will schedule a Design Review Workshop with AE, Owner or Designee and PM to receive final comments. AE shall provide written responses to all comments received at the Design Development Workshop. After the comments are resolved and the resolution accepted by the Key Stakeholders, the AE shall incorporate them into the Construction Documents. All parties shall be advised that no further functional input may be accommodated without adversely impacting project timelines and budgets.

2.4 Construction Documents Phase (CD 95%)

Unresolved issues from the approved Design Development submittal will be identified in writing by the AE and require written approval by Program Management and Owner within 10 business days of receipt. AE shall prepare the complete set of Contract Documents (Drawings and Specifications) that describe the technical requirements in detail of the Work to be done under the Construction Contract. This submittal does not correspond to any package required by the OSF and shall represent approximately 95% complete Construction Documents.

2.4.1 95% CD Submittals shall include:

1. Updated OPR, BOD, and whole building energy simulation shall be provided if there are any changes from DD.
2. Updated Construction Cost Estimate provided by Program Management.
3. Construction Phase Review Process Checklist provided by Program Management. A/E shall provide a completed AIA D200-1995 (latest version) to Program Management and Owner.
4. Annotated set of DD documents or written report indicating that all OSF, Owner and Program Management review comments from DD review have been addressed and/or incorporated into the Construction Documents.
5. Provide 95% Complete Project Specifications.
6. Provide updated LEEDv4 scorecard and write a brief statement outlining any changes in the LEED principles that will be applied from DD.
7. Provide an electronic copy of all calculations and the geotechnical report as part of the submittal.

2.4.2 95% Construction Drawings shall include:

1. Drawing orientation and scales shall match the Architectural Drawings with the exception of Civil and Landscaping Design.
2. **Civil**: All aspects of the site development work shall be complete and detailed to include, but not limited to:
    - Grading
    - Drainage structures and associated piping
    - Detention ponds
    - Earth retaining structures
    - All drives
    - Parking
    - Curbing and walkways
    - Site access
    - SCDOT requirements
    - Acceleration and deceleration lanes
    - All structures (new and existing, including those to be demolished) dimensionally located as appropriate

- All utility connections
- Playing fields
- Permanently installed physical education equipment
- Fencing
- Tree save areas
- New landscaping
- Erosion control and a complete project phasing plan (for work to be performed at existing campuses).

3. **Architectural**: All aspects of the work shall be fully developed and detailed for this submittal and shall include, but not necessarily limited to:
    - Fully dimensioned plans with room names and numbers, door numbers and finishes indicated, and coordinated with structural and all other building systems
    - Complete exterior elevations
    - Complete building sections
    - All major wall sections
    - A roof plan indicating slopes and the location of all equipment, penetrations and access points
    - Reflected ceiling plans indicating all materials, fixtures, devices and changes in plane
    - Interior elevations showing fixture and building system device locations, door schedule including hardware sets, door/frame elevations and typical frame details
    - Window schedule with elevations and typical details
    - Finish schedule
    - Full specification sections for all required work.
4. **Structural**: Provide all foundation and framing plans, fully dimensioned and coordinated with the Civil, Architectural and MEP & FP disciplines including, but not necessarily limited to, the size and spacing of all framing member, slab/floor elevations and bearing heights, slab depressions, openings for ductwork, etc., section details at typical and special conditions, and reinforcing schedule.
5. **MEP & FP**: Construction Drawings shall be complete and fully coordinated with all disciplines (Civil, Architectural, and Structural, etc.) showing the location of all units of equipment and their distribution systems. Documents shall also include completed riser diagrams, system details, fixture and equipment schedules, and full specification sections for all required work. Provide complete control diagrams and sequence of operations with initial operating schedules, occupied set points, unoccupied set points, interfaces to internal equipment controls, and alerts and notifications.
6. **Kitchen:** Where a new or renovated kitchen is part of the Project, Construction Drawings shall provide a fully developed and dimensioned enlarged plan (1/4" = 1'-0") with a complete equipment schedule, locating all utility connections. Additionally, provide full specification sections for all required work.

7. Security: Provide a series of plans that address classroom security, camera locations, access control and site fencing.

2.4.3 95% CD Review Process

1. The AE shall submit a written response to all 95% CD Review Comments within 30 days of receipt to ensure the comments were understood and shall be correctly incorporated into the Bid Documents.
2. The CxA shall back-check comments made during the DD phase and submit a final commissioning review document.
3. Once the 95% CD comments are incorporated and all issues resolved, the Architect publishes the Bid Documents (100% CD Documents)
4. 100% CD Documents to be submitted to OSF for Approval

2.5 Bid Phase

The AE shall assist Program Management in preparation of information for bidders, the bidding process, preparation of proposed contract forms, and Conditions of the Contract regarding Project Stakeholder roles and responsibilities during construction.

2.5.1 Bid Phase Activities

To be determined and prescribed by Program Management and approved by Owner

2.6 Construction Contract Administration (CCA) and Construction Phase

The AE and Program Management shall ensure that the contractor roles and responsibilities indicated below are included as requirements in bidding and construction contract documents.

2.6.1 Overview

The Contractor joins the existing Project Team. The first Project Team Meeting shall be the Pre-construction Meeting hosted by the Owner and Project Manager. The objective of this meeting is to engage the team and to clearly define roles and responsibilities, establish ground rules for communication and problem solving during the Construction Phase.

The AE's role during the CCA and Construction phase shall be in accordance with their contract. In general, the AEs act as Owner's Representative to determine whether the Contractor is constructing the Project in general conformity with the overall design concept and intent. The AE observes the work, reviews progress reports, submittals, and certifies the applications for payment, attends Project Team Meetings, prepares and recommends contract modifications, and inspects the Project for Substantial and Final Completion.

A Pre-Final inspection shall be held after all systems are in place and in operation. The Program Manager requires the Contractor and sub-contractors to attend this inspection including, but not limited to, the HVAC, Plumbing, Electrical, TAB, Building Automation System and Kitchen sub-contractors.

2.6.2 Construction/CCA Submittals

1. **Contract Documents**: AE updates the Bid Documents with any changes occurring during the Bid Phase and submits the final 100% Construction Documents prior to contract award and work commencing.
2. **Construction Quality Assurance Plan**: The Contractor shall submit a Quality Assurance plan for review and approval by Program Management and Owner.
3. **Construction Phase Schedule**: The Contractor submits a Construction Phase Project Schedule to include major milestones and dates for Construction Phase Submittals and Construction Phase Activities to bring the Project to Substantial completion on the agreed upon timeline and within the agreed upon budget. Schedule shall include the necessary time allocation for final testing and commissioning of the building envelope and all energy-using systems. All work and testing shall be complete prior to substantial completion inspection.
4. **Construction Phase Review Process**: The Construction Phase Review Process provides a process for RFI distribution, review and approvals, a change order process, a financial review process, interdisciplinary coordination reviews, quality assurance reviews, OSF reviews and approvals, and other agency and AHJ reviews and approvals as identified herein and in the Agreement between Owner and Contractor.
5. All Contractors and subcontractors via Program Management shall deliver the required extra materials not later than 5 weeks prior to the start of the Functional Performance Testing.
    a. Preventative Maintenance Equipment Forms
    b. Extra Materials Delivery Form
    c. Corrective Action Report Form
    d. Operations & Maintenance Training Form
    e. Sewer, water and storm drainage documentation that is required by local municipalities and all final video inspection documentation.
6. **Contractor submits a checklist** of all submittal documents necessary for Close Out including, but not limited to, product bonds and/or warranties, spare parts, shop drawings, Owner training and demonstrations, maintenance supplies (attic stock), equipment manuals and certifications required by the Specifications.
7. **Meeting minutes**: Project Manager shall keep meeting minutes including for the Kick-off meeting to establish roles and responsibilities, the communication protocol and a problem-solving methodology.
8. **RFIs:** The Contractor shall be responsible for keeping the tracking log of Requests for Information (RFIs). The Contractor shall review RFIs submitted by Subcontractors for accuracy and correctness prior to submitting to the AE for response. If an AE response to an RFI has a cost or schedule impact, the Contractor shall notify Owner and Project Manager immediately and use the appropriate channels to get approval to proceed with the work. The Contractor shall keep one set of Record Documents onsite which is continuously updated with responses to RFIs.
9. **Change Orders:** To be determined by Program Management and Owner.
10. **Payment Requisitions:** To be determined by Program Management and Owner.
11. **IBC Special Inspection Reports:** To be determined by Program Management

12. **Checklist of Permits**: Contractor shall issue a checklist of required permits for the Project, including agency, permit description, contact person, date requested, and date acquired.

13. **Utility Connection Approval:** AE shall coordinate with utility providers and provide each utility with all required documentation and approvals so that utilities may provide temporary (if necessary) and permanent utility connections to the Project. Utility bills shall be paid from Project funding until the building is turned over to the Owner.

2.6.3 Construction Phase Review Process

To be determined by Program Management and Owner

2.6.4 Construction Project Management

To be determined by Program Management and Owner

2.6.5 Construction Contract Administration

To be determined by Program Management and Owner

2.6.6 Test and Balance (TAB) – See General Division 01

2.6.7 Commissioning (Cx) – See General Division 01.

2.6.8 Red Zone Meetings

The Owner, Program Management Team, A/E and Contractor shall hold a "Red Zone" review conference at the appropriate time during construction. Follow the standard agenda in Appendix G.

2.7 Project Close-Out

2.7.1 Close-Out Overview

During the Closeout Phase the Contractor shall be responsible for developing the Punch List, coordinating the Training of O&M personnel by the Equipment Manufacturers, providing the CxA with Operation and Maintenance documentation including Warranties, reviewing the As-Built documentation with Owner and obtaining the Certificate of Occupancy. The CxA shall be responsible for compiling the O&M manual and verifying that the O&M personnel received the appropriate training to operate and maintain the building in the manner it is intended. The Contractor, AE, Program Management and Owner shall be responsible for reviewing the Punch List and deciding which items the Contractor is responsible for completing before Final Completion is obtained. A Final inspection shall be held with Owner, AEs, all Contractors and Subcontractors to demonstrate to Owner that all systems in the building are operating as designed and intended. For any system not operating as designed, the warranty shall not commence until system is certified by the Commissioning Authority and AEs.

2.7.2 Close-Out Submittals

1. Functional Performance Test documentation shall be submitted by the CxA
2. Final Commissioning Report shall be submitted by the CxA
3. As Built Documents: As-built drawings shall be submitted by the Contractor to AE. AE shall obtain marked up prints from the Contractor to produce and deliver electronic As-builts in both AutoCAD and PDF formats.

4. An electronic copy of all approved shop drawings shall be provided by contractor to Program Management.
5. Contractor shall submit all forms required by OSF.
6. Owner shall provide a list of Owner Furnished/Owner Installed (OFOI), Owner Furnished/Contractor Installed (OFCI), and an Interior Signage schedule of previously approved room names and room numbers.
7. The Contractor shall provide the equipment/system submittals in accordance with the requirements of Division 01 to the CxA.
8. The Contractor shall provide the preventive maintenance equipment data sheet to the CxA in accordance with the requirements of Division 01.
9. All Contractors and subcontractors shall submit O&M data for systems and equipment being commissioned as specified elsewhere and as applicable in accordance with ASHRAE Guideline 4-2008 through the Program Management. O&M data shall be submitted in accordance with the requirements of Division 01.

2.7.3 Training

See Division 01.

2.8 Post Construction

2.8.1 Inspections

The Project Manager shall host two post construction inspections by the Project Team to assure that the building is continuing to operate in accordance with the plans and specifications and that there are no unresolved issues with operation of the facility. These inspections shall address building envelope and all energy using systems including, but not limited to, Plumbing, HVAC and electrical work.

The first post construction inspection shall take place 6 months after final construction inspection. The second post construction inspection shall be held 1 month prior to expiration of the 1-year warranty period. All discrepancies and deficiencies discovered during these inspections that relate to defective materials or defective workmanship shall be corrected by the Contractor at no additional cost to Owner.

2.8.2 Training

See Division 01.

PART II: DIVISION & DISCIPLINE SPECIFIC REQUIREMENTS

The requirements of the following Divisions shall be included in the contract documents unless otherwise approved by Owner. AE shall review and coordinate all Divisions prior to completion of DDs to avoid duplications, contradictions, errors, and omissions. Questions, comments, and/or concerns regarding any of these requirements should be addressed in writing to the Program Management for resolution or clarification with Owner.

Owner will update these Divisions on a regular schedule to be communicated by Owner. AE will be expected to comply with all requirements that are current at the commencement of their specific Project.

DIVISION 01 - GENERAL REQUIREMENTS

ENERGY AND SUSTAINABILITY REQUIREMENTS

New schools shall be designed to meet the Certified level requirements of LEED for Schools. A draft LEEDv4 scorecard is included as Appendix B, AE shall maintain a LEED scorecard, update it throughout the project, and include the final scorecard in project closeout documentation.

Project performance will be evaluated on the following metrics as defined below and on the output of the Whole Building Energy Simulation:

- Energy Use Intensity (EUI): Energy Use per Square Foot
- Meet ASHRAE 90.1 2010 or IECC 2015
- Water Use: Gallons Per Square Foot
- Indoor Environmental Quality (IEQ)
- Annual Carbon Emissions
- Life Cycle Cost

Whole Building Energy Simulation

Shall be provided by a P.E., AEE BESA, or ASHRAE BEMP using a computer aided load design software to demonstrate compliance with Energy and Sustainability metrics above:

- Acceptable software programs shall comply with ASHRAE Standard 140 -- Standard Method of Test for the Evaluation of Computer Based Energy Analysis Computer Programs, current edition, limited to Autodesk Revit, IES Virtual Environment, Trane TRACE, Carrier HAP, eQuest, Energy Plus, or Open Studio. (If another software tool is proposed, Engineer shall submit in writing for Program Management approval, detail how the tool will be used, and methodology to be applied and program input and output summaries.)
- Simulation shall be for 8760 hours per year for both design and energy consumption of the operations of all energy using systems.
- Load designs shall produce design day calculations as well as simulated operating load profiles and energy consumption profiles for a weekday, weekend, and holiday for both occupied and unoccupied hours.
- Output reports shall show individual space and terminal HVAC equipment peak design loads, as well as the central system/building peak load design sizes. The simulation shall use set

points and scheduled occupied and unoccupied times for the various spaces and space use types found in the schools (classroom, kitchen, cafeteria, media centers, gymnasiums, administration areas, etc.) as stated in the Design Requirements or as documented in the Project Specific OPR. Space use and occupancy schedules shall be as prescribed in the Appendices to ASHRAE 90.1 User's Manual, Table G-M -School Occupancy and shall be modified as required for any specific function at the school not covered in the ASHRAE User's Manual.

- Diversity: All HVAC systems having central plant equipment, such as chilled water cooling, hot water heating, variable air volume systems, water source heat pump system, cooling towers, boilers, pumps, piping, and associated equipment shall be sized using industry prescribed diversity factors or actual central system/building design loads as provided by the whole building energy simulation described above with any appropriate safety factors. When diversity is not used to design the central system equipment, copies of the load design software input and output reports along with a written justification accompanied with appropriate energy and economic analysis to justify not providing diversity in the central equipment sizing shall be provided to Program Management for approval.
- U-value: Include building envelope U-value assumptions and calculations.
- Duct system calculations: Include static pressure calculations used for fan sizing and the basis of design (software, spreadsheet, manual "Ductulator", etc.)
- Hydronic system calculation: Include friction loss and pump sizing calculations and the basis of design (software, spreadsheet, "System Syzer", etc.)
- Mass flow calculations: Include building and zone pressurization relationships. Pressurization calculations shall demonstrate areas that are under slight positive pressure, negative pressure or neutral pressure as appropriate for the area of the building being served. Buildings shall be maintained at a slight positive or near neutral pressure relationship with respect to the outside.
- Lighting and Power: Include lighting calculations for all exit signs, building exterior, grounds/site and parking, and all building power distribution systems based on actual fixtures and equipment specified.
- Fenestration: AE shall limit the total amount of fenestration such that it is in compliance with LEEDv4 Certification guidance.
- Demonstrate energy conservation by reducing lighting power density; eliminate light trespass at site boundaries as prescribed in the current version of the IESNA Lighting Handbook.
- Acoustics: Design, calculation and measurement shall demonstrate compliance with the HVAC background noise level requirements of not more than 45 dBA for major renovations. New Construction shall demonstrate compliance with the current edition of ANSI/ASA S12.60 – "Acoustical Performance Criteria, Design Requirements and Guidelines for Schools."

EXTERIOR MOCK-UP REQUIREMENTS

Exterior Walls

Provide a freestanding mockup of a typical exterior wall construction and include a detailed description of the mockup components. Depending on the school design, interior mock-ups may be required. The mockup shall be a minimum 8 ft. long by 8 ft. high and be a composite representation of the actual design for the purpose of evaluating the quality, workmanship and establishing the color and pattern. The mockup shall include the following:

- Intersection of the various wall components

- A control joint showing sealant colors
- Window openings, flashing, waterproofing seal, etc.
- All air barrier system components, membranes, flashings, sealants, etc.
- Through wall flashing joints and dams

Sprayed On Fire Resistive Materials

Mock-ups for sprayed on fire-resistive materials shall have at least 100 sq. ft. of surface done for each UL test. Check for density and bond strength.

STORAGE AND HANDLING OF MATERIALS

All materials shall be stored to meet LEED v4 Construction Indoor Air Quality Plan and handled on site in accordance with manufacturers' recommendations in such a way that no warranties are voided.

LEVEL OF CLEANLINESS

The facility shall be turned over to the Owner clean to APPA Level 2 (Ordinary Tidiness Indicators).

ASBESTOS/LEAD FREE DOCUMENTATION

AE/Contractor shall provide a notarized letter to Owner stating that no asbestos or lead containing materials were used in the design or construction of the Project. See Appendix F for sample form.

COMMISSIONING REQUIREMENTS

All new Owner construction and major renovations require Commissioning (Cx) of the building's energy using systems, the building envelope and other assemblies. Cx shall follow the format and content recommendations of ASHRAE Standard 202 - 2013. ASHRAE defines Cx as "a quality-focused process for enhancing the delivery of a project that requires verifying and documenting that all of the commissioned systems and assemblies are planned, designed, installed, tested, operated and maintained to meet the Owner's Project Requirements". The Commissioning Authority (CxA) shall be retained by Owner or Program Management and shall inform Key Stakeholders and Project Team members of Owner requirements. Owner or Designee shall facilitate a workshop during the Feasibility/Conceptual Design Phase to document Project Specific requirements including any deviations to these Design Requirements. Owner or Designee is required to update the Project Specific OPR over the course of the entire Project.

The CxA Requirements are:

- CxA shall review the OPR and Basis of Design (BOD) and the Design Submittals during all Phases of the Project Design to ensure compliance with the Design Requirements and the Project Specific OPR. Submit written report of the third-party review to Program Management.
- CxA shall write the initial Cx Plan and provide milestones to the Contractor that shall be included in Construction Phase schedules. CxA shall update the Cx Plan over the course of the Project.
- CxA shall review the Construction Submittals of all systems and materials related to the Cx process to ensure compliance with the Design Requirements and the Project Specific OPR.
- CxA shall create Pre-Functional Test Checklists.
- CxA shall conduct periodic site visits and send site visit reports to the Project Team that includes any Cx-related issues found while onsite. The CxA shall track Cx issues on a log to document when the issues were identified, proposed resolutions, final resolutions and when the issue was closed and verified by the CxA.

- CxA shall witness a sample of airside and waterside (if applicable) Test and Balance (TAB) procedures and verify that systems are functioning as the design intended, and if not, document issues and resolution procedures.
- CxA shall create Functional Performance Test procedures and oversee testing of equipment and systems.
- CxA shall obtain required O&M Manuals, warranties, training materials, etc. from the Contractor. CxA shall produce the Systems and Assemblies Manual following ASHRAE Guideline 1.4-2014 "Procedures for Preparing Facilities Systems Manuals.
- CxA shall review the equipment and systems Operations & Maintenance (O&M) Manuals to verify compliance with the Design Requirements and the Project Specific OPR.
- CxA shall witness a sample of the Owner Facility Management Training and verify that all training requirements are completed by Contractor.
- CxA shall participate in Program Management/Contractor's pre-final and Final Occupancy Inspections, if required.
- CxA shall submit the Final Cx Report within 30 calendar days of Final Occupancy Inspection.
- CxA shall conduct a 10-month Post Occupancy Inspection/warranty review of facility systems and assemblies. This site visit shall be scheduled before the warranty phase has ended. Final Cx Report shall be updated to reflect results of 10-month Post Occupancy Inspection.

The following Systems and Assemblies Required to Be Commissioned:

- HVAC
- Boilers and Domestic Hot Water Systems
- Building Automation System
- Building Automation Controlled Lighting Controls Systems
- Electrical Distribution
- Security Systems
- Renewable Energy Systems
- Emergency Generator
- Building Envelope

Specify the following Cx Requirements by Project Phase

Feasibility and Conceptual Design Phase (FCD):

- Program Management shall:
  - Distribute Design Requirements to Key Stakeholders and Project Team Members
  - Facilitate Owner's Project Requirements Workshop
  - Develop the Project Specific OPR document to include:
    - Project Description
    - Team Members (contact info., roles and responsibilities)

- Project Schedule and Scope
- Occupancy Schedules
- Deviations to Design Requirements and/or Education Specifications

- The CxA (if retained) shall:
  - Develop Initial Cx Plan which shall include preliminary schedule, process, testing procedures, individual responsibilities, documentation requirements, communication and reporting protocols, training and evaluation procedures.

Schematic Design: (SD)

- Review BOD to verify compliance with Design Requirements and OPR.
- Review Design Submittals to verify compliance with Requirements, BOD and OPR. Create a Design Review log to track comments related to Cx. Submit the log to the Project Team to review and for their response. The shop drawings shall be organized into separate files by specification section in PDF format.
- If CxA review of Design Submittals reveals non-compliance with Requirements, BOD, or OPR, communicate impact on Cx Schedule, Training needs or other Owner's Requirements and Update OPR and Cx Plan accordingly.
- Develop Cx Requirements for Design Development Documents.

Design Development: (DD)

- Review Design Submittals to verify compliance with Guidelines, BOD and OPR. Update the Design Review log to track comments related to Cx. Submit the log to the Project Team for their responses.
- If CXA review of Design Submittals reveals non-compliance with Requirements, BOD, or OPR, communicate impact on Cx Schedule, Training needs or other Owner's Requirements and Update OPR and Cx Plan accordingly.
- Develop Cx Requirements for Construction Documents.

95% Construction Documents (95% CD)

- CxA shall perform a Back-check of comments made during the DD phase and submit a final commissioning review document.

Construction

- Participate in the Contractor's Pre-Construction meeting with Contractors.
- Conduct a Pre-Construction Kick-off Commissioning Meeting with contractor and subcontractors
- Update Cx Plan
- Provide Cx-related milestones to the Contractor to incorporate into the Project Schedule
- Review Construction Submittals related to Cx

Pre-functional Process

- Create Pre-Functional Tests checklists for Contractor completion
- Witness a sample of Contractor Start-up of Systems

- Review Pre-Functional Test checklists completed by Contractors

Functional Testing

- Verify and Witness TAB of HVAC
- Verify BAS Sequence of Operations
- Verify BAS functionality Point to Point
- Review BAS Sequence of Operations documentation and verify it is correct
- Create Functional Performance Tests
- Witness completion of Functional Performance Tests conducted by Contractors
- Issue and distribute Status Reports and Issues Log
- Witness Owner Training
- Review O&M Manuals and Owner Training information and create Systems Manual

Post Occupancy

- Review Contractor Callback issues provided by Program Management between Final Inspection and ten-month Warranty Walk-Through review.
- Participate in ten-month Warranty Reviews
- Update Issues Log
- Update Final Cx Report

TRAINING REQUIREMENTS

Specify the following training requirements for Owner Personnel:

- The time required for training shall be specified as appropriate for the system or component in the contract documents. Training shall be coordinated by Program Management and scheduled 30 days in advance with Owner prior to substantial completion. Similarly, if systems require sending Owner personnel to the factory, this shall be coordinated 30 days in advance of the factory visit with Program Management and be included in contract documents. Program Management shall be responsible for the sequencing of training deliverables and schedules so that all training requirements are met prior to substantial completion and within the required timeframes.
- At a minimum, training is required on the following:
    - HVAC
    - Domestic Hot Water
    - Domestic Water Booster Pumps
    - Sump pumps
    - Lighting Controls
    - Emergency Power and Generators
    - BAS system and controls
    - Fire Alarm

- Elevator Systems
- Automatic Fire Protection Systems
- Security
- Communications/Technology
- Marquee Signage and Sound Systems
- Door Hardware
- Specialty Finishes
- Envelope
- Utility feeds

- Owner personnel shall receive comprehensive training from manufacturer's factory authorized/certified personnel using formal written curriculums and classroom instruction on the proper use, operation and maintenance of all systems 90 – 120 days prior to Substantial Completion.
- Owner personnel shall receive comprehensive Functional Hands-on Field Training in the proper use, operation and maintenance of all systems 14 - 30 days prior to Substantial Completion.
- Contractor shall be required to compile all the necessary information and materials for training Owner personnel and others as directed.
- Owner Food Service Personnel shall receive comprehensive Functional Hands-on Field Training in the proper use, operation and maintenance of all food service equipment within 10 business days following equipment start-up. Training shall consist of 2 separate sessions, with the second occurring no more than 30 days following occupancy
- The CxA shall review the Contractors submittal of required Training Documentation and Operations and Maintenance Manual and organize it into the Systems Manual. The Systems Manual shall be in electronic PDF format with a table of contents that includes links to each section. The Systems Manual shall be produced 30 to 40 days prior to substantial completion to be available for Owner personnel for classroom instruction.
- The Owner Training sessions shall be videotaped by the Contractor and provided to Owner at completion of the training sessions.

Contractor shall furnish the following materials in the O&M Manuals:

- A copy of the training plan, including schedule, syllabus, and agenda. Compile and provide all training Materials provided by the manufacturers.
- A detailed description of each system and its components, wiring and control diagrams, installation procedures, and control sequences for starting equipment, operating equipment in all modes and shutting equipment down.
- A written schedule in electronic PDF and a Microsoft Excel spreadsheet of all equipment manufacturers, including model numbers and serial numbers.
- A parts list, including source of supply and recommended spare parts.
- All required emergency instructions and safety precautions.

- Maintenance information for each piece of equipment to include overhaul instructions and lubricating schedule including type, grade, temperature, and frequency range.
- Approved submittals for each piece of equipment and the Controls.
- Scanned PDF copies of record drawings, shop drawings and As-Builts.
- Product information identifying performance curves, rating data, features, and options on all installed equipment.
- Copies of approved certifications and laboratory test reports.
- Copies of warranties.
- Test procedures including the impact of testing and operation of fire and life safety systems.
- Contact information for each Contractor who installed equipment.
- Contact information for local manufacturer representative for each piece of equipment.
- A schedule of uninterruptible power supplies and Emergency Power Generation, including a list of equipment and design kW load on each.

WARRANTIES AND MAINTENANCE AGREEMENTS

General Requirements

- Warranties shall include all material and labor cost for corrective action or replacement. All warranties shall commence from the date of Substantial Completion, not from equipment startup date.
- Program Management shall respond within 24 hours after a complaint is issued via Owner work order system. After 24 hours, Owner shall have the right to repair and back charge Program Management.
- AE shall require, as a bid alternate, a two (2) year Contractor's warranty for all Work from the date of substantial completion to be provided by the Contractor.

One (1) YEAR WARRANTY MATERIALS & LABOR

- All Work shall be fully warrantied for one year from the date of substantial completion by the Contractor.

Two (2) YEAR WARRANTY

- Sheet waterproofing shall have manufacturer's standard warranty plus a 2-year labor warranty from installer.
- Outdoor air units shall have a 2 years Labor.

Five (5) YEAR WARRANTY MATERIALS AND LABOR

- Wood Doors
- Outdoor Air Unit compressors, coils, piping, refrigeration circuits, manufacturer's controls and accessories
- LED Marquee sign including LED Message Center, modules cabinet, structure and installation.
- Termite Control
- Transient Voltage Surge Suppression (TVSS)

- Surge Protection Devices (SPDs)
- All coastal protective coatings on HVAC cabinet, equipment, condenser coils and coils exposed to 100% of outdoor air.
- Roofing – replacement projects and new construction

Ten (10) YEAR WARRANTY MATERIALS AND LABOR

- Fiberglass Reinforced Plastic (FRP) Door Systems
- Operable Partitions
- Pre-Engineered Walkway to include metal failure, fastener failure, and finish failure.

Twenty (20) YEAR WARRANTY

- All aluminum window finishes shall carry a 20-year coastal finish warranty (i.e. warranty shall permit product use in coastal environments)
- All aluminum storefront and curtain wall finishes shall carry a 20-year coastal finish warranty (i.e. warranty shall permit product use in coastal environments)
- All fixed and telescoping audience seating shall include replacement structural steel components, nets, bolts, axles and wheels as necessary to maintain the integrity of the original installation.
- All metal wall panels systems and assemblies shall carry a 20-year coastal finish warranty (i.e. Warranty shall permit product use in coastal environments)

Twenty (20) YEAR NO DOLLAR LIMIT "SYSTEM" WARRANTY

- Modified Bitumen Roofing
- Built-Up Roofing
- A complete roofing system warranty to include insulation, cover boards, fasteners, all membrane components, all base and counter flashing components, walk pads, and all roofing accessories. Warranty shall remain intact and warrant roof systems performance based on the latest version of IBC (International Building Code) for the Southeastern United States.
- Sheet Metal Roofing for entire roofing system which shall include coverage for weather-tightness failure, finish cracking, peeling, color fading, flashing failure, and/or trim failure
- Fluid Applied Membrane Roofing Systems

Thirty (30) YEAR WARRANTY

- Asphalt Shingle Roofing

DIVISION 02 – EXISTING CONDITIONS

Owner requires an environmental consultant to coordinate on all types of demolition and waste disposal if any study indicates the presence of hazardous materials as defined by OSHA or other regulatory bodies.

SELECTIVE DEMOLITION

Require Selective Demolition (removal of a portion of an existing structure and selected site elements) when buildings are to remain.

- The extent of demolition shall be clearly shown on the drawings for each discipline affected.
- Unless otherwise noted, demolished materials shall become Contractor's property.
- The Contractor shall prepare and implement a Waste Management Plan on all projects following the LEED v4 Prerequisite for Materials and Resources – Construction and Demolition Waste Management Planning:
    - Establish diversion goals and describe where the materials will be taken and how the recycling facility will process the materials
    - Provide a written report detailing all major waste streams generated, including diversion and disposal rates.
- The Contractor shall document (photographs, videotapes) the extent of demolition, pre-demolition if Program Management requires this for the Project.
- The Contractor shall notify Owner 14 days prior to start of demolition If Owner indicates that they will occupy portions of the facility adjacent to selective demolition.

COMPLETE DEMOLITION

Complete Demolition is the total removal of an existing structure, to include removal of known below-grade construction and existing utilities shown on the site survey. In some instances, utilities may be abandoned in place when approved by Owner. Owner or Designee shall notify Contractor in writing when complete Demolition can begin. After notification, any remaining contents (furnishings, equipment, etc.) shall become the Contractor's property.

- The Contractor shall prepare and implement a Waste Management Plan on all projects following the LEED v4 Prerequisite for Materials and Resources – Construction and Demolition Waste Management Planning:
    - Establish diversion goals and describe where the materials will be taken and how the recycling facility will process the materials
    - Provide a written report detailing all major waste streams generated, including diversion and disposal rates.
- When Contractor is asked to remove and salvage any items, for example historic items, that these items be labeled as "remove and salvage".
- Contractor shall accomplish building demolition only by mechanical or hand methods; explosives or imploding are not allowed.
- Contractor shall submit an environmental protection plan addressing environmental protection, dust control, and noise control measures.

- Contractor shall coordinate with District's environmental consultant studies indicate the presence of hazardous materials.
- Site restoration as a result of demolition activities shall be addressed in the specifications.

DIVISION 03 – CONCRETE

GENERAL REQUIREMENTS

- AE shall specify pre-placement meetings for all concrete work.
- AE shall require Contractor to mix, finish and cure concrete flooring and subflooring in accordance with manufacturer's written installation instructions for each type and location of flooring shown in the finish schedules.
- AE shall specify a porosity inhibiting admixture to reduce moisture in slab.
- Installations shall require initial floating to form uniform and open textured surface plan, free of lumps, humps, divots and hollows.
- Contractor shall finish and measure surface so gap at any point between concrete surface and unleveled freestanding 10-foot long straightedge resting on two high spots and placed anywhere on surface shall not exceed 3/16 inch.

CAST-IN-PLACE CONCRETE

- Vapor retarders and perimeter slab insulation requirements shall be coordinated with Division 07 Sections.
- Color additives and specialty toppings shall not be specified unless approved by Owner.
- Permanent sealers, such as epoxy coatings, shall be specified in Division 9.

PLANT PRE-CAST STRUCTURAL CONCRETE

- Tilt-up precast panels that are site precast and finished on site shall not be used.

PLANT-PRECAST ARCHITECTURAL CONCRETE

- Insulated precast Architectural panels, with thin brick facings, or stone facings may be used for portions of a building or entire building envelopes.
- Feasibility studies on their use shall include cost, structural implications, effect on construction schedule and maintenance requirements.
- Precast concrete panels shall not be left exposed as an interior finish in any application.

Specify the following Design Requirements for Precast Concrete Panels:

- General:
    - Insulation shall comply with current International Energy Conservation Code adopted by SC and ASHRAE 90.1 at minimum. Discuss with Owner Engineering Director before beginning design.
    - Wall Panel Size – standard design dimension shall be 12'-0", 12'-8", or 13'-4" wide x 32' to 45' tall x 7.5" to 9.5" thick depending on specific loading conditions and module Architectural details.
    - No more than 10% of total panel pieces shall vary from the nominal standard width. Non-standard panels shall be utilized at building corners to make up dimensional differences.
    - Wall Panel size and detail shall be repetitious.

- Joints – standard joint width shall be ¾” for precast wall panels. Plan for tolerances accordingly in exterior Architectural details and window system compatibility. See current edition of Precast/Pre-stressed Concrete Institute (PCI) Handbook.

- Architectural Details
  - Reveals – standard reveal width shall be 2” at the mouth, 3/8” deep; other reveal patterns shall occur in 2” increments and no deeper than 3/8” to protect reinforcing clear cover. Do not use elaborate patterns. Budget allotment is the equivalent linear footage of 6 horizontal reveals per panel. Reveals used to surround brick areas count against this allotment.
  - Colors shall be selected from 3 standard concrete mix designs (Gray Rock Gray – gray cement with granite aggregate, Buff – antique white cement with white aggregate, Modified Buff – antique white cement with brown aggregate) all using locally available coarse and fine aggregates. Select from 3 standard sandblasted exteriors (moderate, medium, heavy) that may be mixed together to highlight Architectural details throughout the building.
  - Brick - Modular brick may be used for accents using standard sheet coursing dimensions not to exceed 10 courses tall. Do not use non-linear coursing patterns. Corner bricks shall not be used. Maintain no more than 50% brick coverage across the building elevation, preferably per panel. Brick shall be selected from the standard Endicott color/texture sample boards (16 colors, 4 finishes each = 64 brick options).
  - Prototype Design – maintain simple Architectural features repeated throughout each elevation.

- Openings and Other Elements
  - Windows – shall be standard size window openings following OSF guidelines. Limit opening sizes within wall panels to three different sizes to economize production and set up costs. Use of more than three different window opening sizes shall require the approval of Program Management and Owner. Refer to tolerance of rough openings per PCI Handbook.
  - Positioning Openings – maintain all openings (doors and windows) a minimum distance of 18” of any edge of wall panel to prevent additional engineering design and reinforcing materials costs. Standardize opening positions within wall and panel members to economize production.
  - Metal/Glass Integration – “ribbon” glass areas, large storefronts, and glass/metal curtain walls in place of load bearing precast elements shall not be used with precast panels.

- Manuals and Resources
  - Design Manuals – use PCI Handbook.

DIVISION 04 – MASONRY

GENERAL REQUIREMENTS

- Provide a broad scope specification on specified masonry wall components. Do not use multiple narrow scope sections for brick, mortar, and concrete masonry units.
- Interlocking concrete unit masonry and masonry constructed with surface-bonding cement shall not be used as building components.
- Cavity walls constructed of brick veneer, rigid insulation, and CMU back shall be acceptable as the building envelope for additions to existing structures already using this type of construction.
- Rigid insulation shall be installed in such a manner as to prevent thermal bridging in exterior wall systems.
- Split face block shall not be used, and ground face block shall only be used in limited Architectural accents and detailing.
- Bull-nosed concrete masonry units shall be used at pedestrian corners
- Use products with recycled content and regional materials per LEED v4 Requirements

UNIT MASONRY ASSEMBLIES

- All corridors and group toilets are required to be constructed with CMU walls. Exceptions for interior administration areas and other low traffic, non-student areas are permitted with approval from Owner.
- Use an integral water repellent for exterior applications of concrete masonry units with the exception of exterior face brick. (Water repellent may be used on interior face brick as a deterrent to soiling and staining.)
- Require parging and waterproofing of exterior faces of below grade masonry walls.
- Exterior brickwork shall enclose all structural columns and beams of concrete or steel.
- Use Bull-nosed concrete masonry units at pedestrian corners at vertical walls with the exception of the base course, where square corners are allowed.
- Face brick shall comply with ASTM C 216.
- Drawings and Specifications shall include face brick manufacturer, size, color, and bond pattern. Do not use a brick allowance. Face brick shall be utility size.
- Mortar for CMU shall be a mix of Portland cement and lime, Type S. Mortar for face brick applications shall be mortar cement, ASTM C 1329, Type N.
- Grout for unit masonry to comply with ASTM C 476, and note “Grout” on the drawings. AE shall avoid non-specific notes such as “Fill block with concrete” or “fill bond beam with concrete”.
- Masonry joint reinforcement and ties for multi-wythe walls shall be adjustable (2-piece) type with single pair of side rods and continuous diagonal cross ties or ladder type with separate adjustable veneer ties engaging the cross ties. Horizontal reinforcing with multiple side rods alone shall not be used to tie face brick to CMU backup. All shall be made of hot dipped galvanized steel. Corrugated metal ties are not acceptable.

- Adjustable masonry veneer anchors for attachment to metal studs shall have pronged legs to bridge insulation or sheathing and contact studs.
- Require cavity drainage material so that cavities are kept clear of mortar droppings.
- Require extruded polystyrene insulation for cavities.
- Require field quality control testing for mortar and for grout in reinforced masonry walls.

STONE CLADDING

Use of natural or precast stone requires written permission from Owner. In the event that permission is granted, it shall be limited to historic preservation or renovation projects where matching is necessary.

MASONRY RESTORATION AND CLEANING

- High pressure cleaning is not acceptable and cleaning materials shall be approved by both the brick and mortar manufacturers prior to cleaning.
- For historic structures or materials, the Secretary of Interior Standards for the Treatment of Historic Properties and the National Park Service Preservation Briefs for masonry Restoration and Cleaning shall be followed.

DIVISION 05 – METALS

STRUCTURAL STEEL

- The steel fabricator shall either be AISC certified or provide documentation certifying that all steel fabrications are be made in accordance with AISC standards and guidelines.
- A light grey primer shall be used for interior exposed structural steel and shall remain unpainted.
- Exterior structural steel shall be hot dipped galvanized, and field or factory painted with high performance coating
- Where steel members are to be fireproofed, no field primer is required.
- A pre-installation conference shall be held shortly after the layout is performed.

STEEL JOISTS

- Specify open-web K-series joists for floors and roofs, and LH-series for long-span applications.
- Specify a light gray primer for all joists.

COLD-FORMED METAL FRAMING

- Provide submittal requirements for design calculations, shop drawings, and installation drawings for curtain-wall framing supporting exterior masonry veneer, floors, and roofs.
- Performance requirements shall require that member depths are shown on the drawings.
- The fabricator shall design the metal thickness based on the design loads and deflection criteria specified. The design loads shall be shown on the structural drawings.
- Specify G60 coating for non-masonry panel supports, and G90 coating for masonry wall supports.
- Deflection tracks for vertical deflection clips shall be designed to allow for construction tolerances and to accommodate live load deflection of the primary building structure.
- Un-punched studs and track shall be used when fabricating lintels.
- A Pre-installation conference shall be held shortly after the Cold Formed Metal Framing layout is performed.

METAL FABRICATIONS

- Steel lintels shall be hot dipped galvanized steel.
- Steel framing and supports for mechanical and electrical work shall be coordinated with Divisions 23 and 26.
- Use ferrous metals for typical components.
- Use hot dipped galvanized steel for exterior components.
- Shapes shall be chosen that are easy to maintain and shall not retain water. Circular shapes are preferred.

EXTERIOR METAL PANELS

Use of exterior metal panels must be approved by Owner. Exterior metal panels shall be located a minimum of 8 ft. above ground level. Metal panels shall be an integrated system with the

insulation and fasteners approved and inspected by the manufacturer. Aluminum Composite Panels shall not be used.

METAL STAIRS

- Specify preassembled metal stairs with concrete-filled metal pan treads.
- Structural calculations and detailed shop drawings shall be prepared by a qualified professional engineer licensed and legally authorized to practice in South Carolina.
- Specify pipe and tube railings as an integral part of the stairs, however, when handrails and railing systems are required as isolated units, they shall be specified in the following section "Pipe and Tube Railings." Painted handrails and railings are not allowed.

PIPE AND TUBE RAILINGS

- All handrails and railings shall be fabricated from aluminum.
- Painted handrails and railings are not allowed.
- Specify placement of each joint system on shop drawings. These shop drawings are to be included in close out documents to Owner.

GRATINGS

- Specify metal bar gratings, expanded metal gratings, formed-metal plank gratings, and extruded-aluminum plank gratings as required for the specific project and application.
- All exterior or weather-exposed gratings shall be made of hot dipped galvanized steel.

ARCHITECTURAL JOINT SYSTEMS

- Specify exterior and interior building joint systems, with and without fire barriers that accommodate movement resulting from one or more causes such as thermal changes, seismic forces, or wind sway.

DIVISION 06 – WOOD, PLASTICS AND COMPOSITES

ROUGH CARPENTRY

- The use of wood construction shall be approved prior to the Schematic Design Phase.
- The use of wood shall be limited to furring, nailers, blocking, miscellaneous lumber, and construction panels -- wood nailers and blocking are not required to be fire-retardant.
- Plywood is required to be pressure treated.
- Plywood and composite wood-based materials installed on the inside of the air barrier shall be free of added urea-formaldehyde per LEED v4. If the construction type requires non-combustible materials or assemblies, consider a different product or assembly.
- Fire-retardant plywood shall be used with caution for roof construction and only where specifically approved in writing by OSF prior to including it in any Contract Documents.
- All lumber and plywood materials shall be stored off the ground and under cover and shall be vented to prevent condensation and warping.
- Wood materials that come into contact with the ground or masonry shall be properly treated with moisture and pest protection.

FINISH CARPENTRY

- Specify cope at returns and miter at corners to produce tight fitting joints and use of scarf joints for end-to-end joints.
- For Major Renovations: Damaged or defective finish carpentry shall be repaired to eliminate functional or visual defects. Where not possible to repair, require contractor to replace finish carpentry and adjust joinery for uniform appearance.

INTERIOR ARCHITECTURAL WOODWORK

- AE shall require compliance with “Architectural Woodwork Standards” published by the Architectural Woodwork Institute (AWI)
- Transparent Finished Casework; Casework is required to be made of premium graded oak and of a heavy-duty construction.
- Doors: Construction and thickness shall be designed to prevent warping.
- Shelves: Do not exceed spans of 3 ft. for ¾ in. thick shelves and 4 ft. for 1 in. thick shelves.
- Countertops: General use and group restroom countertops shall be solid surface materials (countertops and backsplashes). No laminate or concrete countertops will be permitted. Coordinate color selection.
- Cabinet Hardware: shall be heavy duty, 4-inch pull rod for drawer and door pulls
- Drawer Slides: shall be100lb. capacity wheeled slides with self-closing feature.
- Door Hinges: shall have concealed hinges, European style, self-closing with built-in horizontal and vertical adjustment. Require 5 knuckle hinges on typical casework
- Require door silencers for all cabinet doors.

- All cabinets and/or casework shall be constructed of premium grade wood. Non-cabinet or furniture grade plywood is permissible only if finish veneer is applied. Particle core materials are not accepted.
- Where transparent finish is shown, cut doors and drawer fronts of each run of cabinets from one "counter front" sheet of plywood and install them in the same position so that the grain runs vertically and grain matches between adjacent doors and/or drawers. Contractor shall be required to submit samples of transparent finishes that show the extremes in color variation.
- Enclosed cabinets shall not be installed underneath sinks. All sink base cabinets shall be slotted / perforated to allow ventilation.
- Shelving: For PE and Custodial area shelving the shelving shall be metal with a maximum shelf length of 36-inches and be 24-inches deep.
- Media Center: the sill height for windows shall allow for installation of 48" high wall mounted shelving units. Freestanding units shall not be more than 48". Wall units may be up to 72" high.
- Contractors shall not install architectural woodwork until the building is enclosed, the permanent heating and cooling system is in operation, and the residual moisture from plaster, concrete masonry or terrazzo has dissipated.

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

ROOF ASSEMBLIES

- AE shall contract with an independent Registered Roof Consultant (RRC) if project involves any roofing, including but not limited to new construction, roof replacement, modifications to the existing roof systems, and new penetrations.
- The RRC shall write and furnish the AE with all (Division 7) specification sections related to the roof design and exterior wall systems, including all components.
- The RRC shall monitor roof construction and final acceptance and provide weekly inspection reports to Program Management, the Contractor, and AE within three (3) working days of each visit.
- RRC shall submit a letter to Program Management stating their recommendations have been incorporated into the design.
- Low Sloped Roofs: Specify a modified bitumen or fluid applied roof system with a minimum slope to point of discharge of 1/4 inch per foot.
- Canopies and Covered Walkways: Specify overhead canopies/covered walkways at primary building entrances, car loops and bus drop-offs as follows:
    - Structure shall have sufficient slope to drain water away from the building.
    - Structure shall not drain across sidewalks
    - Sheet metal panel systems shall be used for soffit construction. Gutters and downspouts shall be used to direct water away from the sidewalks or discharged water into underground storm drain lines. (Stucco and drywall soffits shall not be used.)
    - Canopies shall be factory coated and not field painted
- Skylights: Overhead sloping glazing shall be used only with approval of Owner on a specific project, prior to the start of the Design Development phase. Overhead glazing shall meet OSHA 29 CFR 1910.23.
- Insulation: Minimum R-value insulation shall be used in the initial Whole Building Energy Simulation with additional insulation added to improve building envelope performance as justified by life-cycle cost analysis (performed by AE). Refer to OPR for project specific requirements for energy conservation and envelope insulation values.
- Provide a roof information card that identifies materials, manufacturers, substantial completion data, contractor, designer, contact for warranty repairs, and other basic information.
- In Big Box Spaces (i.e. Gymnasium, Multi-Purpose Rooms, and Cafeterias) specify an Acoustical Steel Roof Deck to control acoustics.

EXTERIOR WALL ASSEMBLY

- Single wythe exterior walls are not allowed.
- The floor, wall and roof shall be designed to perform as a unit so that it is energy efficient and leak free.
- A/E design team shall form a Building Enclosure Team (BET) to ensure continuity for the entire building enclosure: floor, roof, and walls. The BET team shall consist of a SC Registered

Professional Engineer or Architect, Registered Roofing Consultant (RRC), Registered Waterproofing Consultant (RWC), and a Registered Exterior Wall Consultant (REWC).

- The BET will be a part of the A/E team during the design development phase, contract document preparation, design reviews and especially during contract administration.
- A/E shall submit a letter to Program Management stating the BET recommendations have been incorporated into the design.
- The A/E shall formulate a quality assurance plan (QAP) that starts with the plans and specifications preparation and includes the construction a mock-up wall that has facets of the flashing and a window in it. The QAP will be in accordance with the latest guidelines of the Air Barrier Association of America (AABA).
- The wall system components shall have been tested together to produce a systemized code and standard compliant unit that meets as a minimum ASTM E2357 (Air Leakage), ASTM E331 (Water Leakage), NFPA 285 compliant (Fire Propagation, and ASTM E119 (Fire Resistance) latest versions.
- The wall system shall at a minimum have an air/water resistive barrier, foam insulation (minimum R value of 12 (ASTM C518), mortar dropping protection, flashing materials (including end dams, corners and weep vents) and hook & ladder brick ties. The wall system shall be coordinated and submitted as one package for approval by the BET.

BUILDING ENCLOSURE TEAM REQUIREMENTS

- BET shall coordinate their work with the established Project Schedule.
- BET will assist the Architect with review of applicable close-out documents.
- BET will be available for consultation by phone or email as needed during the project.
- **Design Development Phase**
  - The building enclosure walls, windows, doors, and roof shall perform as an integrated system.
  - BET shall attend two quality assurance (QA) review meetings for elementary and middle schools and four QA meeting for high schools to review and discuss proposed building envelope systems and proposed detailing systems.
  - BET shall provide design review of Architect's guidelines, details, and other standards for consideration in the development of building enclosure walls.
  - BET to provide design, details, specifications, and other standards for consideration in the development of the roof system. Specifications shall follow the format provided by the Architect.
  - BET shall review preliminary specifications for all materials and assemblies and materials associated with waterproofing/air barriers for the wall, exterior wall penetrations, and roof edge detailing and adjacent vertical wall connections.
  - BET shall provide a written review of Architect's building enclosure wall system and applicable specifications.
  - BET shall provide complete specifications for all materials waterproofing the roof, including, but not limited to general roofing, roof insulation, flashing roof penetrations, flashing roof

structures, flashing roof equipment, roof to wall intersection flashing, and parapet waterproofing. Specifications shall follow the format provided by the Architect.

- BET shall provide all required roof related details drawn in AutoCAD or modeled in REVIT on sheet layout formats provided by the Architect for incorporation into the project drawing set. Architect will provide the digital files to be used as the basis for detailing.
- BET's drawings and specifications shall be signed and sealed by a Licensed Engineer in the State of South Carolina or a Registered Roof Consultant. Where applicable, a Registered Waterproofing Consultant or a Registered Exterior Wall Consultant will seal the drawings for work applicable to waterproofing or exterior walls for which the BET has total design authority.

- **Design Review**
  - BET shall provide building enclosure walls design review to include, but not be limited to, exterior window and door openings, wall cladding (veneer) terminations, air barrier and water barrier systems and building expansion joint details.
  - BET shall provide recommendations (in the form of comments, mark-ups, sketches and/or recommended products) to the Architect, for consideration in the development of the construction documents as they relate to the building enclosure wall details.
  - BET shall review applicable specifications generated by the Architect and provide comments for recommended changes.
- **Construction Administration**
  - BET shall review and accept, as appropriate, shop drawings and submittals as required by the Contract Documents related to the BET generated roofing specifications. Unacceptable submittals shall be processed with the Architect until compliance with specifications is realized.
  - BET shall provide comments to Architect for one review of building enclosure wall shop drawings and submittals as required by the Contract Documents.
  - BET shall participate in one preconstruction and one mock-up review meeting pertaining to the building's enclosure wall system(s) to confirm the contractor has a clear understanding of the methods of application and installation of the specified products.
  - BET shall participate in one preconstruction meeting pertaining to the roof system(s) to confirm the contractor has a clear understanding of the methods of application and installation of the specified products.
  - BET shall provide interim site visits during construction of the roof system(s). Site visits shall be once a week during the installation and details. Provide one punch list inspection and one final inspection.
  - BET shall provide interim site visits during construction of the exterior walls, windows, and doors. Milestone visits shall be as follows.
    - Substrate inspection prior to installation of weather resistant barrier and air barrier if applicable.
    - After completion of weather resistant barrier and air barrier if applicable.
    - At the initial 3 days of thru-wall flashing installation.

- Thru-wall flashing prior to brick installation.
- Windows after installation.
- Window flashings after installation and prior to cladding.

- BET shall prepare and submit reports relaying information pertaining to weather, area worked, application methods, and material types installed that day. Reports shall be submitted to the Owner and the team by COB each Friday.

FLOOR WATERPROOFING

- Discuss floor system with Plant Operations Flooring Manager at DD stage
- Specify floor waterproofing for restrooms, custodial closets, dishwasher rooms, kitchens, showers, and other areas with water faucets/sinks/etc.
- Specify the turn up membrane 4 inches at walls.
- Prior to installation of finish flooring, the Contractor shall flood the entire waterproofed area with water at least 2 inches deep at the shallowest point for 24 hours.
- Testing shall be completed in accordance with ASTM D 5957. Contractor shall repair any leaks and retest.

ELASTOMERIC SHEET WATERPROOFING

Where applicable, require sheet waterproofing.

WATER REPELLENTS

Water repellents shall be used in accordance with Southwestern Research Institute (SWRI) standards.

BUILDING INSULATION

- Insulation values shall be equal to or exceed the most current ASHRAE 90.1 or IECC Energy Code adopted by SC. Consult with Owner Energy Manager prior to selecting insulation thickness.
- Spray fireproofing over the exposed portion of the insulation shall be tinted to be able to observe complete coverage.
- Roofing and wall insulation shall be staggered to avoid thermal bridging at seams and to produce the desired thickness.
- Wall insulation joints shall be sealed, and all penetrations shall be sealed with expandable foam.
- Acoustic Insulation shall be installed for Recording Studios, Music Rooms and Practice Rooms.
- Lightweight insulating concrete or Exterior Insulation and Finish Systems shall NOT be used.

AIR BARRIER SYSTEMS

See current published IECC code for requirements. (use current version whether or not SC adopted)

ASPHALT SHINGLE ROOFING

- Shall not be used except on outbuildings and field houses. When used, shall be designed and built with 30-year architectural shingles with 130 mph or the latest requirements of Charleston County whichever is greater.
- Downspouts shall drain into an underground drainage system.
- Gutters shall have leaf guards installed
- Gutter downspouts shall have cast iron boots at ground to protect from landscape equipment and other damage.
- Gutter Boot height shall be a minimum 3 ft. above grade

SHEET METAL ROOFING

- Standing seam roofing shall be used for medium pitched roofs. Asphalt shingles shall not be used.
- System shall be a prefabricated, pre-finished metal panel roofing system.
- System shall include the metal panels, sliding clips and other attachments, flashing to adjacent construction and other accessories. As an option, standing seam metal roofs shall have removable, repairable panels.
- System shall meet the requirements of UL580 and ASTM E 1592.
- Finish of all roofing panels, trim and accessory elements shall have shop-applied high-performance anti-corrosion coating.
- Use of exposed fasteners shall be minimized and all fasteners, exposed or covered, are required to be of stainless-steel construction and shall match the color of roofing by means of factory-applied coatings.
- All metal panel roof areas shall drain into external gutters and downspouts.
- Downspouts shall drain into an underground drainage system.
- Gutters shall have leaf guards installed
- Gutter downspouts shall have cast iron boots at ground for protection from landscape equipment and other damage.
- Gutter Boot height shall be a minimum 3 ft. above grade

MEMBRANE ROOFING

- Single ply Thermoset or Thermoplastic roofing is not permitted.
- Minimum slope to point of discharge shall be ¼ in. per foot and built into the structure. Use of tapered insulation or to execute replacement of existing tapered roof insulation systems for obtaining primary slope shall not be used unless a roof replacement project requires the additional slope to meet building code.
- All low slope roof areas shall be accessible by means of a roof hatch, exterior door or exterior roof ladders. Roof hatch shall be located in a service area, typically located in a custodial closet.
- Roof Insulation: Insulation thickness shall be a minimum of two layers as required to meet specified thermal resistance.

- Flashing: Base flashing shall be type recommended by membrane manufacturer to meet warranty requirements. No vertical lap joints in flashing closer than 8 ft. o.c. shall be permitted.
- Downspouts shall drain into an underground drainage system.
- Thirty (30) ft. of underground roof drainage piping shall be smooth wall to facilitate cleaning.
- Gutters shall have leaf guards installed
- Gutter downspouts shall have cast iron boots at ground to protect from landscape equipment and other damage.
- Gutter boot height shall be a minimum 3 ft. above grade

SBS MODIFIED BITUMEN BUILT-UP ROOFING

- No "Single Source" specification shall be allowed.
- Require a minimum 2-ply modified bitumen roof for low slope roofs with a prefabricated, reinforced, homogeneous Styrene-Butadiene-Styrene (SBS) block copolymer modified asphalt membrane secured to a prepared substrate. Both reinforcement mats shall be impregnated and coated on each side with a high quality SBS modified bitumen blend. The roof system shall pass ASTM D 5849 and be resistant to cyclic joint displacement at 14°F. Passing results shall show no signs of membrane cracking or interply delamination after 500 cycles as manufactured and 200 cycles after heat conditioning according to ASTM D 5147. The modified bitumen cap sheet shall have a factory applied surfacing. Phased installation shall be allowed when approved by the manufacturers in writing.
- The minimum design performance standards shall be as noted:
    - Base Sheet: Glass fiber and/or polyester reinforced ply sheet, meeting or exceeding requirements of ASTM D 6163, D 6164 or D 6509, Type I or II, Grade S. Base sheet shall be fully adhered. Mechanical fastening only allowed with CCSD permission. If allowed, the base sheet shall be ASTM D 6164, Type I, Grade S base ply.
    - Cap Sheet: Glass fiber and/or polyester reinforced ply sheet, meeting or exceeding requirements of ASTM D 6163, D6164 or D6222, Type I or II, Grade G. Granules to be white.
    - FM Class 1A-90 minimum (Must still meet site specific wind and seismic requirements)
    - FM LSPD 1-49 for Perimeter Flashing
    - FM LSPD 1-29 for Above Deck Roof Components
    - NRCA Roofing and Waterproofing Manual (Current Edition)
    - SMACNA Architectural Sheet Metal Manual (Current Edition)
    - *(SMACNA details shall be modified to meet project specific requirements and shall be shown on the drawings.)*
- For low-slope roofs, the building structure shall slope a minimum of ¼-inch per foot. Sloped insulation may be used to form crickets and direct water to roof drains and scuppers. Interior roof drains shall have tapered insulation around all four sides of the drain to create a sump. Place a granular surfaced SBS modified bitumen target ply around the roof drains. Strainers shall remain in place at all times once the drains are connected to the building drainage system.
- Specify a two-ply base flashing system with surfacing to match roof surfacing

- Perimeter nailers and cant strips shall be of treated wood and installed in accordance with FM 1-49. Provide polyisocyanurate board insulation and cover board. Cover board shall be roof system manufacturer's recommended material. Indicate R-values on the drawings.
- Base flashings shall be secured with termination bar at 6-inches on center, with top of base flashing sealed with reinforcement fabric and asphalt roofing cement. Base flashing shall be minimum 12-inches above roof.
- Walkway pads shall be placed at the roof hatch and at the service side of the rooftop HVAC units. Specify mineral-granule-surfaced walkway pads and show the locations on the roof plan.
- When a fire-rated roof assembly is required, verify that the manufacturer's roof system, including the metal deck has been tested by UL.
- Interior roof drains shall be cast iron, including bowl, clamping ring, and strainers, with stainless steel bolts. Roof drains shall be located as close to midpoints between columns as reasonable.
- The Roof Consultant (RRC) shall have at minimum a Registered Roof Observer (RRO) to provide quality assurance inspections beginning the initial 2 days of roof construction and continuing once per week until substantial completion.
- The RRO shall provide Owner with weekly written QA reports.
- Design modifications to the roof system(s) shall be approved by Owner, Program Management, AE, RRC and if appropriate the roof system manufacturer. These modifications shall not have an effect on the specified warranty(s).
- The RRC shall provide a punch list inspection and a final inspection after the punch list items have been completed. Written reports shall be provided to Owner for both inspections.
- Downspouts shall drain into an underground drainage system.
- Thirty (30) ft of underground roof drainage piping shall be smooth wall to facilitate cleaning.
- Gutters shall have leaf guards installed
- Gutter downspouts shall have cast iron boots at ground to protect from landscape equipment and other damage.
- Gutter Boot height shall be a minimum 3 ft. above grade

FLUID APPLIED MEMBRANE ROOFING SYSTEMS

RRC shall specify fluid applied membrane roofing system as the first choice on renovation projects and as an alternate on all new construction. See Appendix A for Basis of Design Manufacturers.

MANUFACTURED ROOF SPECIALTIES

Specify roof specialties including copings, fascia, gutters, and downspouts be formed, fabricated, finished, and assembled in the factory. Where possible, one manufacturer should be responsible for all the roof specialties on the Project.

ROOF EXPANSION ASSEMBLIES

- Expansion joints shall be constructed as a raised curb with a sloping 24-gauge galvanized pre-finished metal cover with interlocking standing seam joints at a maximum spacing of 10 feet. Secure with concealed fasteners every 8-inches on one side of the joint. The opposite side shall

allow for expansion and contraction. Height shall be in accordance with manufacturer's recommendations.

- Pre-manufactured expansion joint covers, e.g. Expandoflash, shall not be accepted.
- Isolate non-supported roof/wall sections and changes in deck directions.
- Specify minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal edge and expansion joints.
- Require documentation of coordination for installation of exterior wall joint systems with roof expansion assemblies.
- Require all contractors involved to sign off that all transitions are watertight following installation.

ROOF ACCESSORIES

- Roof accessories (pre-manufactured metal curbs and equipment supports, safety rails, relief vents, ridge vents, heat and smoke vents, and roof hatches) shall be galvanized steel sheet metal construction with a factory primer. Roof vents and roof hatches may be aluminum with a backed enamel finish. Hatches shall be 30"x36" and specified with full safety rail system around the hatch that meets the latest OSHA safety requirements.
- AE shall attempt to design roof and located equipment to avoid the need to utilize safety rails. If safety rails are necessary, AE shall submit plans for location of safety rails to the Program Manager for approval. AE shall verify requirements for safety rails around roof mounted equipment with current OSHA, OSF and AHJ requirements.

SPRAYED-ON FIRE-RESISTIVE MATERIALS

- Coordinate locations of fireproofing with the structural engineer.
- If fireproofing is to be exposed, and aesthetics is a concern, specify a sample or mockup for approval.
- Steel columns in mechanical rooms and high traffic areas shall be protected by cast in place concrete in lieu of spray on fire protection.
- Specify field quality testing for dry density and bond strength.
- Provide cementitious-sprayed fire-resistive materials with a minimum dry density of 39-lb/cu. ft. for exposed applications.
- Some manufacturers claim that the minimum dry density resulting from laboratory tests is sufficient to meet the Project requirements. The AE may specify higher densities to satisfy other requirements in addition to fire rating and durability. Clearly note in the specifications that the specified dry density and thickness shown are required regardless of the manufacturer's fire-resistive claims.
- Require Contractor to be responsible for sequencing the work, if Contractor installs equipment before the fireproofing, Contractor shall protect all installed work from over spray.
- The original installer, using the original means and methods for installation, shall do all patching of the fireproofing. Isolation patching of the fireproofing is not acceptable.

THROUGH-PENETRATION FIRESTOP SYSTEMS

- All firestopping shall be installed by a single subcontractor certified to install through-penetration firestopping systems.
- Shop drawings shall show each kind of construction condition penetrations and the manufacturer's tested firestop design designation to meet the required ratings of all UL Assemblies shown. This documentation method requires a single source responsibility for the design and product delivery for the Project. UL Assemblies shall be specified.

FIRE-RESISTIVE JOINT SYSTEMS

- A single source manufacturer shall detail and supply the joint systems for the entire project.
- Require the Contractor to submit details on each proposed assembly identifying intended products and applicable UL Assembly or UL classified device.
- Require the Contractor to coordinate with review agencies when inspection or rated penetrations are required.

JOINT SEALANTS

- Use elastomeric sealants. Limit latex sealants to non-moving joints in drywall construction.
- Use low or ultra-low modulus sealant for use on metal copings, metal fascia, and other metal components where a high degree of thermal movement is expected.
- Use low to medium modulus sealants for typical exterior and interior joints between masonry, concrete, doorframes, windows, and joints between combinations of these materials.
- Use medium to high modulus sealants for applications where joint movement is limited to +/- 25%, for example glazing, curtainwall, and structural glazing applications.
- Caulk precast concrete joints with a low to medium modulus sealant capable of withstanding structural movement of 50% in extension and 50% in compression without adhesive or cohesive failure.

DIVISION 08 – OPENINGS

GENERAL REQUIREMENTS

- Wood and hollow metal doors shall not be hung until the building is enclosed, the permanent heating and cooling systems are in operation and indoor relative humidity has been maintained at a level of less than or equal to 55% for a minimum of 7 consecutive days. Contract documents shall require contractor to create and maintain a log of relative humidity readings for the purpose of documenting these conditions prior to installation of doors.
- Selection of glazing type for reception and vestibule spaces must be discussed with Director of Security during the Schematic Design Phase.
- Hollow metal door closers shall be bolted through door**.**
- Show typical window elevations, schedule of each type and size, locations, in wall construction details, and glazing details on shop drawings.
- Doors exceeding 7 ft in height require approval by Owner
- Blinds shall be furnished under FF&E.
- Ten percent (10%) of window and door openings shall be water tested after installation
- Doors and hardware subjected to hurricane force winds may be hurricane rated as separate components and can be used in lieu of assembly rated components for renovations and new construction.
- Owner supplied access control
    - Any opening that the Owner or access control provider touches, they shall supply and install the closer if it is FRP, HM or Wood
    - Storefront openings and closers shall be supplied by the Contract Hardware Distributor (CHD) and installed by the Storefront supplier
    - Mullions shall be supplied by the CHD and installed by the GC/Storefront installer
    - If the opening is electrified and it's a pair of doors, the Owner/access control provider shall supply the mechanical and electrified exit devices.

FRONT DOORS

Main Entrance shall be equipped with a doorbell and an AIphone shall be provided by the Door Access Control vendor

KITCHEN DOORS

- Exterior kitchen doors shall be equipped with a doorbell and peephole by Doorscope Model 2000 or Owner approved equal.
- Doors from loading docks into the kitchen receiving areas shall be a minimum of 8 feet tall and 48 inches wide.

EMERGENCY EXIT DOORS

All emergency exit doors serving multiple spaces shall be double doors.

WOOD DOORS

- Swinging interior “A” label and “B” label double doors shall be wood. Only domestic species of wood shall be used.
- Structural Composite Lumber (SCL) core wood doors with transparent finish in hollow metal frames shall be used on most interior doors including 20-minute constructed fire doors. Thermal fused style doors with a thermally fused face may be used as an alternative. Doors shall be pre-fitted, pre-finished and pre–machined at factory for finish hardware. High density mineral core blocking reinforcement for mineral core doors shall be provided at hinge, closer, lock and strike locations. Doors shall be 1-3/4 in. thick and 7ft.high.
- Wood doors shall be solid 5-ply hot pressed (cold pressed not acceptable) bonded core with no added urea formaldehyde and no use of formaldehyde-based glue in the manufacturing process.
- All doors in instructional areas shall have narrow vision lights. Vision lights shall be laminated and attack resistant (4 minute minimum) Director of Security shall be consulted on the size of vision lights on classroom doors.
- No doors shall be delivered to the building until weatherproof storage space is available. Doors shall be stored in a space having controlled temperature and percent relative humidity range between 30 and 60 percent (conditioned air). Stack doors flat and off of the floor to prevent warping. Protect doors from damage and direct exposure to sunlight.

HOLLOW METAL DOORS AND FRAMES

- INTERIOR
  - Doors shall be 1-3/4 in thick and 7ft. in height and be full flush.
  - All interior metal doors, metal frames and metal sidelight frames shall be hollow metal and shall be:
    - ANSI A250.8, grade 3 extra heavy model 2A (welded, seamless) primed doors for field finish for interior doors
    - Face sheets and frames fabricated from 16-gauge cold rolled steel. Knock Down frames are not allowed.
- Jamb anchors at masonry wall openings shall be standard wire anchors and jamb anchors for plaster and gypsum wallboard partition openings shall be a minimum of 18-gauge steel. Frames at masonry walls shall be filled with grout.
- Specify door reinforcement as follows:
  - A minimum of 12 gauge for hinges and be continuous channel for the full height of door
  - 12 gauge for closers and be a continuous channel for the full length of the header
  - 14 gauge for strikes and be a continuous channel for the full height of the door
  - 7 gauge reinforcements for hinges on frames
  - 26 gauge steel plaster guards or mortar boxes welded to the frame shall be provided at hardware cutouts where installed in concrete, masonry or plaster openings
- Vision lights shall be provided at stairs/corridor doors, except at 3 hour labeled openings. Glaze with ¼ in. UL labeled glass at fire rated doors and ¼ in. tempered glass at other doors. Light size shall be 3 in. x 33 in. at fire-rated doors. Director of Security shall be consulted on the size of

vision lights on classroom doors. Vision lights shall be located as required by ADA. Glazing kits shall be (concealed type) flush with door surface.

- All doors off hallways, corridors, and stairways shall have stainless steel kick plates. For main exit doors, kitchen, storerooms, and other doors subject to heavy use, specify extra-large stainless steel kick plates.

EXTERIOR DOORS (FRP DOORS)

- FRP doors shall not be field painted - the color needs to be made into the material.
- Exterior doors shall be continuous stainless steel or aluminum hinges.
- Water testing of door shall be required
- Door shall meet 3rd party testing in accordance with Florida Building Code or meet ASTM E330, ASTM E1886, ASTM E1996 .

ACCESS DOORS AND FRAMES

- Shop-primed galvanized steel shall be used for general locations and stainless steel for wet locations.
- Locations for access doors for above ceiling equipment shall be shown on drawings.
- Access doors are not permitted for above ceiling HVAC equipment larger than 5 tons of cooling capacity. Refer to Division 23 for detailed access requirements.

OVERHEAD COILING DOORS AND GRILLES

- Overhead roll up doors and grilles shall be of metal construction and shall not interfere with required egress from occupied spaces.
- Dish return at cafeterias shall be stainless steel roll up doors.
- The design of the kitchen/serving area shall not permit the use of fire-rated roll-up doors.
- Doors shall be manual operation by crank or chain unless size dictates otherwise.
- Specify a slide bolt locking device (no lock cylinders permitted).

ALUMINUM ENTRANCES

- Door reinforcement shall be a minimum of 12 gauge for hinges and shall be continuous channel for the full height of door,
- Door reinforcement shall be a minimum of 12 gauge for closers and shall be a continuous channel for the full length of the header
- Door reinforcement shall be a minimum of 14 gauge for strikes and shall be a continuous channel for the full height of the door.
- 7 gauge reinforcements shall be used for hinges on frames.
- 26 gauge steel plaster guards or mortar boxes welded to the frame shall be provided at hardware cutouts where installed in concrete, masonry or plaster openings.
- Finish shall be Anodized or Kynar (Kynar to be provided with Coastal Warranty).

ALUMINUM STOREFRONT

- All exterior single access point openings shall be Fiberglass Reinforced Plastic (FRP) doors with aluminum storefront frames. Consult Owner before specifying.
- Multiple access point openings requiring electronic locks or swipe cards shall be aluminum store front doors and frames. All electronic locks shall be motorized electronic latch retraction or electrified mortise lock. Electronic strike mechanisms are only allowed with Owner approval.
- Exterior storefront applications shall include a thermal break.
- Door stiles shall be minimum of 5 inches in width.
- If Blade Stop frames are supplied, the storefront manufacturer blocking shall provide (Blade Stop Spacers) for closers, mullions and rim exit devices.
- Finish shall be Anodized or Kynar.
- Vertical rod assemblies are not allowed.

GLAZED ALUMINUM CURTAIN WALLS

- Glazed aluminum curtain walls are seldom used in school projects comprised of one or two stories (floors) and must be approved by Owner. Storefront systems are usually adequate.
- Require project specific preconstruction testing.
- When both aluminum storefront and glazed aluminum curtain wall systems are used on a project, clearly define and label each type on the drawings to correspond to the specifications.
- Require a curtain wall consultant when using curtain walls or specify delegated design to be provided by curtain wall manufacturer.

STEEL WINDOWS AND FRAMES

- Exterior windows shall be inoperable except for locations dictated by OSF requirements
- All exterior windows shall be equipped with insulating glass.
- Hollow metal glazing frames shall be fabricated from 14-gauge cold rolled galvanized steel.
- Do not extend hollow metal window systems to ground level.
- Frame anchorage at masonry openings shall be standard wire anchors. Frames at masonry openings shall be filled with grout. Frames at drywall or plaster openings shall be minimum 18-gauge steel and at a minimum shall be placed at the top, center, and floor.
- Blinds shall be furnished under FF&E.
- Water testing window openings shall be required.

ALUMINUM WINDOWS

- Specify thermally broken, single hung aluminum windows
- Provide aluminum egress hardware and opening devices for windows designated as egress windows. Indicate windows for emergency use by mechanically fastened signage.
- Windows shall be based on performance requirements listed in AAMA/NWWDA 101/I.S.2. Specify Heavy Commercial (HC) class, performance grade 40.

- Product data shall include manufacturer's specifications and test reports from an AAMA accredited laboratory.
- Samples for each specified finish type shall be provided.
- Hinges shall be concealed stainless steel. Cam handles and strikes shall be bronze. Double hung egress windows shall have only one center lock. Two locks shall be required on all other double hung windows.
- Insect screens shall be aluminum wire fabric, charcoal grey color.
- Windows shall match the storefront color and finish.

SKYLIGHTS

Skylights and solar day lighting tubes shall only be used when no other type of natural day lighting design is possible. Specify factory-assembled glazed unit skylights with integral curb for installation in flat roof areas. Skylights shall require fall protection around them. Clerestory windows are preferred. All skylights require Owner approval.

GLAZING

- Impact resistant, insulated, Low-E glass shall be used for all exterior applications throughout the District on all projects.
- UL rated ballistic resistant glazing and frames may be required for reception areas and security vestibules. AE to confer with Owner Security personnel on level of protection required.
- No sidelight windows shall be allowed on interior doors including classrooms unless otherwise directed by the Director of Security.
- Use Solargray, Solarbronze and light green Solex glass tints. When selecting a tint, maximize visible light transmittance while balancing code requirements for solar heat gain coefficient (SHGC) and U-values. Other colors may be considered and approved by Owner.
- When multiple glass types are used in the Project, identify each type on the drawings and provide a glass schedule in the specifications to describe the characteristics of each type.

ONE WAY MIRRORED GLASS

All elementary school work rooms, CD-kindergarten rooms shall require at a minimum, one-way, ½ lite mirrored glass installed in doors.

FINISH HARDWARE

- Hardware shall be based on the approved hardware shown in the Appendix A: Basis of Design.
- AE shall schedule a hardware coordination meeting with Hardware consultant, Owner Locksmith, and Owner Security office.
- The hardware installation specifications shall require the installers to have been certified by attending the Assay Abloy training. They shall produce the certification as a shop plan submittal.
- Finish hardware shall be stainless steel. Interior door hinges shall be aluminum or brushed chrome. Exterior doors shall have continuous aluminum hinges. Panic devices shall be anodized aluminum or stainless steel.
- All non-rated exit devices shall have the ¼ turn hex key dogging. Only the main entrance, faculty and students shall have keyed entry and ¼ turn hex key dogging.

- All double door entrances and foyer entrances shall have removable mullions (require a tool to remove), with the exception of those pairs of doors designated loading and unloading of furniture and other large objects (band rooms and performing arts areas) which shall have key removable mullions.
- All corridor fire rated doors shall utilize the appropriate trim and shall have the appropriate magnetic hold open device connected to the fire alarm system. AE shall specify floor finish below all fire rated doors.
- Six (6) months after acceptance of the Project, the installer, accompanied by Owner's representative (for quality assurance) and the finish and security hardware representative(s) shall inspect all hardware. Require Contractor to fix items covered under warranty.
- All exterior doors, staff entrances, foyer egress doors and other strategic locations identified on a project specific basis shall utilize an electronic latch retraction with a card swipe with keypad.
- Offices to hallway doors shall utilize a separate card reader by strike and mortise lock.
- Vestibule to office doors shall utilize a separate card reader/keypad with an electrified mortise lock.
- Lock cylinders:
    - Shall match facility restricted keyway.
    - Door keying shall be grandmaster keyed as approved by Owner and after a keying conference with school officials takes place.
    - Provide three (3) keys per lock cylinder.
    - On renovation projects where the existing hardware shall remain in place, any new lock shall be keyed to the existing system as determined by Owner's locksmith. Contractor shall directly contact and communicate with Owner's locksmith for specifications. Owner's locksmith will install all final cores with the assistance of hardware supplier. The hardware supplier shall provide Owner with the final bitting list on all projects to be included with project close out documents.
    - On renovation projects, where additions and renovations exceed 50% of the existing facility, all lock hardware on existing doors shall meet ADA standards.
    - On all new construction and major renovations, locksets shall be provided with red construction cores.
    - On all new construction and major renovations provide 25 master keys.
    - All hex exit device dogging keys and restroom privacy keys shall be turned over to the Owner's locksmith.

KEY BOX

Provide key box in school vault, sized to hold 150% of building keys. Keys to be installed in key box by Owner locksmith at substantial completion.

KNOX BOX

Require a recessed Knox Box Series 4400 in the building exterior near the main entrance (usually near where the remote Fire Alarm Control Panel is located).

ACCESS CONTROL

- Access control requires careful planning with the Owner Security Office and IT Department. They will determine where access control is required and what type will be required for each opening. Appendix A has a list of door designations and required hardware.

DIVISION 09 – FINISHES

GENERAL REQUIREMENTS

- All finishes including colors, textures, sizes, and accessory materials shall be detailed in a Finish Schedule on the drawings. All floor, wall, and ceiling finishes shall be listed with a corresponding color or finish code. All colors shall be approved by the Owner and shall follow Owner color palettes.
- All Carpet throughout the building shall come from one manufacturer.
- All carpet and other flooring products will come from the Owner approved Flooring List. Final approval of the selections will be by the Owner not Program Management.
- No custom flooring products shall be allowed they must be standard off the shelf products.
- Color selections, type of paint, floor patterns, varying ceiling panel types and uses, tile patterns, and painting schemes shall be included in a Color and Material Legend as part of the Finish Schedule. Include color and finish schemes for plastic laminate for millwork, toilet partitions if more than one color is used, acoustical wall panels, painted doors and frames, and exterior field painted components such as doors, frames, ladders, handrails, and exposed structural steel.
- Paint finishes shall be in accordance with the Master Painters Institute (MPI) Architectural Painting Manual. Finish levels G1 through G3 shall not be permitted in any area.
- All paint and coating systems shall be specified to meet or exceed the minimum requirements for LEEDv4 Indoor Environmental Quality standards. Submit product data with written documentation and printed statement of VOC content to demonstrate compliance.
- All paint systems shall be specified to be MPI of three coat systems (primer coat, intermediate coat and topcoat) unless noted otherwise
- Color Palette selection shall follow this procedure:
    - AE shall make color selections from the Owner pre-approved color scheme pallete in new construction projects and major renovation projects.
    - School theme colors may be used in the main lobby, cafeteria, and gymnasium. Owner must approve school colors not included in pre-approved schemes.
- Quarry tile shall only be permitted in kitchen areas.
- AE shall specify that Contractor shall clean and prepare one classroom for Owner inspection as the standard for cleaning and waxing.
- Floor finishes shall be protected from damage and construction activities until turnover.
- AE shall specify that final cleaning and buffing operations after protective covers have been removed shall be completed by Owner's cleaning vendor included in Contractor's construction contract.
- Moisture test shall occur prior to installation of adhesives and reference manufacturer's recommendations regarding moisture content.
- Maintenance stock shall include five cases of floor tile (LVT) and five cases of carpet tile
- No metal or other specialty ceilings shall be used. Refer to Appendix A "Basis of Design Manufacturers" for ceiling material types.

- Show ceiling heights on both the finish schedule and on the reflected ceiling plans.
- Lay-in ceilings are acceptable in single use toilets
- Lay-in ceilings are not acceptable in group toilets.

FLOORING TYPES BY FUNCTIONAL USE

- Academic Classrooms: Carpet Tile
- CD, Head Start, & Kindergarten Classrooms: All carpet shall be carpet tile. Texas Granite or LVT shall be at "Wet Areas".
- Cafeterias and Multipurpose rooms: Texas Granite or Owner approved equal
- Locker Rooms: Unstained polished and sealed concrete
- Art Rooms: Unstained polished and sealed concrete – non-skid
- Laboratories: Texas Granite or Owner approved equal
- Group Restrooms: 8" ceramic or porcelain tile of dark color with dark epoxy grout. See Appendix A for preferred grout color.
- Single Toilets/individual classroom toilets: 8" ceramic or porcelain tile of dark color with dark epoxy grout. See Appendix A for Basis of Design Manufacturers and color.
- Kitchens: 6" quarry tile (dark color with dark epoxy grout)
- Middle and High School Gymnasiums and Practice Gyms: Tongue and groove maple wood flooring only. Number One grade for High School and Number Two grade for Middle School shall be used.
- Stage Floor (Elementary and Middle Schools): LVT or Texas Granite. No steps leading up to the front of the stage.
- Stage Floor (High Schools): Wood flooring system consisting of two layers of ¾" plywood. No tongue and groove strip flooring. No steps leading up to front of stage.
- Corridors: Texas Granite or Owner approved equal
- Offices: Carpet tile
- Media Center: Carpet tile
- Health Suite: Texas Granite or Owner approved equal
- Music Rooms/Chorus: Texas Granite or carpet tile
- Band/Drama Rooms: Texas Granite or LVT
- Computer Labs: Carpet tile
- Stairwell (landing and rises): Raised round dot rubber stair treads (with visual contrasting stripe full width), risers, and landings in dark colors with speckles
- Teachers' Lounge: Carpet tile
- Entrance/Air Locks: Walk off carpet tile for all entrances. Non-Main entrances shall be 8 feet long.
- Mechanical rooms/closets: Sealed concrete

- Electrical rooms/closets, custodial closets: Sealed concrete
- Security rooms/closets, technology rooms/closets: Sealed concrete
- Storage rooms: Sealed concrete
- Maintenance stock shall include five cases of each color of Texas Granite, five cases of floor tile (LVT) and five cases of carpet tile.

WALL FINISHES

- Grout for wall tile shall coordinate with the colors of the tile floor grout.
- Exposed concrete masonry shall be painted. Specialty masonry, for example ground face CMU, when used on the interior shall be protected from soiling and staining. Exterior applications of these materials are covered in Division 4.
- Exposed concrete masonry finished in Food Prep areas shall comply with DHEC requirements.
- Ceramic tile or stainless-steel sheets over masonry in dishwashing rooms.
- Stainless steel shall cover the entire wall behind the dishwasher.
- Gypsum board walls shall be used in administrative areas and in areas where flexibility or expansion is likely.
- Heavy duty guards shall be installed on all corridor corners. Plaster and gypsum walls are not acceptable in corridors, except for intra-office corridors.

GYPSUM BOARD ASSEMBLIES

- Gypsum board walls and ceilings shall be specified as UL and ASTM E 119 assemblies, including steel stud framing, suspension systems, and various types of panel products and installed per USG and/or manufacturers recommendation.
- Gypsum wall board shall be 5/8 in. thick, type X for walls and for ceilings. Provide sag-resistant gypsum board for ceiling applications. Vinyl laminated gypsum grid panels may be used in wet environments such as kitchens, where accessibility may be required, and security is not a primary concern.
- Water-resistant gypsum board shall be used for wet environments and for tile backing not subject to constant wetting including kitchens and group restrooms. Specify cementations backer units for tile backing in showers.
- Abuse-resistant gypsum wallboard shall be used for areas requiring a higher resistance to 8 feet AFF to surface indention and through-penetration.
- Specify galvanized metal studs with a G40 coating for interior wall, and a G60 coating for exterior wall applications. Stud depths shall be indicated on the drawings, but and not in the specifications, unless one size is used throughout the Project.
- Deep-leg deflection tracks shall be used for partitions extending to the structure to accommodate live load deflections. Do not extend partitions to the structure with no provision for deflection. Under normal circumstances, a deflection limit of 1/240 and a wall load of 5-to 15-lbf/sq. ft. shall be acceptable.
- Gypsum board is not allowed in corridors or group restrooms rooms as wall material.
- Specify STC ratings for partitions using sound attenuation blanket insulation.

GYPSUM BOARD SHAFT-WALL ASSEMBLIES

AE may specify gypsum board shaft-wall assemblies for fire-rated enclosures for vertical shafts, ductwork chases, elevator shafts, and other non-load-bearing enclosures as an alternative to masonry shaft enclosures. Structural steel shall not penetrate the shaft.

ACOUSTICAL CEILING TILES

- Acoustical Ceiling Tiles (ACT) shall be manufacturers standard lay in grid, square edge panels, 24 inch x 24 inch with 15/16" grid by same manufacturer in white finish. NOTE: No metal or colored tiles are allowed. White is the standard color.
    - ACT 1: General Ceiling Tile-classrooms, corridors, administration areas etc.
    - ACT 2: High Sound Absorption Areas- Band Rooms, Music Rooms etc. Practice Rooms. Chorus etc.
    - ACT 3: High Moisture and wet areas-Toilets, Locker Rooms, Food Prep Areas etc.
- Washable tiles shall be used in kitchens and serving lines
- Tiles in Multi-Purpose Rooms shall be equal to USG Rock Face 2x2 56335 with # 20428 Panel Retention Clips on 2 opposite sides or approved equal.
- Humidity resistant tiles shall be used in ALL areas
- Install tiles only after building is enclosed, the permanent heating and cooling equipment is in operation and indoor relative humidity has been maintained at a level of less than or equal to 55% for a minimum of five (7) consecutive days. Contract documents shall require the General Contractor to create and maintain a log of relative humidity readings for the purpose of documenting these conditions prior to installation of tiles.
- Specify the following for Ceiling Tiles and Grid Systems – No substitutes
    - Ceiling Tiles
        - ACT 1: General Tile to be installed everywhere except where Type 2 or Type 3 are required.
        - Specify USG High NRC-CAC Radar # 22521 square edge panels with minimum .70 NRC and 40 CAC minimum
        - OR Armstrong High NRC-CAC Fine Fissured # 1810 with minimum .70 NRC and 40 CAC minimum.
        - ACT 2: High Sound Absorption Areas
        - Specify USG Mars # 88134 with minimum NRC 0f .85 and 35 CAC
        - OR Armstrong Calla # 2820 with minimum NRC of .85 and 35 CAC.
        - ACT 3: Moisture, wet areas, food prep and serving areas and toilets.
        - Specify USG Sheetrock ceiling panels 2x2 # 3260 with washable vinyl face.
        - No substitutes
    - Grid Systems:
        - ACT 1 and ACT 2

- Specify USG (Donn) DX 26 HD Grid and Donn #M 18 wall molding with 1 1/8" horizontal leg dimension
- OR Armstrong Prelude XL # 7301 HD Grid and # 7850 wall molding with 1 1/8" horizontal leg dimension
- Note: A ¾" clearance on horizontal leg of wall molding is still required as called for in Guidelines for Seismic Design Category "D"

▪ ACT 3

- Specify Donn DXLA 26 HD Cap Coated Aluminum Grid and Gordon CG WA 20 2" Aluminum Wall Molding

o NOTE: Architect shall clearly define the proper Seismic Design Category to be used for installation purposes and show details of proper installation of ceilings and all accessories required.

ACOUSTICAL WALL PANELS

- Panels shall meet the following criteria:
  - o 7 pcf Density in 1" or 2" thickness depending on absorption requirements by Architect.
  - o Finish to be Guilford FR 701 fabric OR Guilford "Anchorage". Alternative colors are allowable to coordinate with various accent walls and school colors. Owner shall approve color choice.
  - o Installation Method - Z-Clip Method
  - o Edge Detail Square Edge and Square Corners.
  - o High Impact Panels - Same basic specification with a 1/8" High Impact Resistant 16-20 PCF fiberglass laminated to face of panel.
  - o Installation Height: Architect to discuss height of installation above floor with the Project CM prior to detailing on drawings.

ATHLETIC-FLOORING ASSEMBLIES

- Resilient athletic flooring in high school new construction for multipurpose activity/P.E., etc. shall be used for wrestling, cheerleading and dance activities.
- Flooring shall be 3 mm or thicker commercial rubber tile type flooring. See Appendix A for Basis of Design Manufacturers.
- Maple flooring systems shall be used in gymnasiums for Middle Schools and High Schools. Assembly shall include hard maple strips installed over a subfloor system for shock-absorption and shall comply with the DIN standard for shock absorption, ball bounce, vertical and area deflection, surface friction, and rolling load. Wood flooring shall be strip flooring, tongue-and-groove, 25/32-inch thick. Number One grade for High School and Number Two grade for Middle School shall be used.
- Wood athletic flooring systems shall be "AACER" "Cush II" with pads and double ¾" plywood under floor or pre-approved equal; Maple. Oriented Strand Board (OSB) board shall not be accepted.
- Metal accessory components shall be minimum 16-gauge hot dipped galvanized steel.

- Specify gym floor finish. No less than four coats total and not less than two finish coats shall be provided.
- Game line, marker paint, team logo in center court and school name under goals (logo and name in high school main gym only) shall be high-gloss enamel compatible with floor finish. Game lines shall be applied between final seal coat and first finish coat.
- Laminated oak flooring or parquet-block requires Owner approval.

RESILIENT FLOOR TILE

- AE shall specify that contractor shall use Owner's current flooring contractor to furnish and install all Luxury Vinyl Tile (LVT) (VCT is not allowed). AE shall specify that Contractor shall apply three coats of wax following installation, prior to turnover.
- Tiles shall lay square with room. If patterns and alternate tile layouts are part of the design, clearly show the patterns and colors on the drawings.

RESILIENT WALL BASE AND ACCESSORIES

AE shall specify that contractor shall use Owner's current flooring contractor to furnish and install all rubber base and accessories as black vinyl base, 6-inches high and 1/8-inch-thick only; 4-inch base allowed at cabinetry. Floor accessories (carpet edge for glue-down applications, reducer strip for resilient flooring, and tile/carpet joiner) shall be color matched to the finish floor materials. Base required at all sealed concrete floor finishes.

CARPET TILE

- AE shall specify that contractor shall use Owner's current flooring contractor to furnish and install all carpet. AE shall not specify product. Specify carpet color as a part of the building color palette. Moisture test of sub surface shall occur prior to installation of adhesives and reference manufacturer's recommendations regarding moisture content.
- AE shall specify that Contractor shall install carpet after building is enclosed, permanent heating and cooling systems are in operation and indoor relative humidity has been maintained at a level of less than or equal to 55% for a minimum of 7 consecutive days. Contract documents shall require contractor to create and maintain a log of relative humidity readings for the purpose of documenting these conditions prior to installation of panels. Floor finishes shall be protected from damage and construction activities until turnover. Require removal and disposal of floor protection just prior to cleaning and/or furniture delivery.
- Reducer strips shall be installed at all LVT transitions to alternate floor surfaces except where there is a marble threshold.

PAINTING

- All paint finish schedules shall be designated using the Mater Painters Institute Standard Finish Number Nomenclature.
- Coordinate painting systems with shop-applied primers specified in other Sections.
- A mockup of 2 ft. x 4 ft. shall be produced for each color.
- Semi-gloss paint shall be used for sheet rock walls. Block wall surfaces use semi-gloss paint. Finishes in high traffic areas shall be washable.
- A primer or block filler plus at least two finish coats systems shall be used on substrates.

- Per LEED requirements, low to no VOC paint shall be used.
- Specify field painting of exposed bare and covered pipes, ducts, hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment. Painting subcontractor shall paint this equipment, not the mechanical or electrical trades. Painting of mechanical and electrical work shall be limited to items exposed in equipment rooms and occupied spaces.

PAINTING SCHEDULE

Painted Surface Location	Substrate	MPI Paint System Number	MPI Gloss Level	Remarks
Exterior	Asphalt Surfaces (zone/traffic markings for drive and parking areas, game lines)	Ext 2.1B - Alkyd Zone/Traffic Marking, Type N	NA	
Exterior	Concrete Vertical Surfaces, Non-Traffic	EXT 3.1A: Latex Over Alkali-Resistant Primer	5	
Exterior	Concrete Horizontal Surfaces - Decks and Stairs, where coated	EXT 3.2D: Alkyd Floor Enamel (Gloss/Sheen as Specified)	6	
Exterior	Concrete Horizontal Surfaces - Parking Areas and Driveways, Game Lines, etc.	EXT 3.2F: Alkyd Zone/Traffic Marking	NA	
Exterior	Gypsum Board Ceilings – (Typical Areas)	EXT 3.3J: Latex Over Alkali-Resistant Primer	2	
Interior	Gypsum Board Walls – (Typical Areas)	INT 9.2A	5	
Exterior	CONCRETE MASONRY UNITS (CMUs) (Concrete Block and Concrete Brick)	EXT 4.2L: Latex Over Alkali-Resistant Primer	5	Do not paint clay masonry units (bricks)
Exterior	STRUCTURAL STEEL AND METAL FABRICATIONS	EXT 5.3G: Alkyd Over Alkyd Primer	5	
Exterior	GALVANIZED METAL	EXT 5.3L: Alkyd	5	
Interior	CONCRETE MASONRY UNITS	INT 4.2A: Latex MPI #153	5	

Painted Surface Location	Substrate	MPI Paint System Number	MPI Gloss Level	Remarks
	(CMUs) (Concrete Block and Concrete Brick)			
Interior	Gypsum Board Ceilings and Walls (Typical Areas)	INT 9.2A: Latex	5	
Interior	Gypsum Board Ceilings and Walls (High Moisture Areas)	INT 9.2E: Epoxy	5	
Interior	Wood and Hardboard (Paint Finish)	INT 6.4R: Latex	5	
Interior	Woodwork (Clear Finishes)	INT 6.3K: Polyurethane	5	
Interior	Woodwork (Stained Finishes)	INT 6.3E: Polyurethane over stain	5	
Interior	Ferrous Metal	INT 5.1S: Institutional Low Odor/Low VOC Latex System	5	
Interior	Ferrous Metal (Galvanized)	INT 5.3N: Institutional Low Odor/Low VOC Latex System	5	
Interior	Insulation Canvas Jackets	INT 10.1A: Latex	5	Provide anti-fungal additive

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DIVISION 10 – SPECIALTIES

SIGNAGE - REVIEW

- A draft signage schedule shall be developed prior to completion of Design Development stage and requires Owner approval. See Appendix D Interior Signage standards.

ROOM NUMBERING SCHEME

- Room numbering shall consist of (3) numbers
- Alpha identifiers shall be included for main corridors, sub-rooms, storage and custodial rooms, public and private toilets, and electrical and telecommunications/data rooms.
- First floor rooms shall be numbered as 100's
- Second floor rooms shall be numbered as 200's
- Third floor rooms shall be numbered as 300's
- Rooms with odd numbers shall be on one side of the hall and rooms with even numbers shall be on the opposite side of the hall.
- Main spaces that include sub-rooms shall include a letter after the main room number to identify the sub-space.
- Private toilets shall be labeled with the room number followed by the letter T.
- Public toilets shall be labeled with the Letter T followed by the room number.
- Main corridors shall be labeled with the letters CR followed by corridor number
- Stairs shall be labeled with the letters ST followed by the stair number.
- Mechanical rooms shall be labeled with the letter M followed by the room number
- Electrical closets shall be labeled with the letter E followed by the room number
- Data/telecommunications closets shall be labeled by the letter D followed by the room number.
- Custodial/janitorial spaces shall be labeled with the letter C followed by the room number.
- Predetermined storage rooms shall be labeled with the room number followed by the letter S
- Vestibule areas shall be labeled with the room number followed by the letter V

ROOM NUMBERING EXAMPLES

ROOM TYPE	EXAMPLE
1st floor classroom	102
2nd floor classroom	202
Sub-room	102A, 102B, etc.
Public toilet	T102
Private toilet	102T
Electrical room	E102
Main Corridor	CR102
Storage room	102S
Custodial room	C102

Telecommunications/Data room	D102
Vestibule	201V
Mechanical room	M102
Stairs	ST1

INDOOR SIGNAGE

- The room numbers and names in the schedule shall match the room numbers and names on the drawings.
- Once the final building layout design is complete, Owner will use Construction Documents to create the Permanent Room Numbering plan. The permanent numbering plan, matched to original plan numbers, will be provided to the designers. Owner assigned Permanent Numbers are to be used in all final numbering of panels, and As-Built Drawings.
- Signs to identify all rooms and spaces shall comply with ADA recommendations as to character proportion and color contrast. Signage shall also meet ANSI and ADA requirements for tactile characters and/or symbols.
- The room number sign shall be permanently affixed.
- Signs shall be mechanically attached to walls using concealed, corrosion resistance metal fasteners with tamper/vandal resistant one-way heads.
- All signs shall have radius corners.
- Room name and number signs shall be located on the wall adjacent to the strike side of the door and centered approximately 5'-0" above the floor. Where there is no wall adjacent to the strike side of the door the signs may be located on the doors.
- Non-Restricted Use Rooms are considered flexible use and subject to change based on current needs. Therefore, the majority of rooms will be permanently designated on signage only by room number. Each room's signage will contain the permanent room number and a 2" tall slot for an insert that allows the school to generate a description of the room's use and occupant as appropriate. (Rooms such as classrooms, special education rooms, computer labs, foreign language, etc.)
- Large gathering spaces shall be identified with signage that reflects its usage: GYMNASIUM, MEDIA CENTER, CAFETERIA, MULTIPURPOSE ROOM, AUDITORIUM, etc.
- Provide one sign each at gymnasium, media center, cafeteria, multipurpose room, and auditorium to read MAXIMUM OCCUPANT LOAD – xxx (AE to verify number and mounting heights of signs).
- In Cafeteria, traffic flow directions shall be identified with signage that reflects desired traffic: ENTRANCE ONLY, EXIT ONLY, ORDER HERE, PAY HERE.
- Dedicated rooms shall have room number and name that reflects its usage: HEALTH, CUSTODIAL, etc.
- Mechanical/Electrical/Utility/Fire Riser (dedicated) rooms shall have signage stating, "NO STORAGE" on doors of closets smaller than 36" wide, 72" high. Signage for all Mechanical/Electrical/Utility closets shall include floor taping of areas in which storage is prohibited, following dimensions of IFC code.

- Restrooms: In elementary and middle schools the signage shall have BOYS or GIRLS on group restrooms and MEN or WOMEN on public restrooms. In high schools the signage shall have MEN or WOMEN. Classroom restrooms shall be called RESTROOM. Faculty restroom shall be called FACULTY/STAFF RESTROOM.
- Provide one sign for each stairwell with handicap graphic to read: (All stairs shall be numbered) STAIR #
- Elevator Signage: Provide one sign (WITH 3 SLOTS) in the elevator that reads:
    - IN CASE OF EMERGENCY:
    - #1 Use the Emergency Call Button or Phone to Call for Help
    - #2 If Unable to Reach Someone – Use your Cell Phone to Call:
        - Elevator Company - (XXX)-XXX-XXXX [By Elevator Maintenance Company]
        - 24 Hour Call Center (XXX)-XXX-XXXX
        - Security - (843) 296-2166
    - #3 If you are still unable to Reach Someone: Call 911
    - School Name:
    - School Address:
    - Building Number:
    - Elevator Number:

SPECIAL SECURITY SIGNAGE

- Security Signage is provided to assist first responders in the event of an emergency situation at an unfamiliar school building. A secondary but important value is to assist visitor navigation. All security signage is approved by Owner Security Director.
- Exterior doorways shall be numbered. The main entry door shall be door number 1 and every entry door moving clockwise around the building perimeter is numbered sequentially. Only one door needs to be numbered if it is bank of doors. The 6" numbering labels shall be fixed to the door in a manner to be easily read from the exterior.
- Window labels for each rooms' number shall be 4" and be placed on the exterior window in the far left corner in a manner to be easily read from the exterior/outside. Rooms with high bay windows shall have decals on their lower windows if present.
- A permanent graphic map is fixed to the wall at each key entry location showing the building layout and position of entry. (You are here)
- Directional Way finding Signs are posted at key intersections to provide directions to specific areas of the building
- An Evacuation Map is provided for all spaces and is placed in a durable see through acrylic sleeve mounted on wall at the rooms exit. The map orientation is specific to the layout of the building when exiting the room.
- Provide signs to read: SECURITY CAMERAS ARE IN USE, BUT MAY NOT BE MONITORED AT ALL TIMES. (Place at reception, vending, cafeteria, commons area, and any other room with security cameras).

- Provide signs to be installed on the windows leaf of the main entrance pair of doors and at ALL entrance doors. Decal shall read:
    - Decal 1 (Leaf 1): NOTICE: PERSONS ENTERING THE CAMPUS ARE SUBJECT TO SEARCH PURSUANT TO SOUTH CAROLINA CODE 59-63-1110.
    - Decal 2 (Leaf 2): WELCOME ALL VISITORS ARE REQUIRED TO REPORT TO THE SCHOOL OFFICE
- Provide sign to be installed on the office/reception door window. Decal to read:
    - Decal 3: OFFICE SECURITY CAMERAS ARE IN USE, BUT MAY NOT BE MONITORED AT ALL TIMES.
- Provide two (2) signs to install on each telecommunication and facility security room. All telecommunications and facility security rooms shall be numbered. The numbers shall be coordinated with Owner project manager designee. Sign to read:
    - MTR, TR#, or FSR
    - Sensitive Electronic Equipment No Storage Allowed

OUTDOOR SIGNAGE

- Post and panel signage shall be exterior, non-illuminated
- Provide sign outside on kitchen receiving door to read: KITCHEN RECEIVING – RING BELL FOR SERVICE

YARD SIGNAGE REQUIREMENTS

- All yard signage shall be shown on a civil drawing showing quantities and locations. Consider combining key entrance, parking, and drop-off signs to suit the site traffic flow. NOTE SIZES SHOWN ARE MINIMUM: AE to review sizes with current code and adjust as required to meet code.
    - 18 by 18 inch yard sign(s) shall read: STUDENT DROP-OFF AND PICK-UP AREA (Place at car entrance)
    - 12 by 18 inch yard sign(s) shall read: BUSES ONLY (Place at bus entrance)
    - 12 by 18 inch yard sign(s) shall read: NO PARKING SCHOOL BUS LOADING (AE to verify number and sign location).
    - 12 by 18 inch yard sign(s) shall read: NO PARKING FIRE LANE (AE to verify number and sign location).
    - 12 by 18 inch yard signs with handicap graphics shall read: RESERVED PARKING (AE to verify number and handicapped parking lot sign locations).
    - 12 by 18 inch yard signs shall read: VISITOR PARKING (Place at visitors parking, AE to verify number).
    - 12 by 18 inch yard signs shall read: RESERVED PARKING (AE to work with CCSD Security to determine parking lot location and verify total number of parking spaces.)
    - 18 by 18 inch yard sign(s) with right or left graphics arrow shall read: ENTRANCE (at main entrance).
    - 30 by 30 inch reflective yard sign(s) shall read: STOP (at every vehicle exit).

- Require paint vehicular directional arrows at strategic locations, on the drives
- Require paint vehicular stop lines at every vehicle exits, on the drives.

BUILDING NUMBER SIGNAGE

- Each CCSD building has a unique 4-digit number assigned to it by the Facilities Management Department. If the number is less than 4 digits it will have zeros (0) in front of it. Example: CCSD 0011.
- Every single building on every campus that is constructed as part of a project will be assigned a number.
- The Capital Project Manager (CPM) will request this number(s) depending on how many buildings from the FM Project Manager (FMPM) assigned to the project.
- A sign will be located on the right-hand corner of all four sides of the building. If building shape is complex the FMPM will work with CPM and A/E on placement.
- The signs will be no higher than the first floor of a multi-story structure. On single story structures it will be 18 inches below the roof line. The sign will be 24 inches from the edge of the structure. The exact location will be shown on the architectural drawings.
- Signage shall be 6" high by 24" wide; made of .040 thick aluminum, with two holes punched (centered, left and right, on narrow sides) for anchoring.
- Lettering shall be 4" high; Font - Swiss 721 bt; red in color; on a white reflective background field.
- Anchors #8-#10 by 1 ¼". Holes ¼ inch should be predrilled into building using ¼" drill bit.
- Screws are #8 x 1 ½", stainless steel. Screw length may be longer if required,
- The Building number shall appear on the cover sheet of all drawing packages.
- The Building number shall be used by CMI to identify each point on the BAS graphic

SCHOOL LED MARQUEE

- Confirm all LED marquee requirements with IT prior to beginning design.
- LED Marquee shall be located near the main school entrance and setback from the right-of-way in accordance with the County or City sign ordinances. In no case shall the sign be located within fifteen (15) feet of the right-of-way. Marquee Support Structure shall be of material and construction to match the school building
- AE required to show conduit for power and communication cables on electrical drawings.
- LED display shall meet the following:
  - 10 mm outdoor-rated LED matrix display, unless not allowed by municipal ordinance. In such cases, variances will be granted on a case by case basis.
  - Color Capability: 64K minimum
  - Design must be based on 16:9 ratio
  - Estimated LED Lifetime: 100,000 + hours
  - Single or double-sided display as determined by Owner per site conditions
  - Viewing Angle: 90 degrees' horizontal x 40 degrees' vertical (minimum)

- Contrast: 5000:1 (minimum)
- Graphic Capability: Text, graphics, logos, basic animations, multiple font styles and sizes
- Size of Displays: Defined by Owner per site conditions
- External temperature sensor
- Light sensor for automated dimming and brightness control
- Communication Options: Primary physical interface requires fiber to designated TR wall (SM or MM depending on distance). Logical communications via Ethernet. Wireless can be provided only as a back-up but must be capable of security shutdown. Direct connection to local device with password protection for local programming.
- LED Marquee Controller shall comply with the following:
  - Software application with text and graphic displays with modules that support create, schedule, and quickly change the display content.
  - Modules: Message editor, schedule editor, sign previewer, configuration editor, video manager, and on-line interfaces with information providers.
  - PC based Windows application with wireless capability (secondary access, securable)
  - Sign must be able to be manageable remotely.
  - Remote re-boot option preferred.

- Specify a Five (5) YEAR WARRANTY for the complete LED Marquee sign including message center, modules, cabinet, structure and installation.

DIRECTORIES

- Way finding and office directories shall be provided that identify routes to different areas of the campus, i.e. office, auditorium, gymnasium, athletic fields, etc. and shall provide location and option for type to Owner for approval.

VISUAL DISPLAY SURFACES

- Marker Boards: all marker boards shall be magnetic type, provide flag holder brackets at the top of each marker board and map rail at the top of each unit. Porcelain enamel marker boards shall be
  - Balanced, high-pressure-laminated, of 3-ply construction, consisting of face sheet, core material, and backing.
  - Face sheet shall be porcelain enamel clad, stretcher-leveled aluminized steel.
  - Core shall be 3/8-inch particleboard.
  - Backing sheet shall be 0.015-inch thick, aluminum-sheet backing.
  - Aluminum pen tray with radius edges.
- Follow Technology Design Specification for Flat Screen Electronic Devices Requirements.
- Tack boards: shall be vinyl-fabric faced with mildew-resistant, washable vinyl fabric, laminated to ¼ inch thick cork sheet, and factory laminated to 3/8-inch thick fiberboard backing. Mount to allow ½ inch behind the board for air flow. Metal trim and accessories for all marker boards shall

consist of extruded aluminum. Finish shall be Class II, clear anodic finish. Bottom of boards shall be no more than 34 in. from the finished floor.

- Tack strips: shall be ¼ inch cork with metal trim on all sides. Allow one foot of tack strip in hallway between classrooms for each student not to exceed covering a total of 20% of the wall surface.
- Bulletin Boards and Display Cases: Shall be manufacturer's standard illuminated and non-illuminated for bulletin boards and glass display cases.

CLINIC CUBICAL CURTAINS

- Cubical Curtains shall be launderable and flame resistant.
- Fabrics shall be light tight and fade resistant.
- Curtain tracks shall be extruded aluminum, with satin anodized finish.
- Curtain carriers shall be one-piece nylon glides.
- Fasteners shall be stainless steel.

LOUVERS AND VENTS

- Architectural louvers shall be fixed, extruded aluminum with a high-performance coating finish to match storefront system.
- Specify horizontal, drainable, storm resistant blades unless design dictates otherwise.
- Screens shall be ½-inch aluminum mesh, bird screening. Never specify insect screening at outside air intakes, as they clog frequently and require constant maintenance. If insect barriers are required, specify the proper filters and screening as part of the mechanical equipment.

FLAGPOLES

- Shall be ground-set, with base plate and foundation tube, cone-tapered flagpoles made from aluminum.
- Finish shall be clear anodized, Class 1 (0.7 mils).
- Shall be a height of 25 feet for the main school and 15-20 feet for the flagpoles at the stadium, baseball and softball fields. Each flagpole shall be required to withstand a 155-mph wind velocity.
- Shall have the following fittings:
    - Finial Ball: shall be Aluminum flush-seam, size to match pole butt diameter.
    - Truck: shall be ball bearing, non-fouling, revolving, double-track assembly for main school flagpole and single track for others.
    - Cleats: shall be two, 9-inch cast metal cleats with fasteners.
    - Halyards: shall be two continuous, external with lock for main school flagpole, single halyard for others.
    - Flag Snaps: shall be two swivel snaps per stainless steel or brass halyard.

METAL LOCKERS

- All lockers shall have sloped hoods.

- Corridor lockers shall be mounted a minimum of 12” off the floor to allow the floor underneath to be maintained.
- Student Locker sizes shall be as follows:
  - Student Corridor – 12” W x 15” D x 36”H, double tier
  - Kitchen/Coach – 12” W x 15” D x 60”H, single tier
  - For PE:
    - Box – 12” W x 15” D x 12” H, 5 tier
    - Wardrobe – 12” W x 15” D x 30”H, double tier
    - Team Lockers – 15” W x 15” D x 60” H, single tier
    - Women’s Varsity & all Jr. Varsity – 18” W x 18” D x 60” H, single tier
    - Men’s Varsity – 24” W x 18” D x 60” H, single tier

FIRE-PROTECTION SPECIALTIES

- Specify portable fire extinguishers. Mounting brackets and fire extinguisher cabinets to comply with NFPA 10. Fire extinguishers shall be in recessed cabinets
- Fire extinguisher locations and coverage shall be based on Multi-purpose dry-chemical type, UL-rated 4-A:60-B:C, 10-pound capacity. Carbon dioxide type shall be UL-rated 10-B:C, 20-pound capacity.
- Fire extinguishers in mechanical rooms and other services spaces shall be wall mounted with bracket. Provide recessed stainless-steel cabinet types in all other locations to suit fire extinguisher type.
- Fire extinguisher cabinets shall be mill finish aluminum and recessed. Specify recessed cabinet, with exposed flat trim, in walls of sufficient depth. Provide semi-recessed cabinet, with 2-1/2 inch rolled edge trim, in walls of shallow depth. Provide surface mounted cabinet, mounted directly on wall, where it is impractical to recess, such as concrete walls. Fire extinguisher to be Contractor furnished and installed to comply with NFPA10.
- Identify fire extinguisher with silk-screened, vertical letters, applied to the cabinet glazing.
- Fire extinguisher cabinets are to be numbered in consecutive order with engraved three-layer laminated plastic, black letters on white background. Nameplates are to be installed on all fire extinguisher cabinets and wall brackets. Program Management shall approve numbering system.

PRE-ENGINEERED WALKWAY COVERS

- Walkway covers shall be aluminum, consisting of extruded aluminum posts, beams and roof deck panels. Deck screws shall be stainless steel, sealed with seals and washers as recommended by manufacturer. All components shall be from one source from a single manufacturer.
- Specify canopy system to be engineered and fabricated to withstand the design loads indicated on the structural drawings to meet the code requirements for the Project. Submit professional engineer’s certificate.
- Canopy system shall incorporate an external drainage system for discharge at the ground level. Canopy roof systems shall not slope back towards the school.

- If canopy lighting is required, the conduit and lights shall be run below the roof deck and secured to the structure and not screwed through the roof.
- Finish on all exposed components shall be a fluoropolymer 2-coat system. Color shall match storefront system, when used. Verify color selections with Owner.
- Extended drains shall tie in and terminate to underground storm drainage system. Drainage system shall not discharge onto sidewalks.

OPERABLE WALL SYSTEMS

- Operable Wall Systems shall only be used between the cafeteria/cafetorium and a multi- purpose room.
- Panel wall shall be constructed of welded steel 3 ½ in thick with minimum 16 gauge steel face sheets with panel weight not to exceed 10 lbs. per sf
- Suspension Tracks shall be steel or aluminum with adjustable steel hanger rods.
- Panel walls shall be primed steel, fire-resistant, manually operated, individual panels with mechanically operated bottom sound seals. Panels shall be tested to confirm they have field installed acoustical performance of 42 NC.
- Panel walls shall be factory primed (with manufacturers recommended primer for steel) and painted with an erasable marker paint OR factory primed with 2 coats of pre-catalyzed water based semi-gloss epoxy. Total DFT (dry film thickness) minimum shall be 5 mils or 1.5 mils per coat.
- The floor flatness of the multipurpose room/cafeteria shall be coordinated with the wall manufacturer prior to pouring the concrete.
- Trolley load limit must be 50% higher than the maximum weight of the panel.
- Drawings shall show field-assembled wall above the wall panels to maintain the STC rating from top of wall panel to underside of deck. Indicate all joints in the wall to be sealed and any accessories such as pass doors and marker boards.
- Coordinate requirements for overhead structure with the structural drawings. Verify that the support beam flange is wide enough for the panel manufacturer's support brackets.

ACCORDION FOLDING PARTITIONS

- Specify accordion folding partitions, in lieu of operable wall panels, when room separations are frequent. The partition shall have a minimum STC rating 45 per ASTM E90. Pass doors and wall accessories are not required. Set up shall be quick and easy.

METAL STORAGE SHELVING

- Shelving shall be provided by the General Contractor and shall include installation.
- If shelving is provided by Owner FF&E Coordinator, he/she shall provide the installation vendor.
- Manufactured shelving shall be an open style with front box posts, rear angle posts, metal shelves and sway bracing. Metal shelving shall be used in all custodial areas, lawn equipment storage, elementary school playground yard storage, A/V storage, and textbook storage areas and/or as specifically identified in the Educational Specification.

- Basis of Design product for metal storage shelving shall be Clipper Open Storage Units by Penco, or a comparable product. Unit size shall be 36" to 48" wide, 12" to 18" deep and 87" high. (Width and depth shall vary within this range to meet the requirements of each application.)
- All shelving shall be secured to the wall to prevent tipping.
- Shelf label holders shall be provided.
- Posts and beams shall be fabricated from cold-rolled steel.
- Finish shall be standard gray finish enamel.

TOILET PARTITIONS

- Group toilet partitions, urinal screens and doors shall be solid dark color phenolic.
- Toilet partitions and doors shall be floor and ceiling anchored and overhead braced. Urinal partitions shall be floor and ceiling anchored and overhead braced. Prefabricated toilet partitions and metal partitions are not permitted. Toilet partitions shall be secured with vandal resistant stainless-steel machine screws with expansion anchors at masonry and tile walls and with solid blocking at hollow walls and expansion anchors at other walls. Provide stainless steel or polymer resin base trim to conceal floor anchorage and leveling devices.
- Provide continuous brackets to support compartment panels to each other and to the wall.
- Hardware shall be stainless steel. Specify continuous stainless-steel hinges on stall doors. Door hinges shall be self-closing at all locations. Provide rubber-tipped coat hook/bumper on each stall door.
- Urinal screens shall be provided between adjacent urinals and located next to lavatories. Screens shall be floor and ceiling anchored and overhead braced.
- Partition, door and screen components shall be of the same construction and materials.

TOILET ACCESSORIES

- Toilet accessories manufacturers shall be as shown in Appendix A Basis of Design Manufacturers (deviations are allowed if approved by Owner) and shall be furnished and installed by the Contractor.
- Jumbo roll toilet paper dispensers shall be located in a wall recessed, open-faced stainless-steel cabinet that runs from the floor to 1.5 inches below the horizontal grab bar. It shall be sized so that the toilet paper can easily be changed.
- Typical accessories include but are not limited to the following. The schedule and drawing designation follow each item:
    - Paper Towel Dispenser: PTD
    - Waste Receptacle: WR
    - Toilet Tissue Dispenser: TTD
    - Foam Soap Dispenser: FSD
    - Sanitary Napkin Disposal Unit: SNDU
    - Grab Bar: GB
    - Shelf Unit: SU

- Mirror Unit: MU
- Shower Curtain Rod: SCR
- Shower Curtain: SC
- Folding Shower Seat: FSS.
- Hook Strip: HS.
- Robe Hook: RH.
- Mop and Broom Holder: MBH.
- Warm-Air Dryer: WAD.
- Under lavatory Guard: UG
- Infant Care is Project specific

LAUNDRY

- Athletic laundry equipment for high schools shall include a 60 pound capacity washer-extractor and a 75 pound capacity dryer and be located on an exterior wall. Design to 1 set per 1000 student ratio. The athletic washer and dryer shall require access either direct or via hallway with double door entrance for installation and maintenance.
- Residential heavy duty washer and dryer hook-ups shall be provided for access by special student programs. In some schools, based on student population, a second hook-up shall be required.

DIVISION 11 – EQUIPMENT

FOOD SERVICE EQUIPMENT

- Coordinate food service equipment requirements with Owner Food Services Executive Director. The Executive Director shall approve food service consultants and the specific project requirements. Kitchen Equipment and schedules shall be developed based on the approved equipment shown in Appendix A: Basis of Design Manufacturers, no deviations allowed.
- Provide separate Food Service drawings for equipment locations and schedules.
- Specify requirement for coordination drawings to include service utility characteristics.
- Specify requirements for operation, maintenance, and parts data.
- Specify startup and testing requirements for food service equipment.
- Kitchen exhaust hoods, fire-extinguishing systems, fire alarms and disconnects are specified in Divisions 21, 22, 23, 25, and 26.
- Specify a hose bib, reel and floor drain shall be provided in kitchens for the purpose of floor cleaning.

SOUND SYSTEM EQUIPMENT

- Sound system equipment for the Cafetorium shall include two full range column array loudspeakers, one mixer amplifier with dual 70 volt amplifiers, one compact disk player, one wireless microphone system with hand held transmitter with 300 ft. line of sight capability and one rack mounted A/C power distributer.
- Sound System equipment for Middle/High School Football Stadiums shall include 2 full range weather proof and wind resistant speakers, one voice range weather proof long throw horn loudspeaker mounted to poles, one dual channel amplifier with 70-volt transformer outputs, one single rack space mic/liner mixer and one desktop announcers “push to talk” microphone. See Appendix A for Basis of Design Manufacturers.

MEDICAL EQUIPMENT (Outside of Classrooms)

- Medical Equipment wall mounted boxes shall be furnished by the Contractor.
- Stop the Bleed (STB) kits shall be Owner furnished. STB cabinet flush or surface mounted (AE to consult with Owner) shall be furnished by the Contractor. Surface mounted applications shall be 3”x8”x8”.
- AED (Defibrillators) shall be Owner furnished. AED cabinet shall be furnished by the Contractor and be flush mounted in the wall. AED cabinet dimensions are 3”x8”x8”. AED cabinets shall be located on the first floor by the office, near gym/cafeteria/multipurpose rooms and areas where the public is allowed in for exhibits. Minimum of one AED cabinet per floor. Consult with Owner Nursing staff to confirm cabinet size and location during the design process. Installation shall be by contractor and be ADA compliant. Center of cabinet handle shall be installed 48 inches above finished floor. Cabinet shall be equipped with a battery powered alarm.

GYMNASIUM EQUIPMENT

- Athletic equipment shall be aluminum or corrosion resistant steel. Materials shall be factory painted, baked-enamel, and powder-coat finish.

- Anchors, fasteners, fittings, and hardware shall be manufacturer's standard corrosion-resistant or non-corrodible units; concealed tamperproof, vandal and theft resistant.
- Mounting pads shall be wood, neutral color painted finish.
- Specify deployable gymnasium floor covering with holding rack. Covering shall be 32 oz. or greater, 3 ply, resilient reinforced polyester in a single color.

GYM DIVIDER

- Divider curtains shall be the motorized type using electric power.
- Lower section shall be solid vinyl coated polyester
- Upper section shall be VCP woven mesh.
- Provide anti-bacterial and fungi-resistant treatment.
- Provide heavy duty galvanized steel track, beam clamps, and hanger brackets.
- Carriers shall be 1-1/8 inch diameter nylon tire ball bearing wheels, spaced approximately 12-inches on center.
- Provide tieback straps to secure curtain to wall when not in use.

WALL PADS

- Installed around all walls in wrestling room/practice rooms and on gymnasium walls underneath the goals.
- Wall pads shall be 2-inch thick, 3.5-pound density polyurethane foam bonded to a 7/16-inch thick waferboard, fully wrapped with vinyl coated polyester covering.
- Provide "Z-Clip" attachment at the top of each pad.

LED DISPLAYS

- Specify (2) two LED display scoreboards to be wall mounted on the wall in the main gym of middle and high schools. The scoreboard shall be capable of handling basketball, volleyball and wrestling. Controls shall be wireless. Daktronics Model BB-2103-13 (or current equivalent) may be used as the Basis of Design. Minimum size 8 ft. wide x 6 ft high. See Appendix A for acceptable manufacturers.

BASKETBALL

- The High School main competition basketball backboard for high school gymnasiums shall be not less than ½" thick transparent, tempered glass, 72 by 48 inches width by height, with painted markings and rim-restraining devise.
- The Middle School and Elementary Schools backboards shall be 1-1/2 inches thick composite board fiberglass, 72 by 48 inches width by height, with rounded corners, white background and required markings.
- Provide fixed, non-movable, single-rim basket ring competition goal, with no-tie loops for attaching net to rim without ties.
- Supply nylon, 12-loop-mesh nets between 15" and 18" long. Indoor backboards shall have bottom and side edge protective padding.

- Main interior basketball blackboard mounts shall have safety strips (ASTM standards) only retractable installations.
- Gym equipment shall comply with FIBA International Basketball Federation and NFHS National Federation of State High School Associations.
- Exterior basketball courts shall have (2) two outdoor backstops. Include permanent ground installation in concrete base. In Elementary Schools, provide fixed height basketball goals at 8 feet.
- Sound system shall include six full range loudspeakers, one dual 15" subwoofer with fly points, one dual channel amplifier with 70 volt transformer outputs, one dual channel power amplifier, and one single rack space mic/line mixer. See Appendix A for Basis of Design Manufacturers.

VOLLEYBALL

- Volleyball equipment shall include a chrome-finished steel floor plate and inserts removable, paired post standards with adjustable, telescoping height
- Net shall be 32-feet long with a net tensioning system.
- Volleyball net shall be adjustable between 8 feet and 5 feet to allow volleyball or badminton use.
- Include all accessories for a complete installation.
- Provide wall storage hooks for mounting on wall to store game standards.

BASEBALL, SOCCER, FOOTBALL

- Specify (2) two foul poles for both baseball and softball fields.
- Specify (2) two soccer goals with tip-over proof anchors for new construction
- Specify (2) football goal posts shall be provided if a new field is constructed.

GAME LINES IN ELEMENTARY SCHOOL MULTIPURPOSE ROOM

- Set out of bounds lines shall be four ft. from the walls.
- Adjustable basketball goals shall be directly above the out of bounds lines.
- Foul line shall be 15 ft. to the basketball backboard.
- Remaining lines shall be set in accordance with recognized game and age group standards.

PROJECTION SCREENS

- Use of projection screen shall be limited to large spaces (not for classrooms) and conference spaces. Projection screens shall be:
    - Wall or ceiling mounted
    - Front-projection screens
    - Manually operated (Electrically operated screens, if required for the project, require Owner approval.)
    - Viewing surface shall be vinyl-coated glass-fiber fabric with gain characteristics complying with FS GG-S-00172D (1) for Type C screen surface.
    - Edge treatment shall be black masking borders

- Screen size shall be approved by Owner or PM.
- Screen pull rods shall be provided to reach pull bails on screens mounted out of reach.
- Electrically operated screens (if approved by Owner) shall be UL-labeled units, with 3-position control switch for flush wall mounting. Unit shall have motor in roller with permanently lubricated ball bearings.

LOADING DOCK EQUIPMENT

Loading dock equipment shall include dock bumpers, dock levelers, and truck restraints and a dock plate installation.

RESIDENTIAL APPLIANCES

All residential appliances (kitchen, microwave, refrigerator, laundry appliances) in staff lounges, employee and student break rooms, health rooms and home economics classrooms shall be electric operated, Energy Star rated and the color white.

LABORATORY FUME HOODS

- Fume hoods shall be limited to science labs in high schools. Locations and sizing shall be approved by Owner or PM.
- Coordinate the fume hood selection with the mechanical equipment.
- Coordinate the work surface selection with Division 12 Section “Laboratory Casework.”
- Coordinate safety device requirements and locations with the fume hoods.
- Airflow indicators and alarms shall be in accordance with NFPA 45.

STAGE ACCESS

- All new construction shall have ramp access to stages in auditoriums and cafeterias – no chair lifts are permitted.
- There shall be no stair access to the front of the stage in elementary schools.

STAGE CURTAINS

- Fabrics shall be permanently flame resistant or chemically flame resistant with documentation to be included in close out documents.
- Ensure rated walls with electrical panels are sufficient to maintain wall rating.
- Woven cotton shall be velour curtain products
- Medium weight fabric shall range in weight from 20-25 oz. /linear yard before flame-retardant treatment.
- Shall be Fifty percent (50%) fullness exclusive of turn backs and hems.
- Color shall be as required for the specific project requirements.
- Fabricate steel-tract channels from roll-formed galvanized steel, minimum metal thickness to be adequate to hold 200% of curtain weight and provide seismic restraint.

EQUIPMENT BUDGET GUIDANCE

The following table is a list of equipment for reference only and identifies a partial list of items that are furnished to the Project by either the Construction or the FF&E budget lines. All equipment shall be specified to meet EPA Energy Star standards where applicable.

CONSTRUCTION BUDGET (Cost Account 1.0)	FF&E BUDGET (Cost Account 5.0)
Allowable	**Allowable**
Affixed trophy cases (ms/hs)	Art tables and drawers
Apron racks (science)	Chairs
Choral risers (fixed)	Classroom furniture (typ)
Coat hooks	Concession stand equipment
Computer network	Cots
Curtain tracks and curtains (health rooms)	Desks
Dishwashers (science/high schools only)	File cabinets/with rollers
Door switch	First aid kits-mounted (Contractor installed)
Drinking fountains	Flags (brackets provided on marker boards
Elevator	"Gator" HS - Athletics
Eye wash stations w/shower (clinic & science)	Hospital scales (weight scale)
Fire alarm system	Ironing boards (standing)
Fire extinguishers	Kilns
First aid kits (mounted)	Kindergarten Learning Materials (not toys)
Fixed p/e equip. (v.ball & tennis stanchion inserts)	Microwaves
Flag pole	Music Equipment (other than band)
Folding partitions	Music stands
Hardware (all finish hardware)	HS Outdoor athletic equipment (unfixed)
Hose bibs	Portable choral risers
Ice machines (kitchen only)	Refrigerators-K & lounges
Kitchen equipment	Standing bookcases
Knox box fire key access	Standing storage cases
Lab casework	Tables
Lockers	Training Tables
Marker boards w/map & flag holder	Washer / Dryer
Mirrors	Choral risers (ES & MS) – MOBILE
Padding behind basketball goals	Ice machines - HS Athletics
Power driven backboards	Floor scoreboards - HS Athletics
Projection screen (fixed only – portables in FF&E)	Refrigerators for Home Economics
Retractable bleachers	Wardrobe units (cubbies)
Roll-up doors	**NOT ALLOWABLE**
Safety goggle sterilizers	Aquariums
Science lab tables for MS & HS	Autoclaves
Shop equipment (for CC's)	Centrifuges
Signage (interior/exterior)	Custodial Equipment
Sound proof practice rooms	Media Drop Boxes
Staff mail boxes	Laminating machines
Stage curtains	Lawn tools/equipment
Stage lighting	Maintenance tools/equipment
Stage lighting	Microscopes
Storage shelving	Pencil sharpeners
Tackboards	Playground equipment
Tennis stations and nets	Rolling laundry baskets
Theater rigging	Sewing machines
Time out rooms	Wall Decoration
TV/monitor mounts	Wall mounted ironing boards
	Waste Baskets
	Media Ctr Book Check-out System
	Playgroud fall surfaces
	US Mailbox - Contractor Installed
	Water distiller /deionizer units
	Window blinds
	Stoves / Ranges
	Telephone system

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DIVISION 12 – FURNISHINGS

Division 12 – Furnishings remains under development by Owner personnel at this time. AE's are encouraged to provide comments and suggestions for this division during their review.

AUDIENCE SEATING

- Chair Description: Fully Upholstered Back & Seat, 2 Fabrics: Seat: Culp Hathaway/ Back: Absecon Shire. Fabric to meet California Technical bulletin 117. Zipper Seat Covers. Gravity Lift Seat, Full Fold. Chair widths 19"-24". Back to be 35" high off floor with tufted upholstery on face of back. Wood Aisle Panel. Steel stanchions and foot plate.
- Consult with Owner for fabric color and type prior to specifying
- Chair Envelope (Closed Depth): To maximize seat capacity and egress the closed depth shall not exceed 15.5".
- Steel Stanchions: Minimum 14 gauge and 1/4" steel plate foot. Black Powder Coated.
- Inner Back and Seat Frames: Tubular Steel. Plywood or plastic inner structure is not acceptable. Serpentine springs are unacceptable.
- Back Foam: 5" thick at Lumbar. 2" thick at top.
- Seat Foam: 4.5" thick, cold- cured sculptured molded.
- Aisle Panel: 3/4" Plywood core with finished veneer outer surface with louver top to conceal aisle light in panel.
- Aisle Lights: To be housed in top portion of aisle panel beneath wood louver, protected from contact & collision. Fixture to be UL listed, low voltage, 9 LED deluxe warm white bulbs.
- Armrests: Solid Injection Molded Polyurethane, Black. Armrest security screw required.
- ADA Transfer Panel: Swing away panels. Panels to match all aisle panels and have ADA label.
- Row Letters & Seat Numbers: Black Polymer with white letters. Snap into tamper proof receptacle. No rivets, brads or glued on plates.
- Warranty: 5-year standard warranty on metal, foam, plastic. Steel stanchion warranty 15 years
- Attic Stock: 1% of Total number of installed chairs.
- Sample: Provide Sample Meeting Specification.

DIVISION 13 – SPECIAL CONSTRUCTION

Division 13 – Special Construction remains under development by Owner staff at this time. Included below are the items covered under this division. AE's are encouraged to provide comments and suggestions for these items during their review.

- Walk-in Freezer
- Walk-in Refrigerator
- Weight Room
- Stadium Seating
- Vault
- Mobile Classrooms
- Special Structures
- Sound conditioned rooms (band/performance rooms)
- Kiln Rooms
- Athletic Rooms/Weight Rooms
- Greenhouses
- Metal Building Systems
- Metal Towers (band fields)

DIVISION 14 – CONVEYING SYSTEMS

HYDRAULIC ELEVATORS

- Hydraulic freight cargo type elevators shall be used for service and passenger applications. Traction and electric elevators are not permitted.
- All elevator equipment and diagnostic systems shall be non-proprietary. A signed affidavit attesting to this shall be provided by the contractor.
- Elevators shall be full size cabs (7'0" W x 5'6" D) with a rated load of 3000 lbs.
- Elevators shall comply with the latest edition of ASME A17.1, including recent amendments.
- Shop drawings shall show the project specific machine room layout drawn to scale (not the manufacturer's typical machine room layout) for the building. If modifications to the Contract Documents are required to comply with the Code and/or the elevator manufacturer's requirements, the changes shall be clearly shown on the shop drawings. The final machine room layout, required to meet the elevator code, is the elevator manufacturer's responsibility. If installation results in violations to the elevator code, the Contractor shall be responsible for field corrections at his own expense.
- Elevator machine rooms shall be air-conditioned.
- The elevator manufacturer shall provide signed documents certifying that hoist way, pit and machine room layout, including door location, size and swing, locations and dimension of all wall mounted electrical devices and services, as shown in the Contract Documents, are adequate for the elevator system being provided.
- The Installer shall be an authorized distributor of the equipment to be installed, have 5 years prior experience, have a local service office and a staff of qualified technicians. Specify a warranty period of 12 months with a 12-month maintenance service contract beginning at Substantial Completion.
- The Installer shall comply with manufacturer's installation instructions and the approved shop drawings. Drill excavation to accommodate plunger-cylinder units in well casings; fill void spaces between cylinder casing and cylinder with corrosion protective filler, or fine sand. Install plunger-cylinder units plumb and accurately centered. Set sills flush with finish floor surface at landings.
- Sump pumps shall be provided in all elevator pits. Pump units shall be submersible type.
- Operating System shall be a microprocessor and provide battery-powered lowering if power fails.
- Hoist way entrance doors and frames and car doors shall be satin stainless-steel finish. Wall finishes shall be 16-gauge Steel, powder coated to Owner color specification
- Handrails shall be #4 Stainless Steel ½" x 4" two per wall on all walls.
- Key switch control shall be provided in addition to standard activation.
- Emergency communication systems shall meet ADA requirements. See Appendix E for Emergency Elevator Signage.
- Contractor shall supply elevator pads and hooks for protection to be used by contractor during construction. A new set of pads shall be provided to the Owner upon completion of construction. See Appendix E for emergency signage for the interior of the cab.

- Two-way communication systems outside of elevators in areas of safe refuge shall be coordinated with the CCSD Security.

DIVISION 21 - FIRE SUPPRESSION SYSTEMS

SPECIFY the following for FIRE SUPPRESSION SYSTEMS:

- Basis of Design Manufacturers are shown in Appendix A.
- AE shall locate sprinkler/fire pump rooms on the ground floor with exterior access.
- Use wet pipe sprinkler systems throughout all structures wherever allowed by code. A request to use dry pipe systems in areas not required by code shall be submitted in writing to Owner with clear explanation of why they are necessary for the specific application and shall be approved by Owner prior to proceeding with the design.
    - All out-buildings, including sporting event support structures (press box, concession stands, restroom facilities, etc.) shall be designed to avoid the need for automatic sprinkler protection whenever possible. This shall include, but not be limited to, type of construction, height, separation, compartmentation, etc.
- The AE shall be responsible for obtaining local water system information and coordinating flow test with the local water company and Fire Chief. Fire pumps shall be approved only after providing appropriate supporting calculations and meeting with the local fire department to assess their capabilities and equipment.
- Hydraulic Analysis shall show calculated demand and minimum required water supply required.
- Emergency power supplies for fire pumps or engine driven fire pumps shall only be provided where required by the AHJ or code due to an inadequate or unreliable power source from the utility company serving the Project.
- Art kiln rooms shall be equipped with a smoke/heat detector and sprinkler head as required by code.

DIVISION 22 –PLUMBING

Basis of Design Manufacturers are included in Appendix A.

GENERAL REQUIREMENTS

- All water consuming devices shall exceed minimum IPC requirements by at least 20%.
- All interior water coolers shall include two separate units - one standard height and one handicap. The handicap water cooler shall have a water bottle filler on it. All water coolers shall have filters that meet NSF/ANSI 42 and 53.
- Provide floor drains with trap primers at or near water heaters, dishwashers, emergency showers, teacher lounges, nurse offices, single fixture toilet rooms, media centers with attached kitchens and break areas, and CD classroom near sinks.
- Specify underground and under slab DWV piping as Cast Iron (or PVC if approved by Owner). PVC may be used for sanitary sewer pipe outside the 5-foot building footprint
- Potable water piping under slab may be PEX with Owner's permission (copper is the baseline). Circulating pumps cannot be used with PEX. Above grade domestic water shall be copper as the standard.
- Provide positive freeze protection on all water lines subject to freezing conditions.
- A ball valve shall be included in branch piping to all exterior hose bibs. Where suitable, hose bibs shall be located adjacent to exterior mechanical rooms, dropping branch piping exposed in mechanical room and locating ball valve a maximum of 6 ft. above the finish floor. When the hose bib does not align with a mechanical space on the exterior of the building, the ball valve shall be above an accessible ceiling near the exterior wall and the ceiling grid shall be appropriately marked as to the location of the valve.
- Specify maximum distance of 80 feet of pipe between cleanouts for toilet waste lines. Cleanouts to be accessible from interior of building. Cleanouts to be both at beginning and end of lines.
- All new and existing sanitary drainage systems and storm drain systems to the point of service connection or termination outside the building footprint for storm drainage shall be completely cleared with a plumber's snake and flushed after a building is completed and prior to Substantial Completion.
- Tempered water shall be provided only in areas required by OSF and the plumbing code including, but not limited to kitchen, early childhood, kindergarten, Grade 1, and special needs classrooms.
- Nurses' clinics and lounges shall have stand-alone tank style water heaters for tempered water located near fixtures to avoid need for a recirculation pump. These two areas should not be connected to the building's hot water loop.
- Pending funding availability, Teacher's Rooms shall have a separate toilet for staff.
- Chrome escutcheon rings shall be used at all exposed ceiling and wall penetrations.
- Isolation valves shall be used in cold water and hot water mains and branch piping so that water can be shut off to each classroom wing, administration area, group toilets, and science classrooms.
- Group toilets shall have metered faucets.

- Contractor shall provide video documentation of pipe interior of all below grade DWV Systems under building slab and on site to the point of service. Video shall document continuous slope and proper drainage (no dips, no crowns). Video should show all mains and branch connections as well as continuous measurement of pipe length.
- Require Contractor to provide photographic documentation of locations (including burial depth) of all below grade water and DWV systems under slab and on site to the point of service.
- Video and photographs are to be included in project closeout documentation.
- Utility Meter shall be located at property line and/or right of way line in non-traffic area.
- Secondary water meters shall be added for cooling towers, mechanical system make up water and irrigation systems. These shall be separate from main building service in order to avoid sewer charges. All water meters shall be connected to the BAS for monitoring and alarm capability.
- The cost of providing the water services, taps, meters, and vaults/boxes shall be part of the Contractor's responsibilities in the Contract Documents.
- Backflow preventer shall be located with the fire riser/main domestic water riser, located inside the building, directly accessible from the exterior.

PLUMBING IDENTIFICATION

- The following identification system shall be used:
- Paint and code all exposed piping in mechanical and boiler rooms with stencil paint, manufactured stick on or wrap around systems. Piping shall have flow arrows and labels located at 10 ft. intervals, at all turns and at each floor or wall penetration:
- Locate and color code pipe markers and flow arrows as follows:
    - Maximum of 25 ft. and closer if congested
    - Near each change in direction
    - Near each valve
    - Near each branch
    - Near equipment
    - Near origination and termination points
    - Near where pipe passes through walls (on both sides of wall)
    - Near access doors
    - Cold Water – dark blue
    - Hot Water – dark red
    - Gas Lines – Yellow
    - Ceiling valve marker for valves shall be located above **and below** lay-in ceilings. Attach valve marker to adjacent ceiling grid.
    - Above ceiling valve markers: ½ inch diameter self-adhesive color-coded circle. Color code as listed above for system served.

- Below ceiling valve markers: Engraved Phenolic Plastic Nameplates, ¾" tall black surface with ¼" tall white lettering

PLUMBING FIXTURES

- Main domestic water heaters shall be located on ground floor on a slab. Any room containing water heaters shall have a minimum installed clearance recommended by manufacturer. Doorways in rooms with water heaters shall have a minimum clearance of the width of fixture plus 6 inches to replace water heaters.
- AE shall perform a life cycle analysis between a water heater with a tank vs. tankless to determine what unit should be used in the facility. Tankless water heaters are the first choice for the kitchen hot water supply.
- Specify vandal-proof options for all fixtures used by students. This includes but is not limited to handle screws, aerators, showerheads, and water coolers.
- Water closets shall be floor mounted. Specify floor mounted elongated bowl water closets.
- Dimension all floor drain locations on drawings.
- Washer box shall be for all residential type washing machines with cold water, hot water, and drain for both commercial and residential use.
- Shower valves shall have single handle, scald proof control.
- Group restroom urinals and water closets shall be double A or C alkaline battery-operated diaphragm type flush valve, Zurn or Owner approved equal, that are fully compatible with a flush handle if it is needed. See Appendix A for Basis of Design Manufacturers. Public toilets and individual classroom toilets shall have manual type angle control-stop valve with vacuum breaker. Bathroom sink faucets shall be vandal resistant metering type. Faucets with handles or wrist blades are required for lab sinks, art rooms and kitchens
- Specify mop sinks with stainless steel wall protection on all sides. Floor mounted mop sinks shall be pre-cast stone and wall mounted mop sinks shall be cast iron.
- Provide hose bib inside a lock box in group restrooms.
- Fixtures in classrooms shall have faucet necks centered over the drain hole of the sink.
- Classroom restrooms and classroom sinks shall have wall mounted soap and paper towel dispensers provided by Contractor.
- Public use and staff restrooms shall have electric hand dryers and wall mounted soap dispensers.
- Provide clay traps in art room sinks.
- Provide group or multi-user wash fountains in group toilets.
- Show on drawings a freeze proof yard hydrant on a pedestal on the roof within 50 feet of any roof mounted HVAC equipment that shall require routine indoor and outdoor coil cleaning. Hydrant shall be structurally supported such that it is not able to move more than 1/8th inch maximum.

DIVISION 23 - HEATING, VENTILATING & AIR-CONDITIONING

GENERAL REQUIREMENTS

- Building Design should not require smoke evacuation. If required, a separate smoke evacuation system shall be engineered. Automated doors shall not serve as smoke evacuation air intake.
- Prior to HVAC equipment selection a meeting shall be coordinated by the AE to facilitate the integration of proposed equipment manufacturer factory installed controls with CCSD BAS system.
- All HVAC equipment selections shall include pleated, extended media MERV 13 filters with a minimum thickness of 2 inches. If the proposed HVAC equipment cannot accept MERV 13 filters, a complete engineering analysis demonstrating that a combination of increased outside air ventilation greater than code minimum, plus filtration at the proposed MERV rating plus the application of additional air cleaning technologies will perform equal to or better than code minimum ventilation plus MERV 13 filters and remove an equal amount of PM 2.5 from the recirculated air serving the occupied space. The analysis shall show that the proposed solution also provides equal to or better energy efficiency. The Owner has adopted an equipment labeling convention that includes the 4-digit building number in the equipment label. Example RTU-0123-1. Roof Top Unit Name followed by the-Building Number followed by the Schedule Number. This system will agree with the A/E designed mechanical equipment schedule. The tag shall be 6”x4” black background with 1” white lettering. Contact Owner for additional information
- The Owner and Program Manager will schedule a meeting with the Owner's BAS contractor as soon as the system type has been selected. The BAS contractor will work with the Mechanical Engineer to ensure seamless integration of the controls and the mechanical equipment. The Program Management Project Manager and Mechanical Engineer shall submit written documentation confirming the consultations with the BAS contractor.
- Elevator machine rooms shall be air-conditioned.

EQUIPMENT LOCATION / ACCESSIBILITY / SERVICE

Specify the location and accessibility of HVAC equipment as follows:

- Equipment and systems shall be designed and located so that Owner personnel may conduct routine maintenance with minimal interference to the daily operations of the facility.
- All HVAC equipment shall be installed per manufacturer’s recommended clearance guidelines with sufficient space for maintenance personnel to change filters and pull coils.
- All HVAC equipment shall be installed to provide sufficient space for Test and Balance (TAB) and Controls personnel to access control valves and panels
- Equipment (except VAVs) shall not be located in ceilings or in areas where a ladder is required for access or height presents obstacles to maintenance.
- VAVs shall be located in the classroom ceiling right inside the doorway for easy access.
- Roof mounted equipment shall be designed and located so that fall protection is not required and be accessible by a full-sized staircase or elevator. In buildings with pitched roofs, equipment shall be located under the roof and in conditioned attic spaces accessible by stairs. The design must allow for removal of equipment without modifications to the building structure. Ladder access to units in attics is not permitted.

- Condensate floor drains shall be accessible from the front of the unit. The condensate drain system shall not be tied directly into the roof drainage system and it shall not allow water from the roof or storm drainage system to enter the building.
- Expansion tanks shall be bladder type.
- Equipment, mechanical and electrical rooms shall provide consistency in layout and service requirements. A layout shall be provided to Owner for review and approval prior to fabrication or installation.
- Quick disconnects shall be used on all power, water, control and duct connections.
- MEP design drawings shall contain a note telling contractor not to install electrical disconnects on the equipment identification tag. Do not mount disconnects on any equipment access cover or obscure any unit nomenclature or nameplates
- Cooling Towers: shall be located on the ground unless impractical and/or prohibited by the BAR.
- Boilers and Loop pumps shall be located in the main mechanical room, which shall be located adjacent to cooling towers.
- MTR and Security Systems: Shall be located in separate but adjacent rooms. No piping to be installed above MTR room.
- Musical Instrument Storage: Rooms containing band equipment shall be conditioned like occupied spaces.

CLIMATIC DESIGN INFORMATION

- The following Climatic Design Information shall be used for the design of all HVAC systems (Based on ASHRAE Handbook of Fundamentals, 2013 Edition, Chapter 14, Climatic Design Information for Charleston, SC):
    - Summer: 92.1 Dry Bulb Degrees F, 77.6 Mean Coincident Wet Bulb Degrees F (ASHRAE 1% Condition)
    - Winter: 27.3 Degrees F Dry Bulb (ASHRAE 99.6% Condition)
    - Summer outdoor air dehumidification for ventilation: Outside condition: 78.9 Dew Point Degrees F, 84.4 Dry Mean Coincident Dry Bulb Degrees F (ASHRAE 0.4% Condition). Note outdoor ventilation air shall be cooled and dehumidified to approximately 48 to 50 Degrees F Dew Point Degrees F by dedicated outdoor air units before delivery to the occupied spaces. In the winter, the entering outdoor air shall be heated to approximately 65 to 70 Degrees F Dry Bulb before delivery to the occupied spaces.

EQUIPMENT SELECTION AND SIZING

- All HVAC Equipment for Elementary and Middle schools shall be Air Cooled DX. High Schools and CAS facilities shall be decided on a case by case basis. Water Source Systems may be considered if presented to Owner in a BOD with a life cycle cost analysis or other analysis that indicates it is the best alternative for that facility. All units shall have standard 24-volt control circuit and web-based controls capability.
- Provide BACnet building automation system interface between manufacturer's unit controls and Owner BAS. Interface shall provide Owner BAS access and ability to manipulate all of manufacturer's adjustable set points and alarms.

- Coils shall be constructed with copper or aluminum tubing with aluminum fins. All condensate drain pans shall be stainless steel.
- Water Source Heat Pumps (WSHPs) shall be specified as high efficiency (Minimum 18 EER at standard ARI conditions) using R410a. No auxiliary heat other than the heat pump operation shall be provided for wintertime operation.
- Load match pump and piping systems should be considered to reduce cost and operation of a hydronic system.
- All water piping systems shall be designed with isolation valves provided to provide isolation capabilities per floor and per wing shutdown. Isolation valves may be designed as full port ball valves or butterfly type. Valves shall be labeled below and above ceiling with phenolic tags.
- All coils receiving outdoor air (air cooled condensing units, dedicated outdoor air unit coils handling 100% outdoor air, etc.) shall have a factory applied, industry standard 5000-hour salt spray tested seacoast coil coating. Application shall ensure entire coil and fin surface are coated and shall take place during manufacturing process and not on site. If available, the cabinets shall also be factory coated in addition to the standard process.
- Multiple compressor units shall utilize multiple independent refrigerant circuits.
- All units equipped with semi-hermetic compressors shall have oil protection.
- Penetrations thru the sidewalls shall have proper sleeve and be properly sealed.
- All refrigerant lines shall be appropriately sealed when installed and charged with nitrogen after installation, during construction and prior to start-up.
- Designs shall minimize refrigerant line set length on split systems.
- Sewer vents shall be located at least the minimum code required distance from any fresh air intake.
- Direct drive equipment with variable speed drives shall be used for all air handling fans (unless not offered). Any units with belt drive systems shall include a requirement that an extra belt be provided at closeout.
- Specify one extra fuse be provided in each fused disconnect at closeout. Electrical disconnects shall be non-fused unless otherwise required by the electrical code.
- All 3-Phase equipment shall have phase loss / brownout protection.
- All refrigerant systems shall have low and high-pressure switches, not a loss of charge switch.
- All control transformers shall have separate internal fuses or circuit breakers with manual resets.
- Variable speed drives shall be specified on all pumps and fans with motors greater than or equal to 5 horsepower.
- Standing seam Galvalume roof (or Owner approved equal) shall be used on outdoor air units and large air handlers that are constructed of cabinets by individual panels. Single-ply roofing systems or coating systems are not allowed.

AIR COOLED REFRIGERANT (DX) BASED HVAC SYSTEMS

- Systems serving classrooms, cafeterias, media centers, gymnasiums, and other stand-alone spaces shall be Air to Air Direct Expansion (DX) based systems consisting of a combination of split system heat pumps and packaged rooftop heat pumps.
- Units shall have variable speed fans and utilize multi-speed compressors or compressor capacity control to match the load in the space down to a minimum of 30% of design full load capacity (or manufacturers lowest capacity if lower than 30%) to better match loads in space year-round under part load conditions.
- Units shall be provided with economizers and heat recovery only where required by the most currently adopted SC energy code. Consult with Owner Energy Manager before beginning design.
- Ventilation air shall be provided by de-coupled dedicated outdoor air system (DOAS) ducted directly to the spaces (See DOAS requirements below). Where possible, the ASHRAE IAQ method and/or electronic air cleaning shall be incorporated into HVAC system design to minimize the amount of raw outdoor air that has to be conditioned. All HVAC units shall meet the minimum requirements of ASHRAE 90.1 and ASHRAE 62, latest edition adopted by OSF or more current if the facility is seeking certification under a building performance rating system that uses a more current code.
- For single story spaces with flat roofs, or the second story of a two-story building, each classroom shall be fed by individual rooftop heat pumps.
- First floor classrooms in multi-story buildings shall be served by individual split system heat pumps with the air handling units located in mechanical closets at the classroom with service access from the corridor. Air handling units suspended from the ceiling are not permitted.
- Condensing units shall be located on the ground or on equipment rails on the roof if ground space is not available or length of refrigerant lines is not practical.
- Packaged Rooftop DX VAV units shall be specified for the administrative areas with individual VAV boxes equipped with electric SCR controlled reheat serving each space served.
- The VAV unit may either take in outdoor air through the unit or be served by a ventilation air unit at the option of the designer.
- Design discharge air temperature for the packaged rooftop VAV units shall be 52 degrees off the coil during the cooling season
- Manufacturer recommended maintenance access space shall be incorporated into the design and shall be coordinated with the Architect and other disciplines and shall be clearly shown on the design documents for each trade (i.e. reflected ceiling plans, electrical plans, fire protection, etc.).
- Evaporator and condenser coil shall be coated with a coastal environment protective coating.

VENTILATION (DOAS)

- Packaged Dedicated Outdoor Air Systems (DOAS) shall be specified for areas of high occupancy (multiple classroom spaces, multi-purpose/cafeteria, media center, etc.).
- DOAS shall have a duct sensor (temp or humidity) installed that will shut down the unit and send an alarm to the BAS if unit fails to meet dewpoints.

- DOAS shall be located, zoned and sized, where possible, to minimize the need to employ heat recovery devices such as plate heat exchangers and enthalpy wheels in the DOAS.
- All spaces served by the ventilation air units shall be equipped with temperature, CO2 and humidity sensors to allow for demand ventilation based on building occupant CO2 levels (800 PPM max) and manage building humidity levels during both occupied and unoccupied modes. Space temperature, humidistats, and CO2 sensors may be combined into a single wall device.
- The DOAS wheel, supply and exhaust fans shall be equipped with VFD's and the unit shall be capable of modulation down to 50% of the rated design CFM for demand ventilation.
- The DOAS exhaust fan shall be modulated to maintain a positive building static pressure of approximately 0.05" water column which can be adjusted as required by BAS.
- The DOAS shall deliver dry and slightly sub-cooled ventilation air ducted to each space. Ventilation shall not be ducted into the return air duct of the terminal HVAC unit serving the space (such as a heat pump or fan coil unit). Air shall be ducted from the DOAS units directly to each space through ceiling diffusers.
- Option 1: Outside air for ventilation and humidity control shall be provided by Dedicated Outdoor Air Systems (DOAS) designed to provide discharge air in a range of temperatures from cold to neutral 65 – 70 degrees based on the Project specific written Sequence of Operation using a linear supply air temperature reset schedule and to deliver no lower than 48 Deg F apparatus dew point air to handle the latent load of the outdoor air on a design day and to handle some of the people latent load within the building. Design day outdoor air conditions shall be dew point 78.9 DP @ 84.4 degrees F mean coincident DB. However, if space design conditions require a dew point lower than 48 degrees, written justification must be provided.
- Option 2: Summer design supply air conditions for the DOAS shall be 70 degrees F DB max at 55 degrees DB min (adjustable from the BAS) with dew point 78.9 DP @ 84.4 degrees F mean coincident DB entering outside air conditions. Supply air apparatus dew point shall be 44 degrees F.
- The gas fired heating section (or SCR controlled electric reheat where gas is not available) shall be sized to deliver 70-degree air at the rated airflow with 20 degree entering outside air (53 degree rise minimum).
- DOAS shall be provided with economizer mode of operation – with bypass dampers provided as required depending on the unit manufacturer.
- Provide BACnet building automation system interface between manufacturer's DOAS unit controls and Owner BAS. Interface shall provide Owner BAS access and ability to manipulate all of manufacturer's adjustable set points and alarms.
- Owner BAS vendor shall provide BAS controllers to the DOAS manufacturer's factory for mounting and wiring at the factory.
- All floors of DOAS units shall be specified as aluminum or stainless-steel plate type for corrosion resistance.
- DOAS units shall include energy recovery where required by the most currently adopted SC energy code), be capable of varying outdoor air volume based on CO2, variable speed supply and exhaust fans, hot gas reheat and outside air and return air dampers.
- Fan arrays shall require individual disconnects.

COOLING TOWERS (IF WATER SOURCE HVAC IS USED)

- Two closed circuit evaporative coolers or one evaporative cooler with two independent cells shall be provided for loop water heat rejection.
- CTs with standard coils shall be sized for two cells at 35% of the total connected equipment heat of rejection load or optionally 50% of the building's calculated block load (or the simultaneous peak load) considering diversity to provide partial redundancy. Variances from this requirement require A/E to provide calculations and narrative explaining design rationale. A/E must receive Owner approval for any variances from this requirement.
- The block load shall be the maximum simultaneous load the water loop is expected to see at any one time during the year and shall be based on an 8760 hour per year software-based energy and HVAC load analysis of the facility based on the set points and operating schedules expected at the Project.
- CTs casings, pans, hardware and fasteners shall be of all stainless-steel construction (fiberglass shall not be accepted). Heat exchanger shall be either stainless steel or galvanized steel (G180 type).
- Open towers, plate and frame heat exchangers and primary/secondary pumping arrangements are not allowed.
- Separate Sidestream filters shall be provided for all Cooling Tower basins and for all Water Source Heat Pump loop piping systems at each school.
- Sidestream filters shall use the centrifugal separation principle of operation and shall operate continuously when systems are operating.
- Sidestream filters shall be selected for 10% of the system's total flow (10% Basin Pump flow for cooling tower basins and 10% of the loop water pump flow for the loop side of the system) and shall be selected to filter particles from the system that are 10 microns in size or larger. Evacuation of separated solids shall be accomplished automatically by the use of an electrically-actuated purge valve programmed at appropriate intervals and duration in order to efficiently and regularly purge solids from the separator's collection chamber. The purge pipe shall discharge into the nearest floor drain. This valve shall be monitored and controlled by the Building Automation System.
- On major renovation projects or capital maintenance projects, only when no energy model exists. CTs shall be sized based on industry standard diversity factors such as those found in the Daikin/McQuay (Example, not required to use Daikin/McQuay equipment) water source heat pump design guidelines. In no case shall Evaporative Coolers be sized based on the total connected heat of rejection load of all equipment connected to the loop. This requirement to use system diversity in central equipment diversity shall also apply to the sizing of loop water pumps, system water heaters/boilers, pumps and piping mains.
- All CTs shall have two direct driven, variable speed fans and two motors with variable speed drives and two independent tower spray pumps independently controlled. All CT VFDs, control relays and contactors shall be located in the mechanical room.
- All CT shall have ladder and access platforms for maintenance and service. All CTs shall be specified with a swing arm hoist rated (for weight) to maintain all components of tower.

- A Water meter shall be installed on tower feed water and connected to the BAS. Once an expected average evaporation and bleed flow rate is established, an alarm shall be set to notify when flow rate is exceeded for more than 15 minutes any time throughout the year.
- Provide electronic flow meters on all water source heat pump loops connected to the BAS and displayed on the BAS system graphic.

BOILERS

- Facility shall have two (2) high efficiency gas fired, fully modulating condensing Boilers
- Each Boiler shall be required to be ASME pressure certified.
- Boilers shall be sized at 60% of the Block design heat load to add heat to the water loop. See notes regarding diversity sizing of Cooling Towers above. Variances from this requirement require A/E to provide calculations and narrative explaining design rationale. AE must receive Owner approval for any variances from this requirement.
- The total capacity of the Boilers shall not be greater than 75% of the total connected heat of absorption of the equipment connected to the loop and in most cases can be substantially smaller (as small as 25% of the total connected heat of absorption). Variances from this requirement require A/E to provide calculations and narrative explaining design rationale. A/E must receive Owner approval for any variances from this requirement.
- Provide BACnet building automation system interface between manufacturer's unit controls and Owner BAS. Interface shall provide Owner BAS access and ability to manipulate all of manufacturer's adjustable set points and alarms.

PUMPS

- Water shall be circulated to the heat pump units through a variable flow distribution loop fed by two base mounted centrifugal pumps, each sized for 100% of the block load for full redundancy. Each pump shall have a variable frequency drive for variable flow operation. Variances from this requirement require A/E to provide calculations and narrative explaining design rationale. A/E must receive Owner approval for any variances from this requirement.
- All hydronic systems shall have main and standby pumps. See direction for sizing and system diversity indicated under Cooling Towers section.

VENTILATION FANS

- Specify low speed, high volume, no-cage fans in big box spaces (cafeteria, multi-purpose, gyms, media, and auditoriums.) Basis of Design is Big Ass Fans Essence (E1). The fan shall be furnished with standard mounting hardware and all required accessories as manufactured by Big Ass Fan Company or approved equal. If Big Ass Fans is selected A/E shall request equipment with logo only no verbiage (I.e., donkey visual without words Big Ass Fans.)

OCCUPANCY SCHEDULES

- Occupancy Schedules shall be determined on a Project Specific basis and documented in the Project Specific OPR.

SPECIAL REQUIREMENTS BY SPACE

MECHANICAL CLOSETS

- Shall be laid out and designed with the same configuration throughout a project including, but not limited to, location of service clearance, valves, and electrical connections, electrical disconnects,

control panels, filter sizes and access. Minimum clearances in the closets shall be 3' around the services sides (a minimum of two sides of unit, one side may be measured with closet door opened).

OFFICES/CLINICS

- Clinics shall have negative pressure to surrounding areas. See note above regarding equipment sizing when not utilizing DOAS units.

CORRIDORS, ENTRY SPACES, AND ATRIA

- Corridors, entry ways, security vestibules, and atriums shall be tempered as necessary to maintain a maximum of 76 degrees in cooling and a minimum of 65 degrees in heating in occupied mode.
- Tempering for first floor corridors shall use air from classroom units or DOAS units. For multi-story buildings corridors and atrium shall be conditioned separately.

KITCHENS

- There shall be two (2) HVAC zones in the kitchen:
  - Cooking / Prep Area
  - Managers Office and Dry Storage
- A/E shall coordinate kitchen hood with Food Service designer. Hood shall be designed by food service designer and installed by mechanical contractor.
- Rooftop kitchen exhaust fans shall be hinged with sufficient length on the electrical connection so that the fan can be easily moved (tipped) for cleaning and maintenance. Consider kitchen hood make up requirements in selection of HVAC units to serve kitchen and cafeteria.

GROUP TOILETS

The A/E shall establish a negative pressure in these areas and ensure use of direct drive exhaust fans to serve these spaces.

INDIVIDUAL TOILETS

Ceiling mounted exhaust fans shall be acceptable ducted to the outside of the building.

TELECOM ROOMS (TR), MAIN TELECOM ROOM (MTR), AND FACILITY SECURITY ROOMS

- All MTR and TR rooms shall be served by dedicated, air cooled cooling only units equipped with low ambient control and a backup exhaust fan controlled by a line voltage thermostat set to 80 degrees in the event of cooling equipment failure. This fan shall be a minimum of 600 CFM or shall provide the room with a minimum of 10 air changes per hour, whichever is greater. Systems to operate 24/7/365 as required to meet set points.
- TRs and MTRs shall be designed with a raised threshold, walls from the floor to the bottom of floor or roof deck above, with all penetrations sealed to prevent free air return from adjacent spaces.
- Do not connect condensate drains in these areas to other drain systems; pipe directly to outside.
- No piping to be installed above MTR rooms.

- Provide BACnet building automation system interface between manufacturer's TR and MTR HVAC unit controls and Owner BAS. Interface shall provide Owner BAS access and ability to manipulate all of manufacturer's adjustable set points and alarms.
- The size of the dedicated unit shall be sufficient to accommodate the heat generated by the equipment. Refer to the Technology Design Specifications and Facility Security Access Control, Intrusion Detection, and Surveillance Design Specifications as provided in Division 27 for requirements.

INDOOR ENVIRONMENTAL QUALITY

- Temperature - The HVAC systems and BAS shall be capable of maintaining space temperature set points within 2 degrees F (plus or minus) head to foot and from space to space.
    - Set Points - Occupied
        - Indoor cooling shall be 73 Degrees F
        - Indoor heating shall be 70 Degrees F
    - Set Points - Unoccupied
        - Indoor Cooling Set shall be 84 Degrees F
        - Indoor Heating Set shall be 60 Degrees F
- Humidity - Indoor Relative Humidity shall range between 40% and 60% with a design indoor relative humidity of 55%.
- Airflow - Airflow shall be designed in accordance with ASHRAE Handbook, ASHRAE STD 55.1, and STD 62.1.
- Acoustical requirements - Noise levels in classrooms shall not exceed 25 NC (noise criteria).

VIBRATION REQUIREMENTS

- Rotating or vibrating equipment shall be provided with properly sized vibration isolators either as part of the manufactured piece of equipment or as an added component.
- All pumps shall be provided with flexible pipe connections.
- Air handling equipment shall have flexible duct connections (and flexible pipe connections if connected to a piping system).

SEISMIC REQUIREMENTS

Seismic restraint and isolation shall be provided in accordance with the currently adopted code. Seismic, wind restraint, and structural performance criteria shall refer to the structural engineer's drawings.

EQUIPMENT START-UP

- All major/large systems shall have a factory start-up performed by manufacturer trained, certified representative in the direct employ of the manufacturer.
- Provide 48-hour notice of system start-ups of major HVAC equipment to CCSD HVAC shop Foreman.
- All systems shall be labeled correctly and be in agreement with the BAS system.

- All units shall have a factory start up sheet completed (hard copies and PDF) provided in the project close out documents.
- Startup sheets shall include the locations of all supply air, return air, outdoor air and exhaust air-balancing devices.
- Contractor shall change filters on all systems prior to Test and Balance and prior to Owner Occupancy and at any other time if filter condition warrants.
- Water treatment shall begin as soon as the system is flushed of construction debris to the satisfaction of the Commissioning Agent.

SYSTEMS, MATERIALS AND EQUIPMENT NOT ALLOWED

- Fibrous duct liner and duct board
- Copper gas lines
- Condensate pumps are not allowed except for ductless mini split style units.
- Step-up or step-down transformers are not allowed on the input or line voltage side of units. This does not apply to factory-mounted transformers internal to the units.
- No refrigerant piping shall be run in floors, walls or under slab except for penetrations.
- Do not re-use any existing refrigerant lines.

HVAC PIPING SYSTEMS

- Piping for HVAC systems greater than or equal to 2 ½ inches shall be Schedule 40, ERW black steel with either welded or screwed joints. Piping shall be from a domestic manufacturer.
- Condensate lines from AHU's and fan coil units shall be type "L" copper. PVC piping is not allowed for Condensate lines from AHU's and fan coil units.
- Cold water lines and chilled water / hot water run outs less than or equal to 2 inches shall be type "K" copper with soldered joints. (Propress or Owner approved equal may be used for domestic potable water systems in addition to solder joints for copper pipes.)
- PEX shall be considered for under slab domestic water supply with Owner Approval.
- All exposed piping (insulated and uninsulated) shall be painted and color coded.
- Piping shall be color coded as follows with flow arrows and labels located at 10-foot intervals, at all turns, and at each floor or wall penetration:
    - Chilled water - Light Blue
    - Hot water - Light Red
    - Dual Temperature - Orange
    - Make up water - Dark Blue
    - Condenser lines - Green
    - Gas Lines - Yellow
- Chilled water piping shall be insulated cellular glass and flexible elastomeric above ground with manufacturer's recommended factory applied jacket. Thickness per code or whatever is greater. Aluminum or stainless-steel jacketing shall be used for exterior exposed piping.

- Chilled water piping shall be insulated cellular glass below ground.
- Contractor shall dimension actual location of all underground piping on as-built drawings. A minimum of two (2) dimensions from building reference points shall be provided and a bury depth indicated.
- All underground lines shall be marked with a bright colored continuous plastic tape on top of the line. Underground tape shall be detectable type.
- All underground steel piping shall be double wall with HDPE covering and have cathodic protection.
- All piping systems shall be thoroughly flushed, chemically cleaned and filled with appropriately treated water/fluid before placing into operation.
- Hydronic systems shall be connected to bypass all HVAC units and equipment before cleaning and flushing begins and then flushed and the filters cleaned out at least three (3) times before the units are connected to the system and placed in operation. Remove startup filters from pump suction strainers once cleaning and flushing operations are complete and before TAB.
- Provide shut-off valves for all hydronic mains at all take-offs to mechanical rooms and pump rooms.
- Automatic flow control devices shall be used on all hydronic systems
- All Cooling Towers shall be completely cleaned and flushed after all systems are in operation and the site work has been completed prior to turning over to Owner. (AE shall approve flushing procedures and the Engineer shall be present at flushing).
- Sectional shut off valves shall be provided at the supply and return side of all equipment to allow for shut off of a section of piping for repair.
- All damper operators, control and service valves shall be installed such that they can be serviced by personnel standing on the floor of the mechanical room.
- The water source heat pump condenser water loop shall not be insulated.

DUCTWORK

- All duct shall be galvanized metal except:
    - Run-outs to VAV boxes and air distribution devices, flexible duct is allowed – maximum 6 foot length.
    - Kitchen – use stainless steel with welded joints for kitchen hood and dishwasher exhaust.
- During construction, ducts and equipment openings shall be sealed at all openings to protect the duct from construction dust/debris.
- All mechanical systems and equipment shall be inspected before start-up and at final inspection as to the cleanliness; units shall be in “like new” condition and any coils, covers, grills, etc. shall be free from damage.
- Minimize use of exposed ductwork. When exposed ductwork is used (gyms, etc.) it shall be heavy duty double wall spiral dark grey or unpainted
- Insulate all ductwork. Duct insulation thickness shall be 2” minimum or as required by currently adopted SC energy code, whichever is thicker.

- Duct insulation that gets wet shall be removed and replaced.
- All duct shall be constructed to SMACNA seal to Class “A”. All duct shall meet SMACNA Duct Construction Standards for Metal and Flexible Ducts.

REGISTERS AND DIFFUSERS

- Shall use 4-way adjustable volume diffusers
- Shall use aluminum grilles, registers and diffusers in all locations unless steel is required by fire codes.
- Return Air filter grilles shall be used where practical. Areas with high ceilings i.e. café, multipurpose rooms, gymnasiums, etc. shall be filtered at the unit.
- Temporary filters shall be installed in units and on all supply and return grilles if permanent HVAC is allowed to be used for temporary AC to minimize contamination of ducts and plenums. All openings shall be covered until startup so that construction dust and debris does not enter ductwork.
- Slot diffusers and perforated diffusers shall not be permitted. Design of kitchen air distribution, regardless of diffuser selection should be done by the A/E (mechanical engineer) to minimize negative effects on hood operation.
- Provide manual balancing dampers in all run outs to air distribution devices. Do not allow use of dampers in the device for testing and balancing.

DIVISION 25 - BUILDING AUTOMATION SYSTEMS (BAS)

GENERAL SYSTEMS CONTROL

- Consult with Owner for which of the following systems shall be integrated, controlled, managed and monitored through the BAS and Owner Energy Management System:
    - All HVAC systems
    - Lighting (integrated with lighting controls specified in Division 26). Include both interior and exterior lighting
    - Generator(s)
    - Water Heaters
    - Recirculation Pumps
    - Kitchen Hoods (alarm contacts only)
    - Kitchen coolers and freezers (alarm contacts only)
    - Building power demand
    - Building energy consumption
    - Building Natural Gas flow and consumption (Therms)
    - Domestic water flow and consumption (GPM and gallons)
    - Domestic make-up water flow and consumption (GPM and gallons) for all mechanical systems
    - Irrigation system water flow and consumption (Only if connected to a municipal water supply)
- A detailed Sequence of Operations shall be written by AE and programmed into the BAS using the required set points, schedules, etc., defined herein.
- Zoning of lighting controls shall be clearly labeled using wing and/or area names from construction prints in the actual controller itself and in a manual to be delivered with close out documents.
- Specify BACnet building automation system interface between manufacturer's provided controls (all systems listed in this section) and Owner's BAS. Interface shall provide Owner's BAS access and ability to manipulate all of manufacturer's adjustable set points, functions, and alarms.

BAS INTERFACE DISPLAYS

The BAS interface and graphics shall be standard and consistent for all similar systems (system to system) and for all buildings (building to building). Graphics of the following screens to be included as reference: Cooling tower and loop, Chiller and loop (if applicable), WSHP, Floor Plan, Landing Page, and DOAS. The system shall provide the following minimum information by screen:

- Floor Plans shall include:
    - Accurate layout of all rooms and floors
    - Room names and numbers (Room names only need to be included for non-classroom spaces such as media, cafeteria, gymnasium, culinary arts, multipurpose, admin, theater, etc.
    - Equipment location (room number) and callout or ID Tag or number

- Roof Top Plan with equipment location.
- Space temperature/humidity/CO2 as appropriate based on space type. (Space temperature/humidity/CO2 radio button/graphic box shall be green background with white text if all actual readings are within tolerance for setpoint. Box shall turn red or yellow with black text if measured/sensed point is in alarm)
- Current outdoor air temperature/humidity/CO2
- Power demand in kW (current, max today, peak this week, peak this month, peak this year)
- Power consumption in kWh (total today, total week to date, total month to date, total year to date)
- Water consumption in gallons (total today, total week to date, total month to date, total year to date)
- Natural Gas in therms (total today, total week to date, total month to date, total year to date)

- Roof Top DX / Water source heat pumps shall include:
  - Commanded status and actual status of unit (occupied, unoccupied)
  - Room temperature set point (heating and cooling)
  - Room temperature (and CO2 and humidity as defined in Division 23)
  - Unit discharge air temperature
  - Fan status
  - Commanded position and actual position of loop water control valve (open or closed)
  - Current outdoor air temperature and humidity
- DOAS shall include:
  - Current outdoor air temperature, humidity and dew point and CO2 levels
  - Temperature and humidity/dew point of outside supply air entering and leaving energy recovery devices
  - Temperature and humidity/dew point of building exhaust air entering and leaving energy recovery devices
  - Temperature of cooling coil discharge air
  - Commanded and actual supply fan status
  - Supply fan VSD commanded and actual speed
  - Exhaust fan VSD commanded and actual speed
  - Enthalpy wheel status
  - Loop Water System shall include
  - Water flow (GPM) to building
  - Loop Pressures
  - Water supply temperature to building
  - Water return temperature from building

- Loop Water Pumps shall include (INCLUDED ON COOLING TOWER INTERFACE):
  - Status (lead/lag/on/off/speed)
  - Include manufacturer's model and serial numbers, location on the graphic for each unit.
- Boilers/Loop Water Heaters shall include:
  - Status (on/off)
  - Leaving water temperature (setpoint and actual)
  - Flow Rate or Differential Pressure
  - Include manufacturer's model and serial numbers, location on the graphic for each unit.
  - Evaporative Cooling Towers shall include
  - Spray pump status (on/off)
  - Fan status (on/off/speed)
  - Entering water temperature
  - Leaving water temperature (setpoint and actual)
  - Make-up water flow (GPM) and total gallons (today, week to date, month to date, year to date)
  - Include manufacturer's model and serial numbers, location on the graphic for each unit.
- General Exhaust Fans (larger fans not controlled by light switch in space) shall include:
  - Status (on/off/occupied/unoccupied)
  - Include manufacturer's model and serial numbers, location on the graphic for each unit.
- Laboratory Fume Hood Exhaust Fans shall include:
  - All fans not included by a light switch shall include Status (on/off)
  - Include manufacturer's model and serial numbers, location on the graphic for each unit, and with Filter sizes and quantities if applicable.
- Kitchen Hood Exhaust and Make-up Air fans shall include:
  - Status (on/off/speed (if applicable)
  - Include manufacturer's model and serial numbers, location on the graphic for each unit, and with Filter sizes and quantities if applicable.
- Kitchen Hood Make-up Air Heaters shall include:
  - Status (on/off/percent kW or firing rate)
  - Discharge air temperature (setpoint and actual)
  - Include manufacturer model and serial numbers, location on the graphic for each unit.
- TR and MTR Room shall include:
  - Room Temperature level
  - BAS Alarms and Notifications

- Owner BAS vendor shall display within BAS and send Alarms and Notifications to designated District personnel via email and text message for the categories listed below.
- Messages shall repeat transmission of the alarm or notification once per hour until someone logs into the facility management system in response

ALARMS AND NOTIFICATIONS

General Alarm Requirements:

- Space temperature/humidity/CO2 as appropriate based on space type. (Space temperature/humidity/CO2) radio button/graphic box shall be green background with white text if all actual readings are within tolerance for setpoint. Box shall turn red or yellow if measured/sensed point is in alarm)
- All other alarms shall be shown in one of the margins of the floor plan and have a noticeable designation if the point or system is in alarm. Water source heat pumps shall include:
- Alarms for:
    - Room temperature variation +/- 4 degrees from set point
    - Room humidity > 70%
    - CO2 Levels >1600

DOAS Alarms

- DOAS shall have a duct sensor (temp or humidity) installed that will shut down the unit and send an alarm to the BAS if unit fails to meet dewpoints.
- Alarms for coil discharge temperature variation +/- 4 degrees from coil set point
- When commanded and actual supply fan status does not agree with commanded condition within 15 minutes of command.
- When supply fan VSD commanded and actual speed does not agree with commanded condition within 15 minutes of command.
- When exhaust fan VSD commanded and actual speed does not agree with commanded condition within 15 minutes of command.

Loop Water System Alarms

- Loop supply temperature variation +/- 5 degrees from set point in heating or cooling modes.
- High temperature alarm at 115 degrees F
- Low temperature alarm at 40 degrees F

Loop Water Pump Alarms

- When pump status commanded and actual speed does not agree with commanded condition within 10 minutes of command. (lead/lag/on/off/speed)

Boilers/Loop Water Heaters Alarms

- Boiler failure from Boiler Manufacturer's boiler control panel (BCP)

Evaporative Cooling Towers Alarms

- Variable speed drive failure on CT fan.

- When make-up water flow (GPM) exceeds peak recorded flow rate for more than 5 minutes or it exceeds average flow rate for more than 30 minutes.

General Exhaust Fans (larger fans not controlled by light switch in space) Alarms

- None required at project close out.

Laboratory Fume Hood Exhaust Fans Alarms

- When fume hood exhaust fan status is on when zone is unoccupied.

Kitchen Hood Exhaust and Make-up Air fans shall include:

- When hood exhaust and make up air fan status is on when zone is unoccupied.

Kitchen Hood Make-up Air Heaters shall include:

- When kitchen hood make-up air heater status is on when zone is unoccupied.

TR Rooms and Other Stand-Alone HVAC systems shall include:

- Alarm temperature variation >5 degrees from set point

BAS TREND REPORTS

- All trends shall be for 15-minute intervals unless noted otherwise. The BAS compile trending data shall be as follows:
- Global system trends shall include for each site and a cumulative total. This list shall be reviewed Owner Energy Manager for each Project.
    - Outdoor air temperature, humidity/dew point and CO2 levels
    - Power Demand (kW), building main and all submeters (current, max today, peak this week, peak this month, peak this year)
    - Energy Consumption (kWh), building main and all submeters (total today, total week to date, total month to date, total year to date)
    - Water Consumption (gallons), building main and all submeters (total today, total week to date, total month to date, total year to date)
    - Natural Gas Consumption (therms), building main and all submeters (total today, total week to date, total month to date, total year to date)
- DX Heat Pump / WSHP shall be capable of trending
    - Discharge air temperature
    - Unit status (on/off/heat/cool)
    - Fan status
    - Space temperature/humidity/CO2 (set point and actual)
- DOAS shall be capable of trending
    - Current outdoor air temperature, humidity and dew point and CO2 levels
    - Temperature and humidity/dew point of outside supply air entering and leaving energy recovery devices

- Temperature and humidity/dew point of building exhaust air entering and leaving energy recovery devices
- Temperature of cooling coil discharge air Commanded and actual supply fan status
- Supply fan VSD commanded and actual speed
- Exhaust fan VSD commanded and actual speed
- Supply air flow (CFM)
- Exhaust air flow (CFM)
- Loop water control valve position (commanded and actual)
- Outdoor air damper position (commanded and actual)
- Building exhaust air damper position (commanded and actual)

WIRING

- All control wiring shall be routed in conduit and shall be color-coded.
- Conduit, wiring sizes, and type of insulation shall be in accordance with Division 26 – Electrical, and shall conform to the currently adopted edition of National Electrical Code.
- All electrical equipment shall bear UL labels.
- Each control circuit shall be protected by a circuit breaker of the proper size.

DIVISION 26 – ELECTRICAL

GENERAL REQUIREMENTS

- The use of Aluminum wire in a CCSD facility must be approved in writing by the Executive Director of Facilities Management
- Contractor shall provide for TEGG testing of the electrical power distribution system and provide documentation to Owner of the following tests: NFPA 70 compliance, Infrared Thermography, Ultrasonic Testing, De-Energized Testing, Energized Testing, Voltage and Ampere Diagnostics, Proper Torqueing. The TEGG inspection shall be performed by an independent 3rd party electrical contractor certified by the TEGG Service Corporation.
- Specify conduit and raceways as required by the ECMS standards, Technology Design Specification and Facility Security Access Control, Intrusion Detection and Surveillance Design Specifications.
- All electrical service inside the building shall be above grade in EMT.
- All electrical service outside the building shall be contained in stainless steel, NEC approved PVC or NEC approved flexible PVC.
- PVC coated GRC conduit shall be used in high corrosion areas such as cooling towers or areas that are continuously wet.
- Main building feed shall be NEC approved PVC
- Remote Electrical Power Shut down station located in front entrance shall be Knox-Vault #4544 and color shall be aluminum.
- Lighting and convenience outlets shall not be on the same circuit. Wiring for lighting and convenience outlets shall be run in separate raceways.
- Avoid outlets closer than six ft to sinks and/or bubblers (omit unnecessary GFI applications).
- Device plates and cover plates shall be oversized Stainless Steel
- In all classrooms, general use wall receptacles shall be approximately 12 ft on center, with a minimum of two on each wall. Receptacles shall be of the Hard Use Specification Grade 20-amp minimum. Toggle switches shall be Specification grade 20-amp minimum. Backstabbed (quick wired) or decorative outlets and switches shall not be used.
- Provide 208 VAC for printers in all main office areas, mail rooms and teacher workrooms.
- Construction phasing and outage plans shall be included in the contract documents.
- 15% spare circuit capacity shall be provided for future use in all electric panels. Feeder size shall match panel board rating.
- Spare wires shall be capped and labeled as spare. Label shall indicate where the other end of the wire is located.
- Nameplates shall be engraved three-layer laminated plastic, black letters on white background. Nameplates shall be installed on all equipment, panels, transformers, safety switches, etc., denoting equipment name and/or number and “Fed From”. Embossed adhesive tape with 3/16 inch, black letters on clear background shall be adhered to all wall switches and receptacles to denote Panel and Circuit they are fed from. Nameplates shall not be screwed or riveted.

- A typed directory shall be provided for all electrical panel boards, with all circuits labeled. Labels shall show District approved room names and numbers. Handwritten directories are not permitted.
- Require signage reading “Electrical panels inside” if any space contains an electrical panel.
- Outlets in corridors for floor maintenance shall be at least every 50 ft. of corridor with a minimum of one per corridor.
- A duplex receptacle shall be within 25 ft. of both interior and exterior mechanical equipment. Also at least one receptacle at every stairwell landing.
- No stand-alone floor receptacles are permitted in any space. Floor fed circuits that terminate in lab tables or other affixed furniture are acceptable. Where power is fed from a floor penetration, provide floor sleeve extending one inch above floor slab.
- Dedicated outlet and ventilation shall be provided for the kiln in the art area. Owner shall provide AE with cut sheet on proposed kiln for each project. Coordinate ventilation requirement with Program Management.
- Coordinate electric booster heater power requirements with kitchen consultant.
- Lab emergency shut off for receptacles, gas, and water shall be provided on wall adjacent to teacher’s workstation. Empty conduits for future branch circuits shall be stubbed out to a secure location normally above ceiling heights.
- Plenum rated equipment shall be required in designated ceiling plenum areas and these areas shall be clearly indicated on drawings.
- Service clearance for electrical equipment shall be shown on plan views drawn to scale.
- Load tabulation shall be shown on the drawing for each service and each feeder.
- Indicate SCR and A/C rating for all equipment.
- Where load tabulation includes an allowance for existing facilities drawing shall show how the allowance was determined.
- Where a new switch or circuit breaker is added to existing service equipment, drawings shall show its relationship to existing main devices.
- Where an existing service is being utilized or modified drawing show the existing arrangement.
- Ensure rated walls with electrical panels are sufficient to maintain rating.

GROUNDING

- Detailed grounding requirements shall be shown on project drawings.
- Ground main service by exothermic welding the grounding conductor to main cold water pipe, building steel, footing rebar, and at least three 3/4" diameter x 10' long ground rods driven 10' apart outside building in unpaved earth. The rods shall be loop interconnected with each other by a minimum No. 500 MCM AWG bare copper conductor thermal welded, using the proper style mold, to each rod below grade.
- Electrical Contractor shall provide designer of record with written documentation that service grounding system resistance measures no more than 5 ohms. Measurements shall be made

using The Fall of Potential Method. Supplemental grounding electrodes and / or soil supplements shall be installed as necessary to achieve the specified resistance.

- Service entrances shall be protected by ground rod.
- Metal water pipe shall be grounded to electrical service entrance.
- Grounding shall be permanent and electrically continuous, low impedance exothermic weld (cad-weld).

ELECTRICAL SERVICE AND DISTRIBUTION

- The design shall be to establish one electrical delivery point (metering point) for all facilities if possible. This excludes seasonal outdoor sport facilities.
- Service conductors from distribution transformers to service entrance or meter base shall be sized for a maximum of 3% voltage drop. Use the ampacity of the overcurrent protection device on the service disconnect equipment for calculations.
- A short circuit study shall be provided, including all interior and exterior lighting, service and feeder sizes and all circuits over 20 Amps. Voltage flicker analysis shall be performed on systems with motors greater than 40 hp to show that the voltage drop does not exceed 5%. Results/report shall be included in project closeout documents.
- Electrical design shall consider and provide adequate (standard of care) protection from the effects of harmonics and non-linear loads
- Provide dedicated neutrals for computer circuits and LED lighting.
- AE shall conduct a Breaker and fuse coordination study. Report shall be included in project closeout documents.
- Panels fed from a utility transformer shall be service rated. Panels fed from existing panel in a different building shall be service rated.

TVSS AND SURGE PROTECTION DEVICES (SPD)

- Transient voltage surge suppressors shall be provided at main switchboards, distribution panels and on major feeders and branch circuits serving personal computers and other electronics.
- TVSS and SPDs shall be mounted external to the Panel they serve in a separate enclosure and shall not be integrated into or manufactured by the Panel manufacturer.
- The specified equipment shall be designed, manufactured, tested, and installed in compliance with the following standards: U.L. 1449 current edition and IEC61643. It shall be labeled as an Electromagnetic Interference Filter.
- The qualified manufacturer shall have been engaged in the commercial design and manufacture of such products for a minimum of five years.
- Provide five years Limited Warranty from date of substantial completion for all TVSS.

SWITCHBOARDS

- The switchboard shall be designed, manufactured, tested, and installed in compliance with NEMA PB 2. Main section devices shall be individually mounted. Distribution section devices shall be group mounted. Auxiliary section devices shall be group mounted.

- Bus material shall be copper, standard size, fully rated and arranged for future extension. Bus shall be bolted or welded, accessible from front only for maintenance. Grounded and grounding bus shall extend the length of the switchboard.
- Fusible Switch Assemblies NEMA KS 1, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Designed to accommodate Class J fuses.
- Fusible Switch Assemblies, 800 Amperes and Larger: Bolted pressure or high-pressure contact switches. Fuse Clips: Designed to accommodate Class L fuses.
- Molded Case Circuit Breakers shall be NEMA AB 1 with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits, where applicable. Include shunt trip, under voltage release and phase loss where indicated.
- Current Limiting Molded Case Circuit Breakers: NEMA AB 1 molded case circuit breakers. Integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating in RMS amperes symmetrical let-through current, equal to or greater than the switchboard rating. Include shunt trip, and under voltage release and phase loss where indicated.
- Solid-State Molded Case Circuit Breakers: NEMA AB 1, with sensing, timing and tripping circuits for adjustable current settings. Ground fault trip, ground fault-sensing integral with circuit breaker. Adjustable short time trip. Stationary mounting. Include shunt trip, under voltage release, and phase loss where indicated.
- Mechanical type terminals shall be provided for all line and load terminators suitable for copper cable rated for 75 degrees C of the size indicated on drawings.
- Line and Load Terminations shall be accessible from the front of the switchboard.
- Ground Fault Sensor: Ground return type.
- Ground Fault Relay: Adjustable ground fault sensitivity from 200 to 1200 amperes, time delay adjustable from 0 to 1 second. Provide monitor panel with lamp to indicate relay operation, TEST and RESET control switches.
- All indicator lights shall be transformer – LED type.
- Ammeters and Voltmeters ANSI C39.1 direct reading, full range, with 4.5-inch square recessed case and 250-degree scale, white dial with black figures and pointer. Indicating ammeter, 5 amperes, 60-Hertz movement, and 1 percent accuracy. Indicating voltmeter, 120volt, 60-Hertz movement, and 1 percent accuracy. Coordinate with BAS provider and specify power metering and monitoring devices with digital output capability to transfer all data to BAS without special interface devices or translators. Provide digital meters for main service entrance and subpanels to allow sub metering of HVAC systems and lighting systems as a minimum.
- Meter transfer switches rotary multistage snap-action type with 600-volt AC-DC silver plated contacts, engraved escutcheon plate, pistol-grip handle. Ammeter four position including OFF. Voltage seven position including OFF.
- Microprocessor-based metering equipment shall be by switchboard manufacturers and have the functions of a Cutler-Hammer type Westinghouse IQ Data Plus II (Basis of Design). The MM&P shall be UL recognized, CSA certified and meet ANSI standard C37.90. Make provisions for an addressable communication card capable of transmitting all data, including trip data over a

compatible two-wire local area network to a central personal computer for storage and/or printout. The network shall also be capable of transmitting data in RS 232c format via a translator module.

- Metering transformers: Current transformers IEEE C57.13, 5 ampere secondary, bar or window type, with single secondary winding and secondary shorting device, primary/secondary ratio as required, burden and accuracy consistent with connected metering and relay devices, 60 Hertz. Potential Transformers IEEE C57.13, 120volt double secondary, disconnecting type with integral fuse mountings, primary/secondary ratio as required, burden and accuracy consistent with connected metering and relay devices, 60 Hertz. See control specification for current transformer assembly.
- A 4" high concrete housekeeping pad shall be installed for the main switchboard.

DISTRIBUTION AND BRANCH CIRCUIT PANELBOARDS

- Sizes of distribution panels and branch circuit panels shall be shown on drawings.
- Wires shall be labeled and organized in such a manner that maintenance can easily identify and access in panels.
- Wires shall not be spliced in panels and no wires shall be routed through panels to get to other panels.
- Minimum integrated short circuit rating as calculated.
- NEMA PB1 panel board with NEMA AB1 circuit breaker type.
- Buses and ground shall be copper.
- Neutral bus for panel boards being served by nonlinear load (k-factor) transformer shall be rated at 200 percent of the phase bus current.
- Cabinet shall be surface mount type only in electrical/mechanical/storage rooms, fastened with hinged door with flush lock, finished in standard gray enamel.

FUSES

- Spare fuse cabinet shall be wall-mounted sheet metal with shelves, suitable sized to store spare fuses and fuse pullers specified. Finish ANSI gray. One additional set of fuses shall be included as spare at the acceptance, by Owner, of the electrical system.

TRANSFORMERS

- Winding taps for transformers less than 15 KVA shall have six (6) 5 percent taps; two (2) above and four (4) below rated voltage, full capacity taps on primary winding. Transformers 15 KVA and larger shall also meet NEMA ST 20.
- Transformer shall be suitable for floor mounting if larger than 15 KVA and floor and/or wall for 15 KVA and below. Transformer shall be rated for 80-degree C rise above 40-degree C. Efficiencies shall meet or exceed NEMA TP-1 Class 1 efficiency.
- Provide K rated transformers for computer and electronic equipment circuits. Non-Linear Load Isolation transformers shall be used only for dedicated computer loads. Minimum of K-4.
- Housekeeping pads shall be a minimum of 6" high.
- Interior transformers shall be mounted a minimum of 6 inches from wall and secured to housekeeping pad. Provide manufacturer's recommended service clearance on accessible side of transformer.

EMERGENCY GENERATOR HOOK-UP FOR SCHOOLS WITHOUT GENERATORS

- The smallest possible generator shall be used for emergency lighting
- A kirk key interlock system with an 800 amp back fed breaker and a portable generator connection box shall be installed for a portable generator.

PACKAGE ENGINE GENERATORS

- Whole building generators shall not be provided unless required by the Project Specific OPR.

ENCLOSED TRANSFER SWITCHES

- Switches shall be provided with the generator package. Substitutions are not permitted.
- If unit is floor mounted install a 4" high concrete housekeeping pad.
- Components:
  - Mount indicating lights in cover of enclosure to indicate NORMAL SOURCE AVAILABLE, ALTERNATE SOURCE AVAILABLE, and SWITCH POSITION.
  - Mount test switch in cover of enclosure to simulate failure of normal source.
  - Mount return to normal switch in cover of enclosure to initiate manual transfer from alternate source to normal source.
  - Transfer switch shall contain 2 each normally open and normally closed auxiliary contacts.
- Monitor each line of both Normal and Alternate source voltage and frequency. Initiate transfer (alternate inhibit transfer) when normal voltage (alternate voltage) drops below 85 percent or frequency varies more than 3 percent from rated nominal value.
- Neutral switching shall be simultaneous.
- Automatic Sequence of Operation:
  - Upon initiation by normal source monitor initiate time delay (0 to 60 seconds adjustable) to start alternate source engine generator.
  - Initiate transfer load to alternate source (0 to 10 seconds, adjustable) with permission of alternate source monitor.
  - Transfer back to normal source with permission by normal source monitor (0 to 30 seconds, adjustable). Bypass if alternate source failure.
  - Time delay before engine shuts down (0 to 60 minutes, adjustable) of unloaded operation.
  - Engine Exerciser shall start engine every 7 days. The engine shall run for 30 minutes before shutting down. Bypass exerciser control if normal source fails during exercising period. Transfer load to alternate source during engine exercising period.

LIGHTING

- Lighting systems shall be specified with a BACnet interface with Energy Management System specified in Division 25 (BAS).
- Lighting systems shall be controlled by the BAS. Parking and exterior building lighting shall be on separate controls. Owner shall provide lighting schedules.
- General Lighting systems using CAT 5 Power are NOT allowed.

- Lenses shall be .125” or 1/8” in thickness.
- Wall switch products shall be capable of withstanding current surge.
- Generally, spaces shall be lighted with 2 x 4 lay-in 120/277v LED fixtures. See Appendix A for approved LED Basis of Design Manufacturers.
- LED light fixtures shall have been available commercially for a minimum of three years.
- Where rebates are provided by SCE&G, such as their Energy Wise Program, light fixtures, ballasts, lamps and controls shall be specified to maximize the number of rebates available.
- Lighting design shall minimize the number of fixture types
- Custom built light fixtures or one of kind shall not be allowed.
- Areas such as atriums, coves and other difficult to access areas shall use LED lights. Light locations shall not require the use of scaffold or a lift to replace bulbs.
- All lighting systems shall be easily accessible for maintenance and service.
- All classroom lighting shall have dimmable fixtures and dimmers. Row of lights above/adjacent to Flat Screen Electronic Devices or flat screen panels shall be on separate dimmer from other classroom lighting.
- All classrooms and conference rooms shall have line voltage occupancy sensors and shall have duel level switching installed.
- Gymnasiums and other multi-purpose rooms shall be lighted with LED fixtures and shall have safety chain to actual fixture and be controlled by remote dimmers lockable control panel. Gym lighting shall have two zones. One zone shall control fixtures over the playing area and one zone shall control fixtures around the perimeter.
- Elementary and Middle School Cafetorium stage lighting shall be simple LED track type systems. Theatrical lighting shall be LED type and be designed on a per school basis.
- Security and site lighting shall be controlled by and integrated into BAS via BACnet. Security lighting shall be defined as the wall packs on the perimeter of the school and selected parking lot and roadway lights to illuminate access points at the schools.
- All other site lighting including walkway, sign and non-security parking lot lighting shall be LED type and controlled by BAS via BACnet.
- Exterior lighting in stairways and sidewalks shall be flush mounted and easy to access for maintenance. Recessed lighting in concrete is not permitted.
- Exterior lighting for walkway and parking areas shall be LED type using cutoff reflectors and lens to reduce light pollution. Exterior lighting shall be controlled by BAS via BACnet – No photocell lighting.
- Canopy lighting conduit and lights shall be run below the roof deck and secured to the structure and not screwed through the roof.
- Emergency lighting shall be provided by dedicated recess and surface mounted LED fixtures. These shall be installed in all exit corridors, places of assembly, single restrooms in elementary school classrooms and all other areas required by the building code or OSF. They shall be powered by a diesel generator.

- Lighting for corridors, common areas, group toilets and all other areas not controlled by vacancy sensors shall be controlled by the BMS.
- An override button shall be located in each electrical room and in the main administration area shall allow after hours and weekend movement when automatic lighting controls are in override mode. The override in the main administration area shall allow for lighting to be turned on in several areas of the building simultaneously.
- Football, soccer, softball and baseball fields lighting shall be provided by MUSCO or owner approved equal and stadium lighting shall be positioned so that it is accessible for maintenance.
- Modular wiring is not permitted.
- The light fixtures in the individual spaces shall not be used as a junction box.
- Athletic playing field shall be lit by LED lighting with a 25-year parts and labor warranty.

OCCUPANCY SENSORS

- Occupancy sensors shall be specified for space lighting control.
- Line voltage occupancy sensors in the ceiling shall control lighting in classrooms and conference rooms.
- Restrooms shall not use ultrasonic occupancy sensors.
- The Media Center reading room shall use ceiling mounted ultrasonic occupancy sensors – each sensor shall cover no more than a 30 ft. x 30 ft. area with a 20% overlap of sensor coverage.

DIVISION 27 – COMMUNICATIONS

GENERAL REQUIREMENTS

- Information Technology Design Specifications are published on the CCSD Internet Site at: https://www.ccsdschools.com/cms/lib/SC50000504/Centricity/domain/115/contractsprocurement/technicalspecifications/TechDesignSpecs2012.pdf. Refer to the specifications for all details including but not limited to conduit, cable tray, cabling, grounding and bonding
- Facility Security Specifications are published on the CCSD Internet Site at: https://www.ccsdschools.com/cms/lib/SC50000504/Centricity/domain/115/contractsprocurement/technicalspecifications/FacilitySecuritySpecs2010.pdf

COMMUNICATIONS DRAWINGS

- The AEC team shall provide a set of communications documents for the project that will be used by CCSD's Communications cable contractor in addition to the electrical construction documents used during construction based on the International recognized ANSI/TIA 606 Administration Standard for Telecommunications Infrastructure as follows.
- The following drawings should be included as applicable:

T0 - Campus or Site Plans

- Physical and logical connections from the perspective of an entire campus, such as actual building locations, exterior pathways and inter-building backbone cabling pathways on plan view drawings and major system nodes and related connections on the logical system drawings.
- T01 - Overall Site Plan
- T02 - Site Riser Diagram with all site communication conduit quantity and size, cable pull points, telecom spaces identified

T1 - Layout of Complete Building Per Floor

- Layout of complete building per floor. The drawing indicates the location of serving zones, communication equipment rooms, access points, pathways and other systems that need to be viewed from the complete BUILDING perspective.

T2 - Serving Zones / Building Section Drawings

- The building is divided up by its serving zones. Drawing indicates drop locations, communication equipment rooms, access points and detail callouts for communication equipment rooms and other congested areas.

T3 - Telecommunication Rooms - Plan Views

- Detailed look at the communication equipment room. Drawing indicates technology layout (equipment racks, ladder rack, etc.), mechanical/electrical layout, rack elevation and backboard elevation. May also be an enlargement of a congested area of T1 or T2.

T4 - Typical Detail Drawings

- Installation procedures, detail racking, and Detailed drawings of symbols and typical such as faceplate labeling, faceplate types, raceways.

T5 - Misc. Drawings

- T5.1 - Schedules

- TS-1 - Specifications on Drawings
- T-Cover - Drawing set cover page listing all drawings in set

CAD LAYERS

- Communications devices and systems shall be on separate and distinct color-coded layers.
- Suggested layering as follows:
  - COMM - CLASSROOM AUDIO/VISUAL TECHNOLOGY
  - COMM - DATA
  - COMM - WALL PHONES
  - COMM - CABLE TRAY
  - COMM - INTRA BUILDING CONDUIT AND SLEEVES
  - COMM - INTER BUILDING CONDUIT AND SPACES
  - COMM - SURVEILLANCE CAMERAS - INTERIOR
  - COMM - SURVEILLANCE CAMERAS - EXTERIOR
  - COMM - KRONOS CLOCK
  - COMM - DIGITAL SIGNAGE - INTERIOR
  - COMM - DIGITAL SIGNAGE - EXTERIOR
  - COMM - GROUNDING AND BONDING
  - COMM - TELECOM ROOM EQUIPMENT
  - COMM - PUBLIC ADDRESS SYSTEM - INTERIOR
  - COMM - PUBLIC ADDRESS SYSTEM - EXTERIOR
  - COMM - WIFI ACCESS POINT - INTERIOR
  - COMM - WIFI ACCESS POINT - EXTERIOR
  - COMM - BACKBOARDS
  - COMM - CARD ACCESS
- Power receptacles shall be included on T2 serving zone drawings in addition to communication devices for better coordination in the field.

GENERAL TELECOM SPACE REQUIREMENTS

- Each school shall have only one Main Telecommunications Room (MTR).
- The MTR serves as the primary location for critical electronic equipment required for school operations and the main termination and cross-connection point of backbone cabling to other buildings and/or other communications spaces in the same building.
- Most schools will require one or more Telecommunications Rooms (TR) in addition to the MTR. A TR is a secondary location for sensitive electronic equipment and termination and cross-connection point for cabling.

- TRs shall not be used as a passageway to other rooms of any type, for power transformers, custodial equipment, or any other function that would require access for reasons other than service and maintenance of the communication equipment and cabling they house.
- Must be rectangular with no obstructions or protrusions (beams, columns, etc.) that decrease the usable area.
- Minimum clear ceiling height shall be 10'.
- Shall not have suspended, false, lay-in, or hard lid ceiling.
- Shall not have windows.
- Shall have walls that extend to the structure above.
- Water, sewer, chemical, or drain piping of any kind shall not be routed through or within the walls of the room. Measures must be taken to prevent water intrusion and shall be located away from all sources of liquid/ water carrying pipes.
- Lighting shall be a minimum of 50 foot-candles measured 3’ AFF and controlled by a motion detection switch located inside the room near the entrance door. Light fixtures shall be installed 8.5’ AFF.
- The floor shall be sealed. Acceptable floor finish shall be a colored concrete sealant applied prior to installation of equipment in the rooms.
- Shall have a dedicated HVAC system independent of other building HVAC systems located outside of the room, typically on the roof with ducted supply and ducted return.
- Designed for cooling 24 hours per day, 365 days per year.
- Shall have its own thermostat with room temperature maintained in the range of 68° F to 78° F.
- Room finishes shall be light in color to enhance room lighting.
- Plywood backboards in rooms, shall be 4 ft. X 8 ft. x 3/4 in. thick, A-C Grade certified / stamped as fire retardant and painted with two coats of white fire-retardant paint. Fire retardant stamps shall be visible after painting. Backboards shall be mounted securely to walls with 8’ length vertical. Bottom of sheet shall be at top of convenience power receptacles.
- Accessible only from interior public corridors and not through offices, other utility spaces or exterior doors and shall not be shared with electrical, mechanical, janitorial, storage, or any other type of room.
- When fire code requires wet pipe sprinkler systems piping and sprinkler heads shall be located away from the location of communication equipment racks. Sprinkler heads shall be caged to prevent accidental operation.
- Doors shall be 3 ft. 0 in. wide X 7 ft. 0 in. high solid door with a continuous hinge and provided with a dust sweep.
- Door frame shall be prepared on the hinge side for an electronic power transfer cut out at 42” AFF. per detail drawings provided by CCSD. A card reader will be integrated into the door latch. A separate box for a card reader in the wall will not be required.
- CCSD IT lock core shall be installed prior to network equipment installation

Location

- Located so that cable tray and conduit installed to support horizontal cable runs, including any elevation changes, shall not exceed 250'.
- Drawings shall indicate serving zone lines for the MTR and each TR delineating where conduit / cable tray should be installed to prevent cables from exceeding 250' horizontal distance limitations.
- The MTR should be located as close as practicable to main electrical room and elevator equipment room where fire alarm, intrusion detection and elevator equipment controls are located to facilitate installation of emergency phone lines and grounding and bonding,
- As close as practical to the center of the area/zone served.
- Locations that limit expansion such as structural steel, stairwells, and elevator shafts, outside walls or other fixed building walls should be avoided.
- Location and size of the MTR and each TR shall be assessed and approved based on accurate scaled drawings in the SD phase of the project by the CCSD IT Project Manager.
- In multi-story schools a minimum of one TR shall be provided per floor. Additional TR's per floor shall be provided if the maximum cable distance will exceed 250' on any floor as measured from the MTR/TR cable zone as measured to the furthest corner of the building following proposed cable tray and conduit pathways including elevation changes.
- TRs shall be vertically aligned in multi-story buildings whenever possible.
- Shall not service comm outlets on multiple floors.
- Emergency lighting and signs shall be properly placed per AHJ such that an absence of primary lighting will not hamper emergency exit from the MTR/TR.TR/TRs.

Telecom Room Signage

- Line 1 - MTR, TR02, TR03, TR04, etc.
- Line 2 - (Room #)
- Line 3 - Sensitive Electronic Equipment
- Line 4 - No storage Allowed

MTR Specific Requirements

- Size - 12' x 16' minimum
- Plywood backboards - cover 3 walls (do not cover wall with door) at 12" to 108" AFF.
- Corridor wall sleeves - six (6), 4" Hilti or EZ Pathway 4", or equal installed two-inches (2") above the cable tray in the corridor.
- Cable tray - same height as cable tray in adjacent corridor from location of corridor wall sleeves around the room to six inches (6") from the furthest point of the 16' wall where a waterfall device shall be provided at the end of the cable tray.

TR Specific Requirements

- Size - 6' x 9' (minimum)
- Plywood backboards - cover 3 walls (do not cover wall with door) at 12" AFF to 108" AFF.

MTR Power Requirements

- One duplex 120V/20A receptacle 6” AFF on each wall for convenience outlets.
- One quad 120V/20 receptacle on a separate dedicated branch circuit 48” AFF on the right side of a 4’ x 8’ backboard designated for use by the service provider.
- Two 208V/30A-L6/30R twist-lock receptacles on separate dedicated branch circuits at 18” AFF each on dedicated breakers secured to the rear of the equipment racks.
- Four quad 120V/20A receptacles at 18” AFF each on separate dedicated branch circuits secured to the rear of the equipment racks.
- The exact location of the equipment racks and equipment power receptacles shall be coordinated during installation with CCSD IT.
- One 208V/20A - L6/30R twist-lock receptacle on a separate dedicated branch circuit on a side wall at 48” AFF for emergency cooling unit power

TR Power Requirements

- One duplex 120V/20A receptacle 6” AFF at the center of 3 walls for convenience outlets
- One 120V/20A quad receptacle on a separate dedicated branch circuit, secured to the rear of the equipment rack, 18” AFF.
- Equipment racks will be provided and installed by CCSD. Exact location of the equipment rack and power receptacle shall be coordinated with CCSD IT.
- One 208V/20A - L6/30R twist-lock receptacle on a separate dedicated branch circuit on a side wall at 48” AFF for emergency cooling unit power

BDA and CCSD SECURITY RADIO TELECOM ROOMS

- All new schools will require the installation of a wall mounted security radio repeater in one top floor TR. Most new schools will require a first responder BDA distributed antenna system.
- Both systems require wall mounting space, power, and ground bonding in a top floor TR. The TR that will be nearest the roof penetrations for the systems antennas TR shall be increased in size to accommodate both systems and shall provide 3’ of working clearance around the equipment rack, riser cable wall field, and the both radio systems equipment.
- The security radio repeater shall be approximately 24” x 24” with 3’ of clear space in front of the 8” deep cabinet. The BDA shall be approximately 48” x 96” with 3’ of clear working space in front of the wall mounted cabinets that shall be approximately 12” deep.

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

- In addition to the normal electrical ground system, a Telecommunications Main Ground Busbar (TMGB) and a Telecommunications Ground Busbar (TGB) system are required per ANSI/TIA-607.

Telecom Main Grounding Busbar

- A Telecom Main Grounding Busbar (TMGB) (.25” thick x 4” wide x 12” long) with TIA hole spacing and pattern shall be provided, and wall mounted by the electrical contractor near the location of the service entrance conduits 48” AFF in the MTR.

- Approved TMGB Manufacturers: Panduit, Herger, Chatsworth Products, Erica, or CCSD IT approved equal.
- Equipment racks, ladder rack, cable tray, conduits, and outside plant cables with metallic components shall be bonded to the TMGB with a minimum #6 AWG green insulated copper wire.
- All connections to the TMGB shall be made with correctly sized irreversible two-hole compression lugs with two bolts per lug. No exceptions. Screw type electrical ground lugs typically used in electrical panels are not acceptable.
- A telecom bonding conductor (TBC) shall bond the TMGB to the nearest power panel ground busbar and building steel with a minimum #6 AWG green insulated copper wire. The TBC size should be increased based on NEC and TIA standards depending on distance from the MTR/TMGB.
- A Telecom Grounding Busbar (TGB) (.25 thick x 2" wide x 12" long) with TIA hole spacing and pattern shall be wall mounted in each TR by the electrical contractor behind the location of the equipment rack at 48" AFF in each TR.
- Approved TGB Manufactures: Panduit, Herger, Chatsworth Products, Erica, or CCSD IT approved equal.
- All connections to the TGB shall be made with correctly sized irreversible two-hole compression lugs with two bolts per lug. No exceptions. Screw type electrical ground lugs typically used in electrical panels are not acceptable.
- A telecom bonding conductor (TBC) shall bond the TGB to the nearest power panel ground busbar and building steel with a minimum #6 AWG green insulated copper wire. The TBC size should be increased based on NEC and TIA standards depending on distance from the TR/TGB.

Labeling

- All ground attachments shall be properly tagged and labeled in accordance with ANSI/TIA-606.

Testing

- Test per ANSI/TIA-607 with an Earth Ground Resistance Tester used in the Two Point Test Method.

CONDUIT AND BACKBOXES FOR COMMUNICATION SYSTEMS

Communications Conduit

- Shall be Installed in the most direct and accessible route possible (parallel to building lines and located in and above accessible hallways).
- Reamed at both ends and have a plastic bushing installed on each end to prevent damage during cable installation.
- Contain no more than two 90-degree sweeps in any dimensional plane or exceed 100-feet in length between pulling points or interior pull boxes.
- A pull box shall not be used in place of a conduit sweep.
- Pull boxes shall be installed in easily accessible locations or at heights greater than 12' AFF and shall be accessible during working and non-working hours.
- A pull string shall be installed in all conduits with a minimum test rating of 200 lb. prior to CCSDs cable contractor's mobilization to begin work.

- Not be installed through areas in which flammable materials may be stored or over and adjacent to boilers, incinerators, hot water lines or steam lines.
- All conduits shall be bonded and grounded in accordance with the NEC (National Electrical Code) and ANSI/TIA-607.
- Electrical Metallic Tubing (EMT) fittings used for communications shall be insulated throat compression type fittings.
- Rigid Metallic Conduit (RMC) fittings used for communications shall be insulated throat type fittings.
- Flexible Metallic Conduit (FMC) for communications shall not exceed 25' in length and shall be supported off ceiling tiles and away from other trades by dedicated support wires.
- Shall be installed no less than 6" above suspended ceiling grid and no higher than 2" below a roof deck.
- All wall mounted communications outlets shall be located within 3' of a power receptacle. Exceptions are wall phones and time attendance clocks that receive power from the data cable.
- There shall not be more than one communication outlet box per 1" conduit unless pre-approved by CCSD IT. An exception is a wall mounted wireless access point at 96" with a comm outlet below it at 18".
- Telecom outlets shall not be daisy-chained without increasing the conduit size proportionally to accommodate additional cables and potential future growth without prior approval and design by CCSD IT.
- Bends in the conduit shall not contain any kinks or other discontinuities that may have a detrimental effect on the cable during pulling operations.
- All conduits shall have pull strings & insulating bushings installed. Failure to install bushing or pull stings will delay cable installation and the project. Cable will not be installed in any conduits that are not provided with pull string and bushings at both ends of the conduit.
- Conduit and comm outlet boxes in large open areas with ceilings greater than 12'AFF shall be installed below grade to the nearest cable tray and not routed overhead.
- All junction boxes and device mounting boxes shall have box covers provided and installed when the box is installed by the electrical contractor and shall remain covered throughout the project or the telecom outlet faceplates are installed.

Standard Voice/Data Communications Outlet

- 1" conduit to within 6" of cable tray in the corridor extended to a 4" square x 2-1/8" device box with a single-gang mud ring at 18" AFF unless noted otherwise on drawings.
- All interior and exterior single gang boxes and single gang mud rings used for communications shall be installed with the 4" dimension of the box / ring vertical and shall be installed flush with the wall surface.

Standard Classroom Configuration

- A typical classroom detail drawing will be provided by CCSD Information Technology

Gypsum Instructional Walls

- At the location designated for installation of an interactive display at 60” AFF provide an Arlington Industries (TVBS-810) 8” x 10” recessed steel TV outlet box with one 120V/20A duplex electrical receptacle on a separate dedicated branch circuit and one single-gang device box secured to the top of the TVBS-810 for a data outlet.
- Provide a 1” conduit to the cable tray in the nearest corridor from the single gang device box. This assembly shall be indicated on the floor plans as (Audio / Visual box 2) AV2.

Masonry Instructional Walls

- At the location designated for installation of an interactive display at 60” AFF, one 3-gang device box (Raco 263 or Equal), one recessed, clock type, 120V/20A duplex receptacle at 60” AFF on a separate dedicated branch circuit and one single-gang communication outlet at 60” AFF with a 1” conduit to the cable tray in the nearest corridor. This shall be indicated on the floor plans as AV2 (Audio / Visual box 2). ***At the time of this edit, FSR, Inc. is planning to have a box ready by mid-summer that will be the size of a single masonry block designed specifically for use behind wall mounted displays in masonry walls that can be used to support A/V, power and data.***

Masonry and Gypsum Instructional Walls

- On the side of the interactive display opposite the classroom entrance door at 18” AFF provide the following:
- Install one 4” square x 2 1/8” device box with a double-gang mud ring and blank cover no more than 48” from the side of the interactive display furthest from the classroom entrance door. This box shall be indicated on the floor plans as AV1 (Audio / Visual 1) Note: Interactive display’s dimensions vary as technology evolves. Contact CCSD IT Project Manager for display dimensions prior to rough in of device boxes.
- As close as possible to AV1 install one 120V/20A quad power receptacle on a separate dedicated branch circuit 18” AFF.
- As close as possible to the power receptacle install one 4" square x 2 ⅛” device box with a single-gang mud ring and blank cover at 18” AFF for data with a 1” conduit in the wall up to a 2nd 4" square x 2-⅛ “ device box with a single-gang mud ring and blank cover at 96” AFF for a wall mounted WIFI access point and 1” conduit extended directly to the cable tray in corridor.
- Adjacent to the data outlet box install a 2nd 120V/20A quad power receptacle on a separate dedicated branch circuit 18” AFF adjacent to the data outlet. The maximum horizontal distance from display should not be greater than 56”
- Install One 1.25” conduit concealed in the instructional wall between m AV2 to the AV1.
- One 3/4” conduit to within 18” of the location of a PA speaker backbox in the ceiling near the center of the room from the cable tray. Extend 18” of 3/4” Flexible Metal Conduit to the speaker back box that will be provided to the electrical contractor by the PA speaker contractor for installation.
- One 3/4” EMT conduit concealed in wall cavity from AV1 to 36” above the ceiling at the location indicated on the drawings for a sound enhancement speaker junction box above suspended ceiling near center of classroom and 3’ of Flexible Metallic Conduit(FMC) for attachment to the speaker enclosure to be provide and installed by the Sound System contractor.
- Four standard data outlet boxes, four (4) per room is a 4" square x 2 ⅛” electrical box with a single- gang mud ring and blank cover plate at 18” AFF unless otherwise noted.

- One single gang device box for a wall phone at 48” AFF with a 1” conduit to the nearest cable tray. A minimum of 18” clearance shall be maintained around the box and will be required for mounting the wall phone, Cabinets and/or cabinet doors should be located well away from wall mounted phones to meet clearance requirements.

Science Classrooms /Laboratories

- All infrastructure as specified for a typical classroom plus the following additional infrastructure to support a 2nd display as follows:
- A 1.25” conduit from the AV2 device box to 4” square x 2 ⅛” device box 80” AFF to be indicated on floor plans as AV3.
- One 120V/20A duplex receptacle on a separate dedicated branch circuit 80” AFF within 6” to the side AV3 at 80” AFF.
- Location of the 2nd display shall be approved by CCSD IT Project Manager and the Architect prior to design and installation

Computer Classrooms / Laboratories

- All infrastructure as specified for a typical classroom plus the following:
- 1.25” Electrical Metallic Tubing (EMT) from the nearest cable tray to multiple 4”square x 2 ⅛” device boxes with single-gang mud rings for data connections at 18” AFF located at the end of rows of tables that will have up to six computer workstations.
- Two quad 120V/20A power receptacles on separate dedicated branch circuits at the end of each row of tables within 6” on each side of the data device box. Power may also be hardwired to furniture based on type of furniture selected

ANCILLARY LOCATIONS

WALL MOUNTED TELEPHONES

- One 3/4” conduit from the nearest cable tray to a single gang electrical box at 48” AFF. Provide a minimum of 18” clearance around the box.
- Wall phones do not require an adjacent power receptacle.

KRONOS TIME/ATTENDANCE CLOCKS

- One 3/4” conduit from the nearest cable tray to a single gang electrical box and a single-gang device mounting bracket at 48” AFF. Provide a minimum of 12” clearance around the device mounting bracket.
- Kronos Time/ Attendance clocks do not require an adjacent power receptacle.

PUBLIC ADDRESS SYSTEM SPEAKERS

- The PA system contractor will provide PA speaker back boxes to the electrical contractor for installation.
- PA speaker cabling will be installed by CCSD’s low voltage cable contractor.
- PA speakers, tile bridges, speaker grilles and ceiling tile assemblies will be installed by the PA system contractor.
- The GC will provide ceiling tiles to the PA system contractor for mass production of speaker/bridge, tile/grille assemblies.

Exterior Wall Mounted PA Speakers

- One 3/4" conduit to a recessed flush mount 91/2" x 9 9/16" x 6" deep speaker back box installed flush with exterior wall surface 9' to 12' AFG.

Interior Wall Mounted PA Speakers

- One 3/4" conduit from the nearest cable tray to flush mounted single gang device box at 9' to 12' AFF.

Ceiling Mounted PA Speaker - Corridors with Acoustical Tile Ceiling (Less Than 12' Off)

- One 3/4" Flexible metal conduit (FMC) to a speaker back box.

Ceiling Mounted PA Speaker - Gypsum Board Ceilings (Less Than 12' Off)

- One 3/4" Flexible metal conduit (FMC) to a speaker back box.

Ceiling Mounted PA Speaker - (Less Than 12' Off) beyond corridors

- One 3/4" Electrical Metallic Tubing (EMT) conduit to 18" above the ceiling grid location of the PA speaker and attachment to a backbox with 3/4" Flexible Metal Conduit (FMC).

Conference Rooms

- One 3/4" conduit from the nearest cable tray to 18" above the location of the PA speaker in the ceiling grid in the center of the room and extend 3/4" Flexible Metal Conduit (FMC) to a speaker back box near the center of the room. Additionally, extend a 2nd 3/4" EMT conduit to a single-gang electrical box at 48" AFF for a speaker volume control from the speaker back box.

Cafeterias, Multipurpose Rooms, Gymnasiums, and Other Rooms - Ceilings > 12' AFF

- One 3/4" conduit to a 9-1/2" x 9-9/16" x 6" deep speaker back box installed flush with the wall surface at 9' - 12' AFF. All conduit except for corridor walls where the cable tray is located should route down and in the slab across the floor to the cable tray and not overhead.
- In rooms that will require more than one speaker the boxes shall be daisy-chained together with conduit and a single conduit extended to the corridor connecting a maximum of 10 speakers in a single zone.

PA Call Buttons

- Provide a ¾" conduit from the PA speaker back box in the room to a single gang device box at 48" AFF in the following rooms as indicated:
- Classrooms - next to corridor door
- Nurse's Clinic - next to corridor door
- Kitchen - next to the door leading to the serving area
- Auditorium - near the stage
- Multipurpose Room - next to corridor door
- Media Center - at/near circulation desk
- Principals' Conference Room - next to corridor door
- Teacher Workrooms - next to corridor door
- Enclosed small group/student spaces - next to hallway door

PA Volume Controls

- Provide a ¾" conduit from the PA speaker back box in the room to a single gang device box at 48" AFF in the following rooms as indicated on the drawings:
- Conference rooms
- Nurse's Clinic
- PA speaker volume controls shall not be provided in any other offices or areas. The Call Button and Volume control can share the same box and conduit.

SURVEILLANCE CAMERAS

Corridors - ceilings < 12' AFF

- One 3/4" Flexible Metallic Conduit (FMC) up to 25' in length to a 4" square x 2 ⅛ device box with a double-gang device ring flush with the ceiling supported with a "T-Bar type" tile bridge.

Interior Ceiling Mounted - Ceiling < 12' AFF

- One 3/4" conduit transitioned to Flexible Metallic Conduit up to 25' in length with a 4"-square x 2 ⅛ device box and double-gang device ring, flush with the ceiling, supported with a "T-Bar type" tile bridge.

Interior Wall Mounted - Ceiling > 12' AFF

- One 3/4" conduit from the nearest cable tray to a single-gang box, flush with the wall surface, mounted 9' to 12' AFF, with the 4" box dimension vertical.

Exterior Wall Mounted

- One 3/4" conduit from the nearest cable tray to a weatherproof single-gang box with the 4" box dimension vertical and flush with the exterior wall surface.

Surface Mounted External Locations (Canopies, parapet walls, etc.)

- One 3/4" conduit from the nearest cable tray EMT conduit transitioned to 3/4" PVC conduit at exterior wall to 4" square, deep, weatherproof, PVC with external screw mounting tabs.
- If camera locations will be daisy-chained conduit size shall be increased proportionally per NEC to accommodate the additional data cables.

Pole Mounted Cameras or Other Camera Locations Greater Than 250' From A TR/MTR

- One 2" Schedule 40 PVC conduit, 24", minimum, below finished grade in open landscape areas or below sidewalks and 36", minimum, below paved roads or parking lots to a centrally located 24" wide x 36" long x 36" deep maintenance hole.
- From the maintenance hole install 1.25" PVC conduit to each pole base. Above the pole base inside the pole transition conduit to 1.25" liquid tight flexible coated metal conduit to a 1.25" weatherhead 9' - 12' above finished grade.

DIGITAL SIGNS

Interior Wall Mounted

- One 120V/20A duplex receptacle on a separate dedicated branch circuit at 80" AFF.
- One single gang device box within 6" of the side of the power receptacle at 80" AFF and a 3/4" conduit to the nearest cable tray.

Site Marquee Signs

- One 2” schedule 40 PVC conduit 24” minimum below finished grade from the nearest telecom room to a weathertight 16” x 16” x 6” deep NEMA box with a hinged lockable cover secured in an accessible location to the sign structure
- From the 16” box install one 1” Liquid tight, PVC coated, flexible metallic conduit with insulating bushings into the interior portion of the sign structure to provide a sealed weatherproof pathway for data patch cords.
- Provide one 120/20A duplex receptacle on a separate dedicated branch circuit inside the NEMA box.

ACCESS CONTROL

- Hardwired 120V/20A power on a separate dedicated branch circuit and a 1” EMT conduit to the cable tray from the wall mounted location of the card access system power supply in TR locations. Locations in TRs to for power supplies to be provided by CCSD. Power Supply to be provided and installed by the card access contractor.
- Each door with card access will require a 4" square x 2 ⅛” junction box installed above accessible ceiling no more than 12’ AFF close to the door with a 1” conduit to the nearest cable tray for a door controller.
- From the controller junction box install 3/4” EMT to a single gang box at 48” on the RIGHT-SIDE of the door for a card reader.
- TRs and some other interior doors will have a card reader integrated into the door and will not require a separate conduit and box at 48” for a card reader. These doors should be determined early in the design and the door type assigned to assure conduit is correct.
- For doors with electronic push to exit bars and integrated card readers install a 3/4” conduit from the controller junction box above the door into the hinge side of the door frame to the location of the electronic power transfer device in the door frame at 42” AFF.
- For doors with electric strikes the 3/4” conduit from the controller to 42” AFF will need to be installed in the strike side of the door frame.

WIRELESS ACCESS POINTS

Ceiling Mounted in Corridors < Ceiling 12’ Off

- One-inch Flexible Metal Conduit (FMC) to a 4” square x 2-1/8” device box with a single-gang device ring and “T-Bar type” tile bridge centered in the tile. Exact locations of wireless access points will be provided by CCSD.

Ceiling Mounted Other Areas < Ceiling 12’ AFF

- One-inch conduit to a 4” square x 2-1/8” device box with a single-gang mud ring and tile bridge. Exact locations of wireless access points will be provided by CCSD.

Interior Wall Mounted (Ceiling > 12’)

- One -inch conduit to a 4” square x 2-1/8” device box flush mounted with wall surface and a single-gang mud ring, 9’ to 12’ AFF.

Exterior Wall Mounted

- One-inch conduit to a single-gang weatherproof electrical box flush with wall surface, 9’ to 12’ AFF.

Site Pole Mounted

- Two-inch PVC conduit buried 24” minimum below finished grade in open landscape areas and sidewalks and 36” minimum below paved roads or parking lots to a 36” x 24” x 36” hand hole located centrally to serve multiple poles.
- From the hand install 1.25” PVC conduit below grade at the same depth as the 2” conduit to each pole base. Turn the conduit up to 6” above the pole base and interior of the hollow poles.
- Transition the 1.25” conduit to PVC coated flexible metallic conduit to a weatherhead mounted in the side of the pole 9’ - 12’ above finished grade.
- Other pole types may require 2” Rigid Steel Conduit (RSC) to a 2” weatherhead at 9’ - 12’ above finished grade on the exterior of the pole.

SCHOOL SECURITY RADIOS

- A detail drawing of a Dual Antenna Roof Mast will be provided by CCSD Information Technology.
- Location shall be indicated on floor plans for two 2” Rigid Steel Conduits (RSC) with weatherheads through roof, bonded to the building steel and extended to the nearest cable tray close to the TR on the top story nearest to the reception area on the ground floor.
- One 1” conduit from the nearest cable tray to a 4” square x 2-1/8” device box with a single-gang mud ring, 6” above the counter. Exact location at reception desk. Location to be approved by CCSD IT.

VERTICAL / RISER FLOOR SLEEVES

- Core bore to install four 4” rigid steel conduits between vertically aligned TRs.
- Sleeves shall be in the left corner of the room 2” from each wall with 2” separation between each hole.
- The four 4” rigid steel conduit sleeves shall be supported with open channel strut and strut clamps secured to the floor.
- Sleeves shall extend 4” AFF with insulating bushings at each end and be bonded to the TGB in the MTR/TR.
- All conduits or sleeves over three feet in length shall be bonded to telecommunications ground with grounded (bond) insulating bushing.

CABLE TRAY FOR COMMUNICATION SYSTEMS

- Shall be installed no higher than 12’ AFF.
- Shall be steel wire basket suitable for hallways and above acoustical tile ceiling areas.
- Cable tray’s carrying capacity shall accommodate horizontal cable and riser cables.
- Shall be a minimum of 6” wide and 4” deep.
- The use of carbon steel, electro zinc plated wire basket tray is preferred.
- Refer to manufacture fill charts for correct sizing.

- Shall be secured on 10’ centers and within 18” of a splice using a wall support or a standard trapeze support system with 1/2-inch threaded rod in accordance with manufacturer specifications and applicable Building and Electrical codes.
- Single center-mounted steel supporting rod and bottom “T” connector style of support shall not be used.
- Shall meet seismic design category bracing standards required by OSF.
- Shall be sized to accommodate future installations and building growth. Initial cable fill not to exceed 25% of tray capacity.
- Shall be installed only in accessible ceiling areas.
- A minimum of four 4” conduits shall be installed over fixed, hard and inaccessible ceiling spaces at a height < 12’ AFF.
- Cable tray shall transition to a fire rated assembly to penetrate walls. Where conduits require cables to drop down onto cable tray provide plenum rated conduit waterfalls (Panduit CWF400 or equal) installed onto the end of each conduit to prevent kinking of the installed cable bundles.
- Each section shall be grounded and bonded in accordance with ANSI/TIA-607 and manufacturers requirements (bonded to building steel approx. every 60 feet). All splices, T-Sections and bends shall be bonded together. Cable trays shall not be used as an equipment ground nor seismic support or bracing.
- Cables installed in cable trays shall not contain, nor be fastened with Velcro, tape, or plastic type cable ties (tie-wraps) above ceilings.
- Shall meet the requirements in ANSI/TIA-569 and applicable addendums.

Cable Tray Clearances

- Cable trays shall not be placed within 5” of any overhead light fixture nor within 12” of any electrical ballast.
- A minimum clearance of 8” above and 12” to one side of the cable tray shall always be maintained. All bends and T-joints in the cable trays shall be fully accessible from above (within 12”).
- Cable trays shall be mounted no higher than 12’ above the finished floor to the top of the tray or extend more than 4’over a fixed ceiling area.
- Required minimum clearance around cable tray for maintenance access:
- Wall clearance - 6”
- Horizontal Clearance - 6”
- Tray Support and tray above suspended ceiling - 6”
- Above Tray - 8”

Cable Tray in Corridors

- The CCSD IT Project Manager shall approve the design of the cable tray system prior to construction.
- Approved Manufacturing: WBT, Hubbell, Cooper B-Line, Mono Systems, Cablofil Husky.

- Waterfall devices shall be provided and installed, to guard against cable damage, where elevation changes occur from cable tray to ladder rack in MTR and TRs and at any other discontinuous section of tray where there is elevation change.
- Cable tray and/or large diameter conduits, used in lieu of cable tray, shall not pass over classrooms or other occupied spaces that could be disrupted during cable adds, moves, or changes.
- All metallic cable tray sections and conduit shall be bonded together per NEC article 392.60 to form an electrically continuous system and shall be bonded to the telecom ground bar in the MTR or TR and all sections bonded in accordance with the listing requirements of the particular type of system. Cable tray shall be bonded to ground per NEC article 250.96.

Cable Tray- MTR/TRs

- Shall be installed at the same height as the bottom of the wall sleeves, no further than six inches from the point where the sleeves enter room to six inches from the furthest corner of the MTR/TR in an L shape.
- Cable tray shall be supported within six inches of each end and every 5' in the MTR/TR with wall angle brackets. Trapeze or other types of support are not acceptable in the MTR or TRs.

SURFACE RACEWAYS FOR COMMUNICATIONS SYSTEMS

- Used only in areas where cabling cannot be placed within walls, ceilings, or cable trays.
- Secured using mechanical fasteners, double sided sticky tape is not acceptable.
- Comply with the most restrictive requirements of Division 27 for wiring of the applicable class in the applicable location.
- At a minimum, provide a raceway with cross-sectional area equivalent to 1" diameter trade size conduit for communication station cabling.
- Install complete raceway system including track, cover plate, device boxes, radiused inside and outside elbows and manufacturer's category and fiber cabling guideway fittings, splice plates, T's, transitions and extension rings and end caps as required.

FIRE-STOPPING SYSTEMS

- Fire stopping is intended to prohibit the spread of a fire and smoke from one location within a building to another. This means restoring the integrity of rated walls, floors, and ceilings when these barriers are penetrated. The rating of the firestop assembly must meet or exceed the rating of the structure penetrated.
- MUST be a UL listed system/assembly
- Approved Firestop Assemblies for Horizontal Communication Pathways
- All fire rated sleeves shall be UL listed and contain non-removable intumescent fire sealant enough to maintain the hourly fire rating of the barrier being penetrated.
- Fire rated sleeves shall be used in rated and non-rated MTR and TR walls
- Acceptable Fire Rated Sleeves: STI Firestop Products EZ Path Series 44+, Hilti Firestop Speed Sleeve CP 653 or equal.
- The quantity of sleeves per wall penetration shall be based upon the size of the cable tray and the number of cables proposed to pass through the wall initially and in the future.

- The sleeve capacity area shall be equivalent to the area of the cable tray at each side of the wall.
- Non-rated corridor walls - pass cable tray through a slot in wall.
- Approved Firestop Assemblies for Floor Penetrations
- Rock wool and intumescent putty applied filling annular space around cables or spare conduits by a certified firestop contractor after cable installation is complete.

UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATION SYSTEMS

GENERAL

- All designs must be coordinated with and approved by CCSD IT Project Manager
- Conduit shall be Polyvinyl-Chloride (PVC) Schedule 40 or 80 (dependent upon concrete encasement requirements), corrosion-resistant plastic with a 4" inside diameter for underground installations and Galvanized Rigid Steel (GRS) or PVC Externally Coated (GRS) for riser applications.
- Spacers shall be used in the trench to support the conduits.
- A solid core #10 AWG copper wire shall be installed externally along any conduit run for the purpose of locating and tracing the conduit route.
- Fabric multi-cell type of inner duct shall be considered for conduits that will contain multiple cables.
- All installed conduits shall be cleaned and verified with a flexible mandrel and a stiff brush. Mandrels shall be 12" in length and sized to within ¼" of the inside diameter of the conduit.
- All conduits shall be provided with foot-marked mule tape with a minimum of 200 pound pulling tension.
- All unused entrance conduits shall be capped/plugged with expandable type duct plugs, Jackmoon or equal, inside the building to prevent rodents, water, or gases from entering the building.
- Conduit stubs entering the building shall extend beyond the foundation and landscaping to a hand hole to prevent shearing of the conduit and allow for access.
- Conduit entering from a below grade point shall extend 4" above the finished floor in the MTR/TRs. Conduit entering from ceiling height shall terminate 4" below the finished ceiling.
- All future conduit stubs shall be flagged for easy identification and an electronic ball marker shall be placed.
- All metallic conduit and sleeves shall be reamed, bushed, and capped when placed.
- The minimum depth of a trench shall allow for 24" of cover from the top of the conduit to final grade. Warning tape containing metallic tracings shall be placed a minimum of 8-inches above the underground conduit/duct structure to minimize any chance of an accidental dig-up. Both ends of the metallic warning tape shall be accessible after installation.
- There shall not be more than the equivalent of two (2) 90-degree bends (180-degrees total) between pull points, including offsets and kicks. Back-to-back 90-degree bends shall be avoided. All bends shall be manufactured long sweeping bends with a radius not less than 6 times the internal diameter of conduits 2" or smaller or 10 times the internal diameter of conduits larger than

2". Bends made manually shall not reduce the internal diameter of the conduit. All branch conduits exiting a MH/HH shall be designed as subsidiary conduits only (exit from the end wall of the MH/HH, not from the side wall). Lateral conduits entering/exiting MH/HH's are not allowed. The lowest conduit knockouts shall be used first when adding new conduit to a MH/HH.

- The CCSD IT Project Manager shall observe and inspect utilities trenching, excavation, backfilling, and compaction as appropriate. Design shall include Contractor instructions to schedule all inspections prior to commencing trenching and backfilling operations. All installations are subject to satisfactory inspection by the CCSD IT Project Manager.
- Conduits shall be secured with rebar when covering conduits with concrete.
- All conduit bends and sweeps shall be concrete encased to prevent movement and "burn-through" by the pull rope during cable installations.
- Concrete encasement shall comply with State of South Carolina, Department of Transportation standard specifications.
- An orange colored additive shall be raked or trowel-worked into the wet concrete or cement slurry to identify the duct structure as communications.
- Reinforcing bars within the concrete shall be sized accordingly for the load and stress at each location.
- Contact the CCSD IT Project Manager to inspect and approve all conduits prior to encasement.
- Conduit shall be encased in concrete or cement slurry when the following conditions exist
- Minimum conduit depth cannot be attained.
- Conduits pass under sidewalks, roadways, driveways, railroad tracks and at bend points.
- Note: The American Public Works Association has adopted orange for communications, alarm cables or signal lines, cables, or conduit.

Directional Boring

- High-density polyethylene (HDPE) conduit to be used for directional boring.
- A swivel shall always be used to prevent rotation of the product pipe.

Conduit Separation Requirements

- The minimum recommended separation between telecommunications conduit systems and outside surfaces of foreign structures as required by the National Electrical Safety Code (NESC) for personnel safety and the protection of telecommunications equipment shall always be maintained.
- All plastic underground piping shall be kept at a 10' distance from steam/condensate lines unless approved by the CCSD IT Project Manager. When crossing is necessary within the 10' distance limitation, transition to galvanized rigid pipe for at least 10' on either side of the intersection.
- Communications conduits may also require a pipe insulation treatment to be installed.
- If required separation cannot be obtained, an engineered solution shall be submitted to the CCSD IT Project Manager for review and approval prior to the beginning of any installation work.

MAINTENANCE HOLES / HAND HOLES

GENERAL REQUIREMENTS

- MH/HH's are required where maximum cable reel lengths are exceeded, at the intersection of main and branch conduit runs and at other locations where access to the cable in a conduit system is required.
- The maximum distance allowed between buildings and MH/HH's or between two MH/HHs' is 600 feet.
- No more than (2) 90-degree bends in conduit between MH/HHs'.
- MH's and HH's shall be constructed to withstand a minimum of AASHTO-H20-44 full traffic loading.
- All MH/HH covers shall be rated for heavy and constant vehicular traffic, regardless of placement location.
- All hardware in MH/HH's shall be galvanized.
- Pulling eyes shall be a minimum of 7/8-inches in diameter and located at opposite ends of each conduit entrance point.
- All MH/HH covers shall be marked for easy identification (Communications) and have a permanently attached embossed label/plate indicating the assigned MH/HH number. (Contact the CCSD IT Project Manager for MH/HH numbers).
- MH locations where the distance between the ceiling of the manhole and the street level exceeds 24" shall require the installation of permanent steps in the neck of the MH. These steps shall be installed in the neck rings at the same time as the MH is being installed, per manufacturer instructions. Steps shall not be cut and cemented in place after the installation of the neck ring.
- Provide (4) L-Cable Racks HH and (8) L-Cable Racks per MH.
- Where placement location is a roadway, driveway, bike path, fire line, loading dock or trash pickup area, provide only a MH.

Additional HH Requirements

- Minimum hand hole is 36" x 24" x 36" deep.
- All Hand Holes (HH) shall be equipped with slip resistant covers with height adjustment brackets, torsion assist openings, guard bars and hex head type bolts.
- HH's shall not be placed in a main conduit route between two MH's. MH/HH's shall be placed at strategic locations in a conduit system to allow installers to pull cable through the conduit with minimum difficulty and to protect the cable from excessive pulling tension.
- Step rungs are to be installed within a pull box installed deeper than the standard 3-feet and extension rings are required to match grade.
- Coordinate the installation with the CCSD IT Project Manager.

MH/HH Conduit Entry Requirements

- If the total number of conduits being placed is significantly less than the capacity of the termination MH or cable entrance, conduit shall enter at the lower level. The upper space shall be reserved for future additions.
- Conduit servicing buildings or other MH/HH's shall be installed using the subsidiary conduit method. Lateral conduits entering/exiting MH/HH's are not allowed.

- Twenty-two-degree and 45-degree conduit angles are preferred. Regardless of depth, all bends and sweeps shall be concrete encased or coated rigid steel to prevent movement and "burning through" by the pull rope during cable installations.
- Conduits installed between MH/HH's and buildings and between other MH/HH's shall be sloped per ANSI/TIA-758 to ensure proper drainage of water.
- All conduits entering buildings shall be plugged with expandable type duct plugs, Jackmoon or equal, inside the building to prevent rodents, water, or gases from entering the building. MH/HH conduits shall be plugged with duct seal material to prevent the entrance of water and gases.

UNDERGROUND SERVICE ENTRANCE CONDUIT

- Underground conduit shall be Schedule 40 PVC. All 90-degree bends shall be electrical grade, schedule 40 PVC or Rigid Galvanized Steel (RGS) sweeps with minimum bending radius of 36".
- Three 4" Schedule 40 PVC conduits, minimum of 24" BFG below a sidewalk or in open landscape areas, 36" minimum below a roadway, from the nearest right of way to a 36" long x 24" wide x 36" deep composite concrete hand-hole located 6' from the building's exterior wall.
- Trenches to be as straight and a direct line as possible. Routes through unstable soil such as mud, shifting soils, or other hazards should be avoided.
- From the hand hole extend located 6' from the exterior of the building three 4" PVC coated rigid steel conduit, 24" BFG to 4" AFF in the left corner of the 16' wall of the MTR wall where the service provider's equipment will be wall mounted.
- Conduit pathways shall slope down away from the MTR and from the mid-point between any two hand holes to prevent accumulation of water in conduits.
- Additional hand holes should be provided and installed at intervals not to exceed 200'. If the distance from the right of way to the point of entrance into the building is less than 200' then only a single maintenance hole will be required 6' from the exterior wall of the building.
- A ¼" diameter polypropylene pulling rope shall be installed in each conduit from the MTR to the right of way.
- The ends of all conduits shall be plugged during construction to prevent entrance of foreign matter.
- The General Contractor shall assure that all conduits are sealed gas tight in the MTR/TR to prevent ingress of water and noxious gas after the service provider has installed cables.
- A continuous no. 10 AWG copper grounding conductor shall be buried in the bottom of the trench, (or pulled with bore pipe) prior to installation of any conduit, with adequate length at each end for connection to ground system.
- All ends, joints and internal finish of conduit shall be free of sharp edges or burrs which could damage the cable.
- All buried joints shall be glued with cement as recommended by the conduit manufacturer.
- A yellow traceable warning tape shall be installed above each conduit pathway 8" below finished grade. This is applicable to all conduit installed in a trench or bored in.

DIVISION 31 – EARTHWORK

- Division 31 Sections will vary with each project. Renovation projects may have little site work, whereas a new facility or addition may have significant or extensive site work.
- Bind the subsurface reports in the Project Manual.

SITE DEVELOPMENT DESIGN CONSIDERATION

- There are many issues to be addressed in the site design of a school. These considerations include:
  - Allowance for future building expansion and accommodation of future mobile classrooms.
  - Development of circulation patterns that separate pedestrian and bike traffic from vehicular traffic, the bus drop/parking from the parent drop off and staff parking from student parking.
  - Main building entrances are readily identifiable
  - Utilization of exterior terraces/patios for outdoor learning areas.
  - Providing disability access to all buildings and play areas in accordance with State and Local Codes and ADA requirements, including auditorium and cafeteria stages.
  - Minimize the building's environmental impact on the site per the SCDHEC-OCRM Storm Water Management Program
    - run-off control (watershed issue)
    - minimize excavation
    - protect trees at drip lines from construction activities and grade changes
    - minimize grounds maintenance
    - protect wetlands; follow setback requirements set by SCDHEC-OCRM or local jurisdiction, whichever is more restrictive.
    - promote onsite infiltration through the use of pervious concrete, pervious asphalt and/or subsurface retention devices

DEWATERING

Specifies permanent-dewatering requirements not covered in other Division 1 sections. Require Contractor to prepare and submit a Dewatering Plan for approval by the AE and Program Management.

EARTHWORK

- Coordinate this Section with Division 1 Sections, including Allowances, Unit Prices, and Temporary Facilities.
- In general, the site shall be graded to balance cut and fill.
- Specify and adequately define all materials to be encountered or brought to the job site in the course of the earthwork operations. This shall include but not limited to the various soil classifications, sub-base materials, drainage fill, and backfill materials. Clearly define rock materials in both open excavation and trenches. Explosives shall not be used without written approval from Program Management.

- Contractor and Program Management shall obtain written acceptance of final grading from Owner prior to seeding/sodding grounds.
- Rock Definition: Rock material in beds, ledges, non-stratified masses, and conglomerate deposits and boulders or rock material and pit excavation that cannot be removed by rock excavating equipment without systematic drilling, ram hammering, and ripping shall not be removed until it has been cross-sectioned by a South Carolina Registered Land Surveyor. The AE shall classify and verify quantities prior to removal.
- Include by reference, the geotechnical report for the site in the contract documents.
- Undercutting and removing unsatisfactory soils from excavations and recommendations for replacement soils shall be described in the Construction Documents if the amounts can be clearly defined in the documents.
- Specify compaction procedures and requirements to suit the Project.
- Program Management shall coordinate cut and fill needs/supply between current and nearby CCSD projects.

TERMITE CONTROL

- All new construction requires termite treatment of all buildings on the site.
- Initial soil treatment shall be by applying chemical termiticides to the soil (not bait systems). Termiticides shall be registered with and applied in accordance with the Environmental Protect Agency and the South Carolina Department of Fertilizer and Pesticide Control.
- Post warning signs in treated areas.
- Termiticides shall not be applied when soil is excessively wet or frozen, or when rainfall is predicted as imminent.
- Capital Building Program shall pay for the first years' bond.
- Pest Control Operator/Applicator (PCO) shall be licensed with the South Carolina Department of Fertilizer and Pesticide Control. PCO must have an office in the tri county area to service the bond and perform retreatment as required to keep the bond in force.
- Final surface preparation shall be provided by the PCO prior to treatment to include the removal of foreign matter and debris; and loosen, rake, and level soil if it is highly compacted or uneven.
- Treatment of soil adjacent to exterior foundation walls shall be done after all required grading, excavating, and final landscaping and filling operations are completed.
- Voids in block wall construction shall be treated as close as possible to the footing and foundation.
- Trenching or trenching combined with rodding shall be used to treat soil adjacent to the foundation walls.
- A compatible dye shall be used in the termiticide to provide visible evidence or treatment.
- A quality control inspection shall be conducted after treatment and a report submitted to AE and Owner. The report shall include a copy of the bond.

SITE CLEARING

- Site must be fully cleared of all debris in any finished landscaped, hardscaped, or built area.

- Contractor and Program Management shall obtain written acceptance of final grading from Owner prior to seeding/sodding grounds.
- Burning trash or construction debris on site is not permitted.
- Burying of construction debris on site is not permitted.
- Photograph the site conditions prior to site clearing. Photographs shall be included in project closeout documents.

DIVISION 32 – EXTERIOR IMPROVEMENTS

GENERAL

- Provide designated vehicular access to all outdoor athletic facilities, landscaped areas, and interior of tracks. Hardscape, paving materials should be able to withstand vehicular traffic in these areas.
- Require the contractor to maintain all landscaping until written notice of acceptance is received from Owner.

BUS DROP-OFF, PARENT DROP-OFF AND PARKING TRAFFIC

- These three functions shall be separated as much as possible.
- At all drop off areas that discharge or pick-up of students at the loading-unloading zones shall be from the side of the vehicle opposite the driver and toward the buildings. Vehicle stacking shall be accounted for in the design so as not to impede the flow of traffic off campus.
- Parking bays for full-service buses shall be a minimum of 15ft. wide
- Backing up of buses shall not be required or permitted.
- A minimum outside turning radius of 50 feet shall be provided at bus driveways and parking areas. The minimum inside radius shall be 32 feet.
- Lane width shall be such that if a bus goes out of service, the buses behind it shall be able to pass around it safely.
- Sidewalks shall be provided at each loading/unloading area.

BUILDING ENTRANCES

- All primary building entrances used for students shall be protected from weather by overhead cover or soffit and shall be readily identifiable from vehicle approaches and parking lots.
- Each loading/unloading area shall have a covered canopy and covered walkway leading into the building. The canopies shall not drain across sidewalks and shall be sloped away from the building.
- For larger schools the bus drop canopy shall be a minimum of 12 ft. wide and 100 ft. long and walkway canopy to the building be a minimum of 8 ft. wide.
- Bottom of canopy soffits shall be a minimum of 10 ft. above finish grade at bus drops.
- Columns supporting canopies shall be set back from the curbs a minimum of 4 ft. to allow car or bus doors to open.
- Canopies shall be designed to avoid roosting of birds.
- Where canopies and covered walkways block access to courtyards and other areas, coordinate with Fire Department, Emergency Services and utility companies and provide for access to that area.
- Canopy lighting is required on all entrances, bus loop and car rider loop structures. The conduit and lights shall be run below the roof deck and secured to the structure and not screwed through the roof.

SERVICE DOCKS

- Service docks shall be covered or partially covered.
- Dock height shall be at 48 in. Use concrete, not asphalt, for dock surface.
- Specify installation of dock pads and dock leveler.

RETAINING WALLS

Retaining walls with a height of 5 ft. or greater or walls subjected to surcharge loading (i.e. vehicle traffic, sloping backfill, or point loads) shall be designed and stamped by a professional engineer.

STORAGE BUILDINGS

Shall be provided if required by Owner. AE shall consult with Owner on storage need and shall use finish materials and colors to match adjacent buildings.

EXTERIOR MECHANICAL AREAS

- Shall be enclosed with security fencing and vehicle stops.
- Provide reinforced concrete slab with fenced area with proper sized pads/curbs for equipment mounting.
- Slope slab away from building.

HOT – MIX ASPHALT PAVING

- Heavy-duty pavement as specified by SCDOT shall be used for car loading, bus loading, truck access, and delivery drives.
- Pavement marking paint complying with FS TT-P-1952, applied to a minimum wet film thickness of 15 mils.
- Specify field quality control tests to be coordinated by contractor and provided by Owner's testing agency.

CEMENT CONCRETE PAVEMENT

- Concrete shall be specified for service pads and walkways. Stamped, patterned, and colored concrete are not permitted in these areas.
- Control joints, isolation joints, and expansion joints shall be shown on the drawings.
- Expansion joints shall conform to ASTM D 1751, ASTM D 1752, or current SCDOT standards. All roadways, parking lot islands, and dumpster pads/enclosures shall have curb and gutters.
- Curbs shall be tapered (sloped). Blocked curbs are not permitted.

PAVEMENT JOINT SEALANTS

- Joint sealants shall be used for concrete-to-concrete and concrete-to-asphalt pavement joints outside the building. The type of sealant shall be appropriate for its intended use.
- Expansion and control joints in walkways and joints abutting the building at doorways and masonry walls shall be sealed.

UNIT PAVERS

Unit pavers when used shall be kept to a minimum. Setting method shall secure the pavers in place to prevent theft and vandalism.

TENNIS COURT SURFACES

- Use Textured acrylic surfacing for asphalt tennis courts and similar play areas.
- Surfacing shall conform to the Requirements of the ASBA for planarity.
- All surface coatings products shall be supplied by a single manufacturer.
- The Contractor shall record the batch number of each product used on the site and maintain it through the warranty period.
- The installer shall be an authorized applicator of the specified system.
- The manufacturer's representative shall be available to help resolve material questions.
- Do not install when rainfall is imminent or extremely high humidity prevents drying. Materials are to be only applied when ambient temperature is in compliance with manufacturer's recommended installation specifications.

ATHLETIC TRACKS

- All running tracks (high school) shall be designed for 400 meters. High schools shall have eight (8) lane tracks. Track shall be marked per NFHS or SCHSL standards.
- Use Plexitrac Lightening Polyresin running track surfacing system, as manufactured by California Products Corporation as a basis of design. The mixture of specifically gradated rubber granules and Polyresin binders shall be placed over the accepted bituminous concrete base.
- No part of the surfacing installation shall be conducted during rainfall or when rainfall is imminent. After a rainfall, sufficient time shall be given to allow the surface to dry thoroughly. Materials are to be only applied when ambient temperature is in compliance with manufacturer's recommended installation specifications.

ATHLETIC FIELDS

- Contractor shall hold a current CSFM (Certified Sports Field Manager) Certification through the Sports Turf Managers Association or shall be a CFB (Certified Field Builder) through the American Sports Builders Association. If contractor does not hold either of the current certifications, they must submit experience in Athletic Field Construction (at least 3 prior projects) and list of references to the Owner (Plant Operations Designee) for approval.
- Final grade shall be approved by Plant Operations Designee prior to sodding.
- Prior to sodding check slope, all foreign materials and stones shall be removed and the soil shall be leveled and rolled with a heavy (2000 – 4000lbs.) roller. Soil shall be kept damp, not dry or wet, when it is worked. Alternately contractor may drag and roll area until foot marks cannot be seen readily or they are less than ¼ in. deep.
- Organic fertilizer shall be used as a pre plant application applied at a rate of 10-20 lbs. of product per 1000 sq. ft prior to sodding to enhance soil.
- During sodding, area shall continuously be drug/raked to ensure consistent smooth surface from start to finish.
- Sod seams shall be pulled tight and not show any gaps between seams.
- Post sod rolling with a 1-2 ton roller in 2 directions.
- Certified TifTuf Bermuda shall be used.

PLAYGROUNDS

General

- Playgrounds shall be designed based on the CCSD Playground Design Standard Designs (Appendix H). The age groups for differing playground designs are 0-2 years, 2-5 years, and 5-12 years.
- Playgrounds are divided into two distinct areas: 1.) Playgrounds are those with equipment (fall rated) and 2.) Play Areas are those for open play spaces (not fall rated). Size of surfaced area shall be dependent on equipment use zones from playground equipment design and minimum requirements set forth by the playground vendor/equipment manufacturer
- Play Areas are the flat open space with synthetic turf. Play areas shall be programmed at a minimum of 7500sf.
- Playground equipment Designer/Company/Installer shall have a current Certified Playground Safety Inspector Certificate.
- The overall design of the playground, site preparations and equipment location shall be the responsibility of the Architect and Civil Engineer.
- Playground layout and location shall be made based upon the building and site conditions.
- The design shall be conducive to encourage children to interact with each other in a safe environment and shall be developmentally and age appropriate for children of all abilities
- The design shall address ADA access, site preparation, under artificial turf drainage system, playground equipment layout, security and site fencing
- Playground sites shall be accessible from the nearest access point/door of building and General Contractor to provide a connecting sidewalk from access point/door to the play area.
- 0-5 years old classroom doors shall exit directly on to the playground, have sidewalks surrounding the playground and shall have access control.
- Shade structures shall be included in the design and sized appropriately and be rated to withstand 155 mph winds or wind design conditions at site, whichever is greater. Quick release tensioning shall be required at each corner on all cables and be precut to size. No brackets or cable clamps on cables for tensioning are allowed.
- Shade structures shall be located outside of the equipment use zones or integrated into the post and platform structure. Shade structures shall be manufactured to meet International Building Code ratings for wind and live loads.

Equipment

- Equipment selection preference shall be given to accessible features and play events. IPEMA Certified equipment shall be used.
- The A/E shall work with the Owner approved playground equipment vendors to ensure that the design and equipment meets Owner requirements. The Facilities Management Plant Operations Division shall have final approval authority on all aspects of the design. Program Management shall not have approval authority of playgrounds.
- Overhead activities shall not be permitted in equipment design/selection.
- Posts and rails of equipment shall be constructed of galvanized steel and contain a rust-resistant primer process prior to finishing with a super-durable polyester powder coating.

- CAD file shall be provided by the architect to the playground vendor to insure proper layout of equipment as per public playground standard & guidelines.

Surfacing

- Surfacing material shall be Synthetic Turf secured to a concrete curb with ground contact rated treated lumber. Owner must approve artificial turf.
- Surfacing system shall be IPEMA Certified, meet or exceed ASTM standards and CPSC guidelines and be ADA compliant and wheelchair accessible (ASTM 1951)
- Water Permeability: Turf, pad and sand infill shall drain at a rate of at least 150 inches per hour (ASTM F 1551)
- AE shall use the manufacturer's Basis of Design for compacted stone base requirements for the turf grass.
    - Depth shall be up to 4 inches of Number 57 and 89 washed stone
    - Shall maintain ¼" per foot slope and exhibit positive drainage.
    - Density shall be 90% compaction with final condition of stone level and stable
    - Shall maintain porosity to ensure direct drainage.
    - Top of curb shall be elevated 2" above top of compacted stone (or recommended by the manufacturer.
    - Holes drilled for play structures shall be concrete filled up to the level of the sub-base.
- All nails shall be stainless steel
- Playground surfacing systems within the use zone of equipment shall utilize 2" Brock Padding (this a preferred vendor but other options will be considered for evaluation) to achieve a critical fall height that meets or exceeds the fall height (0-12 age groups) of the equipment installed.
- Rubber Wear Mats shall be provided on top of Synthetic Turf Surfacing at all slide exits and around high traffic spinning/rotating equipment.
- Where appropriate, use of recycled materials shall be considered.
- HydroChill shall be used on all artificial turf installations.

Site Considerations

- Site preparations (excavation, grading, drainage, concrete) provided by General Contractor prior to playground equipment installation company's arrival on site:
- Excavation: the playground area shall be excavated to a depth of 6"-7" below finished grade of surrounding sidewalk.
- Grading: the playground area shall be graded away from the building toward yard drains @ no more than 2%.
- Concrete:
    - Contractor shall leave out an open section of sidewalk and/or curbing for equipment and surfacing installation machinery access.
    - Sidewalks surrounding the play areas shall be provided for accessibility and as tricycle pathway.
    - Curbing shall be provided entire way around the perimeter of new play area. Please refer to equipment vendor's design drawings for size and linear footage.
    - 6" below grade and 6" above grade trenched spoils shall be backfilled against outer edge of curb.

- Accessible sidewalk shall be provided from nearest access point/door to the new play area and tied into/ramped up to the new concrete curb.
- Drainage:
  - Storm drains, plumbing clean-outs, and surface catch basins shall not be permitted in the use zone of each piece of equipment or in the play areas.
  - A perforated sock pipe shall be laid in a stone bed on the interior of sidewalk on the low side of site
  - Drain outlets shall tie into the perforated sock pipe and run underneath of the sidewalk and tied into the roof or yard drain system outside of the fenced Playground.
- Soil Compaction: Site subsoils shall be properly compacted to honor equipment and surfacing warranties.
- Landscaping: Sod and landscaping shall be installed after the playground is completed or a pathway through new sod shall be left out for machinery access.

Fencing

- Fencing shall remain uninstalled at the access point for machinery until after playground and surfacing installation is complete.
- Fencing for playgrounds housing equipment designed for 0-2 year old's and 2-5 year old's shall be 4 feet tall powder coated aluminum (confirm with Plant Operations) and shall be placed a minimum of 5 feet beyond the use zone of any playground equipment.
- Height of all fence construction except playgrounds shall be a minimum of 6ft.
- Posts and rails shall be constructed with powder-coated galvanized steel
- All exterior gates shall require panic hardware and locks. Locks shall be included in the hardware schedule.

IRRIGATION SYSTEMS

- SEE Appendix A - DIVISION 32 FOR SUPPLEMENTAL IRRIGATION SYSTEM REQUIREMENTS
- Irrigation systems shall be centrally controlled over the internet. The controller shall be compatible with the Toro Sentinal Central Control system. Drip irrigation shall not be used.
- Irrigation system maintenance shall begin immediately following the installation of each portion for each plant(s) and shall continue until installation of planting is complete, all punch list work is complete and the planting is contractually accepted by the landscape architect and Owner. Owner shall be responsible for all required Irrigation system maintenance after all punch list work is complete and the irrigation is contractually accepted by the landscape architect/civil engineer and Owner.
- The irrigation system shall be designed in accordance with the latest edition of the Irrigation Association & American Society of Irrigation Consultants "Landscape Irrigation Best Management Practices"
- Temporary Irrigations systems shall be used to establish the plants.
- Permanent irrigation shall be defined as any underground irrigation systems. Temporary irrigation shall be defined as any above ground irrigation systems. Two wire systems are not allowed. The system must be compatible with current internet-based control system.
- Permanent irrigation systems shall have the following:

- System ground
- Master control valve
- Flow sensor connected to control unit
- Two data drops to each control unit

- No wells and no retention ponds are permitted for service for irrigation systems.
- Irrigation systems can be installed to help establish plants for one year after the planting period but shall only be at the main, public entrance. The design team shall review the irrigation limits with Owner during the DD document review.
- Irrigation systems shall include piping, valves, sprinklers, sprinkler specialties, and controls Irrigation systems shall have timers, rain sensors, and moisture sensors.
- High School competitive sports fields, high school practice and band fields shall have permanent irrigation systems.
- Irrigation systems shall be metered separately from other site water use and utilize a backflow preventer.
- Maximum four (4) sprinkler heads per zone.
- All heads shall have adjustable swing joints and chrome sleeves.

CHAIN LINK FENCES AND GATES

- Fencing in high profile areas shall be ornamental or 9-gauge black vinyl coated, class 2b, PVC coating that is thermally fused and adhered onto the galvanized steel wire.
- All other fencing including those for the sports fields shall be 9-gauge galvanized steel chain link fence and gates with all accessories, fittings, and fastenings.
- All exterior gates shall require panic hardware and locks. Locks shall be included in the hardware schedule.
- Fencing for playgrounds housing equipment designed for 0-2 year old's and 2-5 year old's shall be 4 feet tall and be placed a minimum of 5 feet beyond the use zone of any playground equipment.
- Height of all fence construction except playgrounds shall be a minimum of 6ft.
- Fabric of fence shall have knuckled selvage at both top and bottom. Do not extend fabric above the top rail.
- All fenced areas, unless specified below, must have 12 feet wide gates to allow for vehicular access. Fencing is required for security around exterior mechanical equipment areas, for security and at exterior sport functions including tennis courts and high school baseball and softball fields. No enclosure fence is required in Middle School Softball Fields, however, a 10 ft. high chain link backstop with a 5 ft. high foul ball screen set at 45 deg shall be provided.
- Mechanical equipment areas shall be enclosed with fence construction a minimum of 6 ft. high. Provide clearance around equipment as required for service and operation. Gates shall be a minimum of 8 ft. wide utilizing double gate design. Where equipment enclosure fencing is adjacent to main buildings the fence construction shall match building construction.

- Tennis courts shall be enclosed with a 10 ft. high chain link fence with 4 ft. wide gates and wind screening.

- High School Baseball and Softball Fields shall be enclosed with a 6ft. high chain link fence with 14 ft. wide service and 4 ft. wide player gates. A fenced bull-pen area shall be provided. Crowd separation fences shall be 4 ft. high. A 12 ft. high chain link backstop with a 5 ft. high foul ball screen set at 45 deg. shall also be provided at softball fields. At baseball fields the backstop shall be 18 ft. high and the foul ball screen shall be 6 ft. high. Dugouts shall be a minimum of 8 ft. high and the fencing between the backstop wing and the dugouts shall be a minimum of 10 ft. high. All framework on backstops and hoods shall be welded. Outfield fence shall be installed with vinyl slats to match school color. Provide protective cover at top of outfield fences.

- Retention and Detention Ponds shall be fenced (6 ft high minimum) and gates a minimum of 12 ft. to allow mowing equipment to service the banks.

- A perimeter fencing plan is required in accordance with Crime Prevention through Environmental Design concept of "territoriality". The plan shall be approved by the Owner in writing.

FIRE TRUCK ACCESS

- Fire truck access lanes that cross play areas shall be defined with a low concrete curb on both sides that does not pose a tripping hazard.

- Fire truck access lanes in other areas shall be marked per OSF in the most unobtrusive way possible.

LANDSCAPING

- Owner Plant Operations shall review and approve landscape plan.

- Landscape maintenance shall begin immediately following the installation of plants for each portion of the landscape plan and shall continue until installation of all plants is complete, all punch list work is complete and the planting is contractually accepted by the landscape architect and Owner.

- Contractor shall maintain building grounds and retention ponds by cutting grass on a biweekly basis at a minimum until Project is accepted by Owner.

- Owner shall be responsible for all required maintenance after all punch list work is complete and the planting is contractually accepted by the landscape architect and Owner.

- The landscape maintenance budget and contracts are set up to edge, maintain turf, clean up in general. They are not set up to maintain beds or to replace mulch on a periodic basis.

- Specify safeguarding of all existing landscaping and monumental trees not identified to be removed due to the construction plans. Removal or damage to such protected areas, plants and trees shall result in chargeback from Owner and required replacement of similar landscaping features.

- Landscaping shall be minimal. Flower beds shall not be considered. A landscape plant list shall be included in the bid documents and project close out documents.

- At renovation/addition projects, the Design shall specify that the Contractor isolate and protect existing planting and lawn areas.

- Any devices such as stakes that are used to secure trees or other plantings shall be installed flush to the ground.

- Trees shall be provided with self-water devices and the contractor shall be required to keep them supplied with water as necessary to ensure survival of the tree during the warranty period.
- No existing trees shall touch the finished building or finished roof. Tree removal shall be evaluated based on full, mature canopy of tree species.
- The AE or Landscape AE shall strive for a Xeriscape design and select plants from commercially available native and adaptive species that thrive in the local climate without irrigation.
- All plants shall be native and non-invasive and shall be accompanied by a certificate stating, "certified under all applicable state and federal quarantines."
- Do not specify plants with thorns, thistles or toxic foliage, flowers or fruit.
- Specifications shall address submittals, quality assurance, delivery and storage, warranties, maintenance, general product requirements, and installation techniques.
- Beds that require mulch use shall be minimized in all landscape designs and will be restricted the area around signs or at the front entrance only or as required by local municipalities.
- Landscaping shall not obstruct weep holes and/or storm drains and shall maintain proper slope for drainage away from structures. Only turf is allowed directly up to the building exterior.

PLANTING

- If permitted.
- All planted beds of any type shall have sterile topsoil.
- No plants shall be planted closer than 4 ft. to the building, trees no closer than 15 ft. to the building. No trees shall touch or overhang the building or the roof. Tree placement shall be evaluated based on full, mature canopy of tree species.
- All shade trees shall be placed in a manner so that mature size limbs shall not touch or overhang buildings or power lines or encroach on adjacent trees. At driveway and parking areas all trees shall be at height at installation that they shall not obstruct motorists' line of sight.
- Use triple shredded hardwood mulch for slope plantings and low visibility and outlying areas.
- Landscape with trees and/or shrubs when slopes in high visibility areas or slopes greater than 3:1 grade. Slopes of lesser grade can be seeded with Celebration Bermuda and irrigated to get them established. Where slopes exceed 5:1 grade, ground cover such as Parson Juniper shall be planted and mulched with a minimum of 3-inch compacted pine bark.
- Require tree/shrub protection fence that is placed at the drip line of the tree.
- Tree, shrub, and ground cover planting shall have a minimum of an 8 in. deep plant beds including 2 in. of decomposed organic matter. They shall receive an application of pre-emergent "herbicide" before area is mulched. A minimum of 3 in. of pine straw mulch shall be applied after herbicide. Islands in parking lots shall be mulched and shall not be planted with grass.
- All shrubs placed near buildings shall be selected from varieties so that at mature height of the planting shall not overgrow or obstruct vision from windows. At driveway and parking areas shrubs shall be selected from varieties so that at mature height of the planting shall stay below the motorists' line of sight.

GRASS SEEDING

- Grass seeding shall not be permitted without Owner approval.

SODDING

- Sod shall be Certified by Zeon or Empire Zoysia.
- Sod with netting or mesh not permitted.
- All rocks and debris to be removed prior to sodding.
- Areas immediately around the buildings and court-yard areas shall be sod unless areas are to be irrigated.
- Competitive athletic fields shall be sod
- Check slope, remove all foreign materials and stones larger than ½ in. Level soil and roll with heavy (250-300 lbs.) roller. Keep soil damp, not dry or wet, when it is worked. Alternately rake and roll area until foot marks cannot be seen readily or they are less than ¼ in. deep.
- Apply starter fertilizer at a rate that shall provide 1 to 1-1/2 lbs. of actual nitrogen/1000 sq. ft. Rake starter fertilizers into soil surface to about 1 in. deep and proceed with grass seeding. From time of seeding to substantial completion the Contractor shall keep maturing grass irrigated on a regular basis.

BUILDING EXPANSION AND RE-LOCATABLE CLASSROOMS

- The planning for future-building expansion and re-locatable classrooms shall consider grading, circulation patterns and utility stub outs.
- Require Mobile Classrooms to be located and installed in accordance with the OSF P&C Guide.
- Fire equipment access around the site will be an important aspect of structure location.

DIVISION 33 – UTILITIES

PIPED UTILITIES – BASIC MATERIALS AND METHODS

- Specify common pipe and utility materials and installation methods throughout project.
- Piping subject to freezing shall be provided with freeze protection.

INTERCEPTORS

- Coordinate with Division 22 – Plumbing.
- Concrete is acceptable.
- Interceptors shall be located outside the building.

SANITARY SEWERAGE

- Specify materials for sanitary sewerage outside the building as follows:
  - Cast Iron (or PVC if approved by Owner) shall be used under slab
  - PVC schedule 40 for pipe and fittings less than 4 inches. For sizes 4 inches or larger, use ASTM D 3034, SDR 26 PVC.
- Top loading classifications of cleanouts shall be as follows:
  - Light Duty: In earth or grass foot traffic areas.
  - Medium Duty: In paved foot-traffic areas.
  - Heavy Duty: In vehicular-traffic service areas:
  - Extra-Heavy Duty: In roads.
  - Sewer Pipe Fitting and Riser to Cleanout: PVC to match pipe. Provide cast iron inspection cover and frame for cleanout.
- Specify quality control testing requirements of sanitary sewer lines to be performed by the Contractor. Report to be included in project close out documents.

SEPTIC TANK SYSTEMS

Specify tank, distribution box, and drainage pipe for septic tank systems. Use of Septic Systems is not permitted unless no possibility of a permanent sewer system is available in the area. If used, attain all permits and adhere to SCDHEC requirements in design and during construction.

SUB DRAINAGE

Specify foundation, under slab, plaza deck, retaining wall, and landscaping sub drainage systems as required by site soil conditions. Materials shall be as determined by the civil and structural engineers.

STORM DRAINAGE

- Storm water discharges and erosion control are covered by SCDHEC under the NPDES Permits.
- Retention ponds shall have banks constructed to accommodate deck mowers to service the banks. Pond banks shall be solid sodded – grass seed is not permitted. The contractor shall irrigate as necessary to ensure the sod is established. Aeration pumps are recommended in all retention ponds.

- All retention ponds shall have a fore bay integrated into the design.
- Grated storm water inlets in grassed areas shall have a 36-inch-wide concrete collar around the entire perimeter. The collar will start at grade and slope down to the inlet. The collar will be a minimum of 4 inches thick and be able to withstand the loads of lawn equipment.

Appendix A: Basis of Design Manufacturers

Division 03 - Concrete

- Pre-Cast Architectural Panels
  - Metromont
  - Tindall
  - Old Castle Precast
- Concrete Admixture
  - Barrier One

Division 04 – Masonry

Division 05 – Structural Steel Framing, Steel Joists, Steel Decking, etc.

- Handrails
  - R & B Wagner, Inc.,
  - JG Braun Co.,
  - Superior Aluminum Products
  - Handrails and railings in shall be fabricated from aluminum - coordinate finish with Owner and Program Management.
- High Performance Coating – Sherwin-Williams
- Prime Coat - Macropoxy 646 (B58W610)
- Finish - 2 coats – Acrolon 218 (B65W651)

Division 06 – Wood, Plastics, and Composites

- Interior Architectural Woodwork
  - Transparent Finished Casework: Casework shall be natural maple and of a heavy-duty construction.
  - Countertops: Plastic Laminate with marine grade plywood

Division 07 – Thermal and Moisture Protection

- Metal Wall Panels
  - The use of metal panel systems must be approved by the Associate of Facilities Management.
- Sheet Metal Roofing
  - Sherwin Williams Anti Corrosion Coating
  - Prime Coat – BondPlex (B71W211)
  - Finish – SherCryl (B66W351)
- Fluid Applied Membrane Roofing (polyurethane elastomeric fluid–applied system)

- Tremco, Inc.
- Sika Corp.
- Kemper
- Simplast
- Soprema

- Fiberglass Doors and Frames (FRP)
  - Special-Lite, Inc.
  - Chem-pruf
  - Tiger Door
  - Commercial Door Systems
- Overhead Coiling Doors
  - Overhead Door Corporation
  - Wayne-Dalton
  - Cornell Iron Works, Inc.
  - The Cookson Company
- Overhead Coiling Grilles
  - Overhead Door Corporation
  - Wayne-Dalton
  - Cornell Iron Works, Inc.
  - The Cookson Company
- Sound Control Doors
  - Wenger

Division 08 – Openings

Door Hardware –Manufacturer Key Below

ITEM	MFG	ITEM NUMBER	LOCATION
HINGE(S)	MK	TB2314 32D	Exterior door
HINGE(S)	MK	TB2714 26D	Interior
HINGE(S)	MK	TB2314 NRP 32D	Exterior outswing
HINGE(S)	MK	TB2714 NRP 26D	Interior security
HINGE(S)	MK	T4B3386 32D	3'6 exterior
HINGE(S)	MK	T4B3386 NRP 32D	3'6 exterior
HINGE(S)	MK	T4B3786 5 26D	4'0 interior
HINGE(S)	MK	T4B3786 5 NRP 26D	4'0 interior security
CONT HINGE	PE	CHS83-HD1	Exterior
CONT HINGE	PE	CHS83-HD1 PT	Exterior electric connection

ITEM	MFG	ITEM NUMBER	LOCATION
CONT HINGE	PE	CFM83-HD1	Exterior
CONT HINGE	PE	CFM83-HD1 PT	Exterior electric connection
PERM CORES	CR	8000 6PIN GMK 626	Key cores
CYLINDERS	CR	1080-114-A02-6 CMK 626	Cylinder
CYLINDERS	CR	3080-178-6 CMK 626	Cylinder
O H HOLDERS	RX	10-336	Standard duty stops
O H HOLDERS	RX	9-336	Heavy duty stop
CLOSER	CR	DC6200/DC6210	Most doors
CLOSER	CR	DC6200 M71	
CLOSER	CR	DC6210 A3	Outswing doors
CLOSER	CR	DC6200 A3 M71	
CLOSER	CR	DC6210 A4	Outswing doors
CLOSER	CR	DC6210 A11	Entry doors
CLOSER	CR	DC6210 A12	Entry doors
CLOSER	CR	DC62940 ET	
CLOSER	CR	DROP PLATE 597F58 (M80)	
CLOSER	CR	BLADE STOP SPACER M77	
ADA OPER	NO	6920	Entry auto opener
ADA OPER	NO	6920 D	Entry auto opener
SWITCH	NO	685	ADA operator
SWITCH	NO	691	ADA operator
MAG HOLDER	RX	998	Fire corridor doors.
DEADBOLT	CR	ML2029 M19	Teacher corridor toilet
PASSAGE SETS	CR	ML2010 LWA 630	
PRIVACY SETS	CR	ML2030 LWA 630	Interior toilet
DEADLOCK	CR	ML 2017	Serving/kitchen
DEADLOCK	CR	ML2017	Locker room
LOCKSETS	CR	ML2051 LWA CT6R (+CYL)	Office
LOCKSETS	CR	ML2055 LWA CT6 (+CYL)	General locking
LOCKSETS	CR	ML2057 LWA CT6 (+CYL)	Storage
LOCKSETS	CR	ML2057 LWA CT6 (+2CYLS)	Classroom
(FOR TEACHER TOILET USE ML2057 X D271)			
REM MULL	CR	907BKM CL6	Pairs of doors

ITEM	MFG	ITEM NUMBER	LOCATION
REM MULL	CR	WS707AKM CL6	Exterior pairs
EXIT DEVICE / Card reader	CR	Ed 5200S M107 M54 MELR M802 TCRNE1 Th957 M52	Entry Door/Secure Door
EXIT	CR	ED5200	Standard panic device
EXIT	CR	ED5200A	Fire exit
CLSRM EXIT	CR	ED5202S CT6 (+CYL)	Classroom exit
CLSRM EXIT	CR	ED5202SA	Classroom exit fire rated
EXIT - ADD	CR	4' LENGTH WO48	4' exit door
EXIT - ADD	CR	SHIM KIT M58	Window kit - exit
EXIT	CR	ED5200S	Standard panic device
EXIT	CR	ED5200SA	Fire exit
EXIT - ADD	CR	WINDSTORM M107	Impact exit add
EXIT TRIM	CR	TH957 CT6R (+CYL)	Outside trim
EXIT TRIM	CR	TH595 CT6R (+CYL)	Outside trim
EXIT TRIM	CR	L955 CT6R (+CYL)	Outside trim
EXIT TRIM	CR	TH955 CT6R (+CYL)	Outside trim
EXIT TRIM	CR	TH950	Outside trim
EXIT	CR	ED5400	Vertical exit - pairs
EXIT	CR	ED5400A	Vertical exit - pairs-fire rated
EXIT	CR	ED5470	Vertical exit -pairs
EXIT	CR	ED5470B	Vertical exit -pairs
EXIT - ADD	CR	LESS BOTTOM ROD M55	xxx
EXIT - ADD	CR	LATCH PULL BACK M94	electric exit
EXIT - ADD	CR	SHIM KIT VR M58	window kit - vertical exit
EXIT - ADD	VD	98/99 RIM	
	HES	SMART PAC 2005 M3	Electric strike accessory
POW SUP	CR	BPS-24-1	Electric power supply
ELEC STK	HES	8500 852	Electric strike-admin entry
ELEC STK	HES	9600	Electric strike-admin entry
CONTROLLER	CR	781N-120	Elec exit power supply - entry
POWER TRSF	CR	EPTL	Wire transfer jamb to door
POWER TRSF	SEC	EL-SEPT	Wire transfer jamb to door
POWER TRSF	SEC	EL-CEPT	Wire transfer jamb to door
A FL BOLT	RO	1945 SET	Locking bolt for inactive leaf
A FL BOLT	RO	1842 SET	Locking bolt for inactive leaf
FL BOLT	RO	557	Locking bolt for inactive leaf
FL BOLT	RO	555	Locking bolt for inactive leaf
SUF BOLT	RO	550-8	Locking bolt for inactive leaf
DP STRIKE	RO	570	

ITEM	MFG	ITEM NUMBER	LOCATION
PUSH PL	RO	70C	
PULL PL	RO	106 X 70C	
COORD	RO	1700	Accessory for pair of interior doors
KICK PL	RO	K1050 10 X 34	
KICK PL	RO	K1050 8 X 46	
KICK PL	RO	K1050 E X 34	
ARMOR PL	RO	K1050 36 X 34	
KICK PL	RO	K1050 8 X 40	
MOP PL	RO	K1050 4 X 35	
FL STOP	RO	471	
FL STOP	RO	443	
WALL STOP	RO	406	
DR STOP	RO	462	
LOCK GRD	RO	321	Security guard for exterior lock
SILENCERS	RO	608	
VIEWER	RO	622	
COAT HOOK	RO	802	
ASTRAGAL	PE	305 CN 84"	
MULL SEAL	PE	5110BL 120"	
W/S	PE	303 AS 36 X 84	
W/S	PE	303 AS 72 X 84	
SMK SEAL	PE	S88D 17'	
SMK SEAL	PE	S88DD 21'	
ASTRAGAL	PE	355 84"	
DR SWEEP	PE	3452 CNB 36"	
DR SWEEP	PE	3452 CNB 48"	
THRESHOLD	PE	171 A 72"	
THRESHOLD	PE	171 A 36"	
THRESHOLD	PE	171 A 48"	
THRESHOLD	PE	2005 AV 72"	
THRESHOLD	PE	2005 AV 36"	
THRESHOLD	PE	2005 AV 48"	
THRESHOLD	PE	2005 AV 96"	
KEY CAB	LU	1205	

Manufacturer Key
MK - McKinney
PE - Pemko

ITEM	MFG	ITEM NUMBER	LOCATION

CR - Corbin Russwin
RX - Rixson
NO - Norton
HES - Hes
RO - Rockwood
SEC - Securitron
LU - Lund
VD-Von Duprin

Division 09 - Finishes

- Resilient Wall Base
  - Refer to District IDC for an approved list of manufacturers and installers which can be obtained by contacting the District Procurement Office
- Resilient Tile Flooring
  - LVT
- Refer to District IDC for an approved list of manufacturers and installers which can be obtained by contacting the District Procurement Office
- Rubber Floor
  - Johnsonite raised round dot stair treads: color codes HNSP – LA7, HNSP – LH9, HNSP – LG6, HNSP – LD3 and HNSP – LB8
- Tile Carpeting
  - Refer to District IDC for an approved list of manufacturers and installers which can be obtained by contacting the District Procurement Office
- All Carpeting
  - Shall be solution dyed fibers
- Restroom Grout Type and Color
  - Mapei Flexcolor CQ or Owner approved equal – Preferred Black (10), acceptable Truffle (115) and Cocoa (79)
- Painting
  - Sherwin – Williams
  - Duron, Inc.
  - ICI Paints
  - Rose-Talbert
  - PPG

Division 10 - Specialties

- Electronic Digital Marquee Signs:

- Contact Owner IT for direction.

- Operable Wall Panels
  - Advanced Equipment Corporation
  - Hufcor
  - Modernfold, Inc.
- Toilet and Bath Accessories
  - Bobrick
  - ASI
  - Bradley
  - General Accessory Mfg. Co
  - Georgia Pacific
- These Products must be specified or as directed by Owner Plant Operations
  - Paper Towel Dispenser - Georgia Pacific Vista Hygienic Push Paddle Dispenser
  - Soap Dispenser - Spartan Lite 'n Foamy # 9751 Foam Dispenser
  - Toilet Tissue Dispenser - San Jamar Reserva Jumbo Roll Dispenser #R3090TBK
  - Warm Air Dryer Surface Mount ADA compliant Excel ThinAir, World Dryer (Verdedri) and Saniflow Speedflow Plus
  - Recessed Automated Touchless Towel Dispenser-Georgia Pacific enMotion MFG Part # 59466

Division 11 - Equipment

- Residential Appliances
  - General Electric
  - Hotpoint
  - Maytag
  - Whirlpool
- Sound Systems
  - Contact Owner IT Projects for direction.
- Interior Score Boards
  - Daktronics
  - Electro Mech
  - Nevco
  - OES Scoreboards

Food Service Equipment

The following is an equipment list (Elementary Schools):

EQUIPMENT SCHEDULE				
ITEM NO	EQUIPMENT CATEGORY	MANUFACTURER	MODEL NUMBER	ITEM NO
1	FLY FAN	MARS AIR DOORS	42CH	1
2	TRACK SHELVING, 4–TIER	EAGLE GROUP/METAL MASTERS	2148E W/ CASTERS & TRACK	2
3	WALK–IN COOLER / FREEZER W/ ALARM, 8'–6" H	KOLPAK	–	3
4	WALK–IN SHELVING, 4–TIER	EAGLE GROUP/METAL MASTERS	2148E	4
5	PREP TABLE W/ SINKS & DRAWERS	FABRICATED	–	5
6	CUTTER, VEGETABLE	ROBOT COUPE	R602X	6
7	PREP TABLE W/ SINKS	FABRICATED	–	7
8	BIN, INGREDIENT	PIPER PRODUCTS	47–75	8
9	BAKERS TABLE	FABRICATED	–	9
10	40 QT. MIXER W/ 20 QT. ACCESSORIES	HOBART US FOODSERVICE	HL400–1STDDEL	10
11	HEATING & PROOFING CABINET	WITTCO	1826–15–BC–IS	11
12	STEAMER, CONVECTION, ELECTRIC	CLEVELAND RANGE	22CET6.1 / 22CET3.1 W/ MODIFIED ES263044	12
13	BRAISING PAN	GROEN	BPP–40E	13
14	FLOOR TROUGH	EAGLE GROUP/METAL MASTERS	FT–2436–SG	14
15	2–BURNER RANGE	CLEVELAND RANGE	450HPEM	15
16	OVEN–STEAMER, COMBINATION	CLEVELAND RANGE	OES–6.20 W/ CST–20–OB	16
17	EXHAUST HOOD W/ U.D.S.	CAPTIVE AIRE	–	17
18	WORK TABLE W/ SPLASH	FABRICATED	–	18
19	S.S. PASS–THRU WINDOW CAP	FABRICATED	–	19
20	REFRIGERATOR, PASS–THRU	DELFIELD	SSRPT1–SH	20
21	HEATED CABINET, PASS–THRU	DELFIELD	SSHPT1–SH	21
22	ICE MACHINE	HOSHIZAKI AMERICA	KM–515MAH	22
22.1	ICE BIN	HOSHIZAKI AMERICA	B–500SF	22.1
23	REFRIGERATOR, REACH–IN	DELFIELD	SAR1S–G	23
24	MILK COOLER	BEVERAGE–AIR	ST34N–S	24
25	TRAY / UTENSIL / NAPKIN CART	EAGLE GROUP/METAL MASTERS	CUSTOM	25
26	HOT FOOD UNIT, 4–WELL	EAGLE GROUP/METAL MASTERS	DCS4–HFU–C	26
27	COLD FOOD UNIT, 3–PAN	EAGLE GROUP/METAL MASTERS	DCS3–CFURN	27
28	FLAT TOP UNIT	EAGLE GROUP/METAL MASTERS	DCS2–STU	28
29	CASHIERS UNIT	EAGLE GROUP/METAL MASTERS	DCS–CUEL–36	29
30	ROLL–UP SHUTTER	BY G.C.	–	30
31	SOILED DISHTABLE	FABRICATED	–	31
32	GARBAGE PULPER W/ CONTROL PANEL & DISPOSAL	IN–SINK–ERATOR	WX–300	32
33	PANT LEG DUCT	FABRICATED	–	33
34	DISH WASHER	HOBART US FOODSERVICE	CLPS66E	34
34.1	BLOWER/DRYER	HOBART US FOODSERVICE	CLE	34.1
35	BOOSTER HEATER	HATCO	S–36	35
36	CLEAN DISHTABLE	FABRICATED	–	36
37	HOSE REEL W/ 15' HOSE	T & S BRASS	B–1432–01 MOD	37
38	HAND SINK	BY PLUMBER	–	38
39	POT & PAN DRYING RACK	CHANNEL	ATDR–3	39
40	3–COMPARTMENT POT SINK	FABRICATED	–	40
41	WALL SHELVES W/ POT HOOKS	EAGLE GROUP/METAL MASTERS	1448E W/ WALL BRACKETS	41
42	CHEMICAL SHELVING, 4–TIER	EAGLE GROUP/METAL MASTERS	2160E W/ P74 POSTS	42
43	MOP RACK	PRINCE CASTLE	936	43
44	LOCKERS	BY G.C.	–	44
45	DUNNAGE RACK	CHANNEL	MD2448CA	45
46	TRAY RACKS	CHANNEL	401A–011	46

Division 12 - Furnishings

- Blinds
  - By Owner
- Site Furnishings
  - By Owner

Division 14 - Conveying Systems

- Hydraulic Elevators Only – No traction type elevators

Division 21 - Fire Suppression

- All piping and fittings shall meet made in USA standards
- Piping
  - Wheatland Tube
  - Allied Tube
  - Northwest Pipe
- Fittings
  - Star
  - Victaulic
  - Viking

Division 22 - Plumbing

- Valves
  - Hammond
  - Nibco
  - Fairbanks
- Pumps
  - TACO
  - Grundfos
  - Armstrong
  - Peerless
  - Bell and Gossett
- Meters and Gauges
  - Ashcroft
  - Palmer
  - H.O. Trerice
  - Taylor
- Domestic Water Heater
  - State
  - Rheem
  - PVI
  - Lochinvar

- A.O. Smith
- Rennai

- Fixtures
  - American Standard
  - Eljer
  - Kohler
- Flush Valves
  - Zurn Aquasense AV ZER series
  - Sloan Regal XL
  - Sloan Royal
  - American Standard
    - Sensor operated flush valves shall use AA batteries
- Faucets
  - Chicago Faucets
  - Zurn Plumbing Products
  - T&S Brass
  - Moen 8884 and 8886 metered faucets
- Water Coolers
  - Elkay
  - Halsey Taylor
  - Acorn/Aqua
  - Oasis
- Express Lavatories
  - Willoughby
  - Acorn

Division 23 - HVAC

- Design Preferences
  - Equipment for Elementary and Middle schools - Air Cooled DX.
  - Water Source Systems shall be considered if presented to Owner in a BOD with a life cycle cost analysis or other analysis that indicates it is the best alternative for that facility.
- Dedicated Outdoor Air Units
  - Greenheck
  - Venmar
  - Governair - Nortek

- Trane/KCC
- Mitsubishi
- Captive Air
- Seasons 4

- Water Source Heat Pumps
  - Trane
  - Daikin
  - Florida Heat Pump
  - Carrier
  - ClimateMaster
  - York (JCI)
- Boilers
  - Riverside Hydronics, Model Centauri Plus 1500MBH to 2000MBH
  - Lockinvar
  - Bryan
  - Aerco
  - Patterson Kelly
- Cooling Towers
  - Evapco
  - B.A.C.
  - Stainless Steel only, no Fiberglass towers will be considered.
- Motors
  - Westinghouse
  - Wagner
  - Century
  - GE
- Controls
  - Siemens
- Pipe / Fittings
  - All pipe and fittings shall meet made in the USA standards
  - Wheatland Tube (Steel)
  - Allied Tube
  - Northwest Pipe

- Weldbend (Welded Steel Fittings)
- Cerro Tube (Copper)

- Specialties Pumps
  - B&G
  - Taco
  - Armstrong
- Valves
  - Hammond
  - Nibco
  - Fairbanks
  - Stockham
- Fired Hot Water Boilers
  - Lochinvar
  - Bryan
  - Aerco
  - Patterson Kelly
- Factory Fabricated Evaporative Cooler
  - Evapco
  - BAC
- Packaged Roof Top Air Cooled Heat Pump Units
  - Trane
  - Lennox
  - Carrier
  - York (JCI)
  - Daikin
  - ICP
  - Rheem/RUUD
- Air to Air Split Systems and Heat Pumps
  - Trane
  - LG
  - Daikin
  - Mitsubishi
  - Lennox

- Carrier
- York (JCI)
- ICP
- Rheem/RUUD

Division 26 - Electrical

- Low Voltage Transformers
  - Eaton
  - GE
  - Square D
  - Siemens
- Switchboards and Panelboards
  - Eaton
  - Square D
  - Siemens
  - GE
- Wiring Devices
  - P&S
  - Hubbell
  - Bryant
  - Arrow-Hart
- Enclosed Switches
  - Eaton
  - Square D
  - GE
  - Siemens
- Enclosed Electrical Shut Down
  - Remote Electrical Power Shut down station shall be Knox-Vault #4500 and be recessed mounted with alarm tamper switch.
- Package Generator Set
  - Caterpillar
  - Cummins
  - Kohler
  - Detroit Diesel
- Automatic Transfer Switches

- Russell Electric
- ASCO
- Zenith
- Caterpillar
- Cummins

- Transient Voltage Suppression
  - Innovative Technology
  - Liebert
  - Datek
  - Eaton
  - Square D
  - GE

- Lighting Fixtures
  - Cree
  - GE
  - Philips
  - Lithonia
  - Hubbell
  - Visionaire - Exterior

Division 32 – Exterior Improvements

- Irrigation System Supplemental Requirements
  - The irrigation system design plan must be approved by the Plant Operations Designee.
  - Contractor shall provide (3) hard copies, PDFs, and Autocad files of the new irrigation system As-builts to owner upon completion.
  - All zones must operate with efficient water pressure. The proper amount of sprinkler heads and the correct nozzle sizes installed in these heads must be achieved to ensure that each zone installed runs with the correct PSI when activated. Spray head zones equipped with standard nozzles will run at 30 PSI, spray head zones equipped with MP rotator nozzles will run at 40 PSI, and rotor head zones will run at 40 PSI as well.
  - All valve and wire connection boxes as well as sprinkler heads that are located in grass areas shall be installed at grade level so that they will not create trip hazards or be damaged by lawn equipment.
  - All heads mounted in the lawn areas shall be mounted on polyethylene pipe flex swing joints composed of 3/8" I.D. poly pipe fitted with (3/8" insert by 1/2" M.P.T.) and/or (3/8" insert by 3/4" M.P.T.) elbows.
  - All sprinkler heads designed adjacent to curbs or pavement shall be installed with a clearance of 1 ½" from the edges of all paved areas to provide for edging and maintenance

operations. No heads shall be allowed to be installed on shrub risers without the consent of the Plant Operations Designee.

- All sprinkler heads installed in bed areas shall not have the top of the head more than ½" above grade and shall be installed with a minimum of a 6" clearance from paved areas.
- Minimum depth of cover over mainline piping to be 18".
- Minimum depth of cover over lateral line piping to be 12".

- Controllers
  - The controller installed shall be a Toro Sentinel. Substitutions will not be considered. Substitutions will not be considered. This is the control system by the Owner District wide.
  - Provide a mother board that is large enough to accommodate all of the zones that are to be wired to it.
  - Install less than 250ft. away from the internet hub.
  - Coordinate exact location of controller with the Plant Operations Designee.
  - Hard wire controller to the closest breaker panel that has space. Provide all necessary conduit and breakers as required.
  - Secure to wall using metallic fasteners made for wall type 48 inches above the finished floor.
  - Ground per the latest addition of the IEC.
- Flow Sensors
  - Irrigation systems shall be equipped with a flow sensor. Flow sensors must be Toro brand and appropriately sized for the application.
  - Flow sensors must be installed downstream of the master valve.
  - Must use direct burial telecommunication shielded cable that's 18 AWG or larger to connect the flow sensor to the controller.
  - Contractors shall not install more than 1000ft of telecommunication cable without proper signal amplification.
- Master Valves
  - All irrigation systems shall be equipped with a master valve.
  - Preferred master valve shall be Rain Bird brand, model PGA –B and sized appropriately for the application.
  - The master valve shall be installed no more than 6ft downstream from the water meter and no more than 2ft up stream of the flow sensor.
- Wiring
  - Irrigation control wire installed above grade shall be incased in PVC electrical conduit
  - All wire splices shall be made using UL approved direct burial connectors and waterproofing materials.
  - Wire runs shall be installed with enough slack and/or occasional expansion loops to prevent excessive strain due to thermal expansion/contraction.

- Wire splices shall be kept to an absolute minimum. Where major concentrations of splices are necessary said splices shall be in an NDS pro-series 10” round or NDS Pro-series square valve box. Splices at valve locations shall be made inside of the valve box. All splice locations shall be noted on the AS built plan.
- All 24VAC control wiring shall be single strand copper wire with polyethylene PE direct burial insulation rated for 300VAC.
- Valve common wires shall have white insulation while valve hot wires shall have insulation red in color. Both common and hot wires shall be at least 14 AWG or larger.
- Valve wiring shall follow mainline piping where feasible and shall be laid in a common trench line with the mainline piping and in the bottom of the trench. Wiring shall be bundled and taped at intervals of approximately 10ft. All wiring shall be installed in accordance with local code requirements.
- All irrigation zone wires (hot and common) will be 14 AWG or larger.
- All boxes used for electronic valves, isolation valves, ball valves and wire connections Preferred manufacturer is NDS Pro-series 10” round boxes or NDS Pro-series square boxes.

- Athletic Fields
  - When installing irrigation for athletic fields valves of any kind shall not be installed in the playing area.
  - Preferred sprinkler heads are stainless steel Rain Bird 6504 rotors attached to 1” swing joint riser assemblies.

Appendix B: CCSD LEEDv4 for Schools Scorecard

LEED v4 for BD+C: Schools
CCSD Draft Project Checklist

Project Name:
Date:

Y	?	N				
1			D	Credit	Integrative Process	1

6	1	23		Location and Transportation		30
		15	D	Credit	LEED for Neighborhood Development Location	15
1			D	Credit	Sensitive Land Protection	1
2			D	Credit	High Priority Site	2
2		3	D	Credit	Surrounding Density and Diverse Uses	5
		4	D	Credit	Access to Quality Transit	4
1			D	Credit	Bicycle Facilities	1
		1	D	Credit	Reduced Parking Footprint	1
	1		D	Credit	Green Vehicles	1

9	3	0		Sustainable Sites		12
Y			C	Prereq	Construction Activity Pollution Prevention	Required
Y			D	Prereq	Environmental Site Assessment	Required
1			D	Credit	Site Assessment	1
2			D	Credit	Site Development - Protect or Restore Habitat	2
1			D	Credit	Open Space	1
3			D	Credit	Rainwater Management	3
2			D	Credit	Heat Island Reduction	2
	1		D	Credit	Light Pollution Reduction	1
	1		D	Credit	Site Master Plan	1
	1		D	Credit	Joint Use of Facilities	1

5	2	5		Water Efficiency		12
Y			D	Prereq	Outdoor Water Use Reduction	Required
Y			D	Prereq	Indoor Water Use Reduction	Required
Y			D	Prereq	Building-Level Water Metering	Required
2			D	Credit	Outdoor Water Use Reduction	2
2		5	D	Credit	Indoor Water Use Reduction	7
	2		D	Credit	Cooling Tower Water Use	2
1			D	Credit	Water Metering	1

15	0	16		Energy and Atmosphere		31
Y			C	Prereq	Fundamental Commissioning and Verification	Required
Y			D	Prereq	Minimum Energy Performance	Required
Y			D	Prereq	Building-Level Energy Metering	Required
Y			D	Prereq	Fundamental Refrigerant Management	Required
5		1	C	Credit	Enhanced Commissioning	6
8		8	D	Credit	Optimize Energy Performance	16
1			C	Credit	Advanced Energy Metering	1
		2	D	Credit	Demand Response	2
		3	D	Credit	Renewable Energy Production	3
1			D	Credit	Enhanced Refrigerant Management	1
		2	D	Credit	Green Power and Carbon Offsets	2

10	0	3		Materials and Resources		13
Y			D	Prereq	Storage and Collection of Recyclables	Required
Y			D	Prereq	Construction and Demolition Waste Management Planning	Required
2		3	C	Credit	Building Life-Cycle Impact Reduction	5
2			C	Credit	Building Product Disclosure and Optimization - Environmental Product Declarations	2
2			C	Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
2			C	Credit	Building Product Disclosure and Optimization - Material Ingredients	2
2			C	Credit	Construction and Demolition Waste Management	2

16	0	0		Indoor Environmental Quality		16
Y			D	Prereq	Minimum Indoor Air Quality Performance	Required
Y			D	Prereq	Environmental Tobacco Smoke Control	Required
Y			D	Prereq	Minimum Acoustic Performance	Required
2			C	Credit	Enhanced Indoor Air Quality Strategies	2
3			C	Credit	Low-Emitting Materials	3
1			C	Credit	Construction Indoor Air Quality Management Plan	1
2			C	Credit	Indoor Air Quality Assessment	2
1			D	Credit	Thermal Comfort	1
2			D	Credit	Interior Lighting	2
3			D	Credit	Daylight	3
1			D	Credit	Quality Views	1
1			D	Credit	Acoustic Performance	1

0	2	4		Innovation		6
	1	4	D	Credit	Innovation	5
	1		C	Credit	LEED Accredited Professional	1

2	2	0		Regional Priority		4
1			D	Credit	Regional Priority: Stormwater Quantity Design	1
1			D	Credit	Regional Priority: Thermal Comfort	1
	1		C	Credit	Regional Priority: Specific Credit	1
	1		C	Credit	Regional Priority: Specific Credit	1

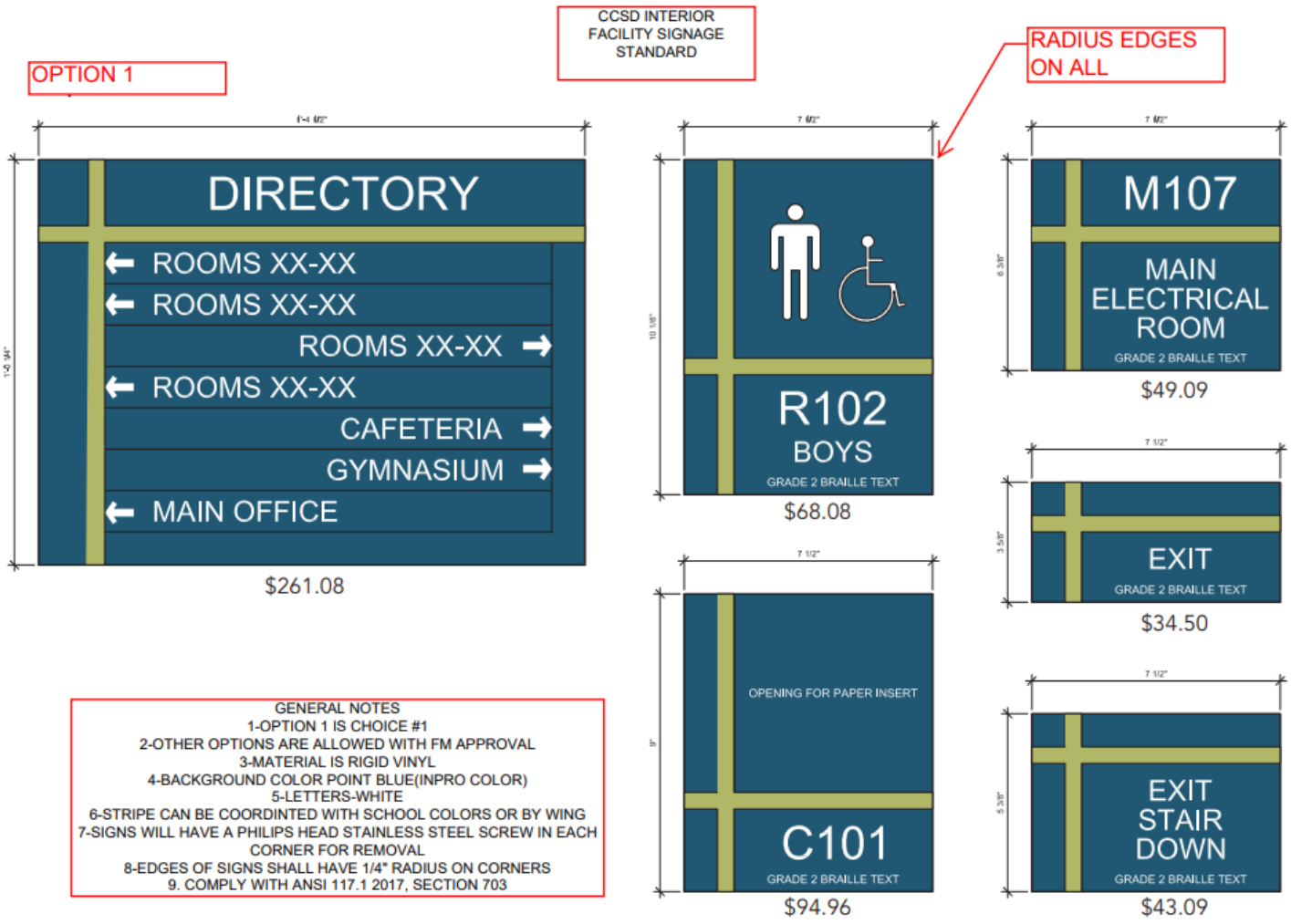
64	10	51	TOTALS	Possible Points:	125

Certified: 40 to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum:** 80 to 110

Appendix C: Room Numbering Scheme Example Chart

ROOM TYPE	EXAMPLE
1st floor classroom	102
2nd floor classroom	202
Sub-room	102A, 102B, etc.
Public toilet	T102
Private toilet	102T
Electrical room	E102
Main Corridor	CR102
Storage room	102S
Custodial room	C102
Telecommunications/Data room	D102
Vestibule	201V
Mechanical room	M102
Stairs	ST1

Appendix D: Interior Signage Standard



Appendix E: Elevator Signage

In Case of Emergency

1) Use the Emergency Call Button or Phone to Call for Help
2) If Unable to Reach Someone – Use Your Cell Phone to Call:

xxxx Elevator(Company) – (XXX) XXX-XXXX[By Elevator Maintenance Company]

OR

24 Hour Call Center-(XXX) XXX-XXXXX [By Elevator Maintenance Company]

OR

Security – (843) 296-2166

3) If You Are Still Unable to Reach Someone: Call 911

School Name:
School Address:
Building Number:
Elevator Number:

Appendix F: Asbestos/Lead Release

SECTION 00 XX XX

ASBESTOS/LEAD-FREE WARRANTY

Owner: Charleston County School District
Building Number:
Project Title:
Project Address:
Project Manual Date:

Date of Substantial Completion: _____

Know all men by these present that we, _____
(Contractor, Subcontractor, Material Supplier or Equipment Manufacturer)

having furnished labor, materials, equipment and/or supplies; installed new [Describe project components i.e. sheet rock, ACT, plumbing piping/fixture etc.] installed system and/or miscellaneous roof system components; from, to and/or on the above referenced Project under contract between the Owner and Contractor, warrant to Owner with respect to said work that no materials containing asbestos fibers or lead containing paint or plumbing fixtures were incorporated into the work, and that, to our knowledge and belief, no materials containing asbestos or lead remain in or are covered by the work.

Exceptions: _____
If there are no exceptions, state "No Exceptions" here.

Signature: _____

Title: _____

_____ State
_____ County

I, _____, a Notary Public for _____ County,
_____, do hereby certify that _____ personally appeared before me this day and acknowledged the due execution of the foregoing instrument.

Witness my hand and official seal, this ____ day of _____, 20____.

_____ (OFFICIAL SEAL)
Notary Public

My commission expires _____, 20__.

END OF SECTION 00 XX XX

Appendix G: Red Zone Checklist

CCSD Red Zone (CCSD RZ) Checklist/POAM

- The CCSD RZ Checklist/POAM is a tool to track the status of critical activities required for substantial completion to help ensure their timely completion to prevent delays with the facility acceptance and turnover.
- The critical activities are organized by section according to the responsible party (i.e. Contractor, Client, and Program Management)
- Critical items missing from this list should be added as necessary to ensure the list is comprehensive. Likewise, unnecessary items should be deleted.
- Any critical items left off the CCSD RZ Checklist that are later identified after initial CCSD RZ meeting is conducted should be added immediately so their progress can be tracked.
- A copy of the CCSD RZ Checklist/POAM shall be maintained in the contract file.

Contractor Responsibility **Critical Activities**	**Point of Contact**	**Sched Comp Date**	**Actual Comp Date**	**Notes**
A. Required for Facility Delivery:				
Final Electrical Connections				
Final Water Connections				
Final Gas Connections				
Critical System Start-up:				
System:				
System:				
DALT (duct leakage) Testing				
TABS (air balancing) Testing				
ACATS (controls) Testing				
Electrical Systems Testing				
Generator Testing				
Superchlorination of potable water systems				
Plumbing/backflow Testing				
Elevator Testing				
Boiler Testing				
Crane Testing				
Fire Alarm/Sprinkler Testing				
Keying Plan Meeting				
Deliver Lockset Cores				
IT Systems Testing				
Telecommunications Connections & Test				
Final Commissioning				
System Training of CCSD/School Personnel				
System:				

System:				
Pre-Warranty Conference				
Contractor's Pre-Final Punch List Complete				
Pre-Final Inspection				
Punch List				
Final Inspection				
BOD/Use and Possession				

B. Required for Contract Close-out:				
Delivery of O&M Manuals				
Delivery of Product Warranties				
Site Restoration				
Final Landscaping				
Spare Parts, Extra Stock, Special Tools, etc.				
As-Built Drawings				
Final Demobilization and Clean-up				
Temp Construction Fence Removed				
Project Close-out Meeting				
Close-out Storm Water Permit				
2nd Season TABS				

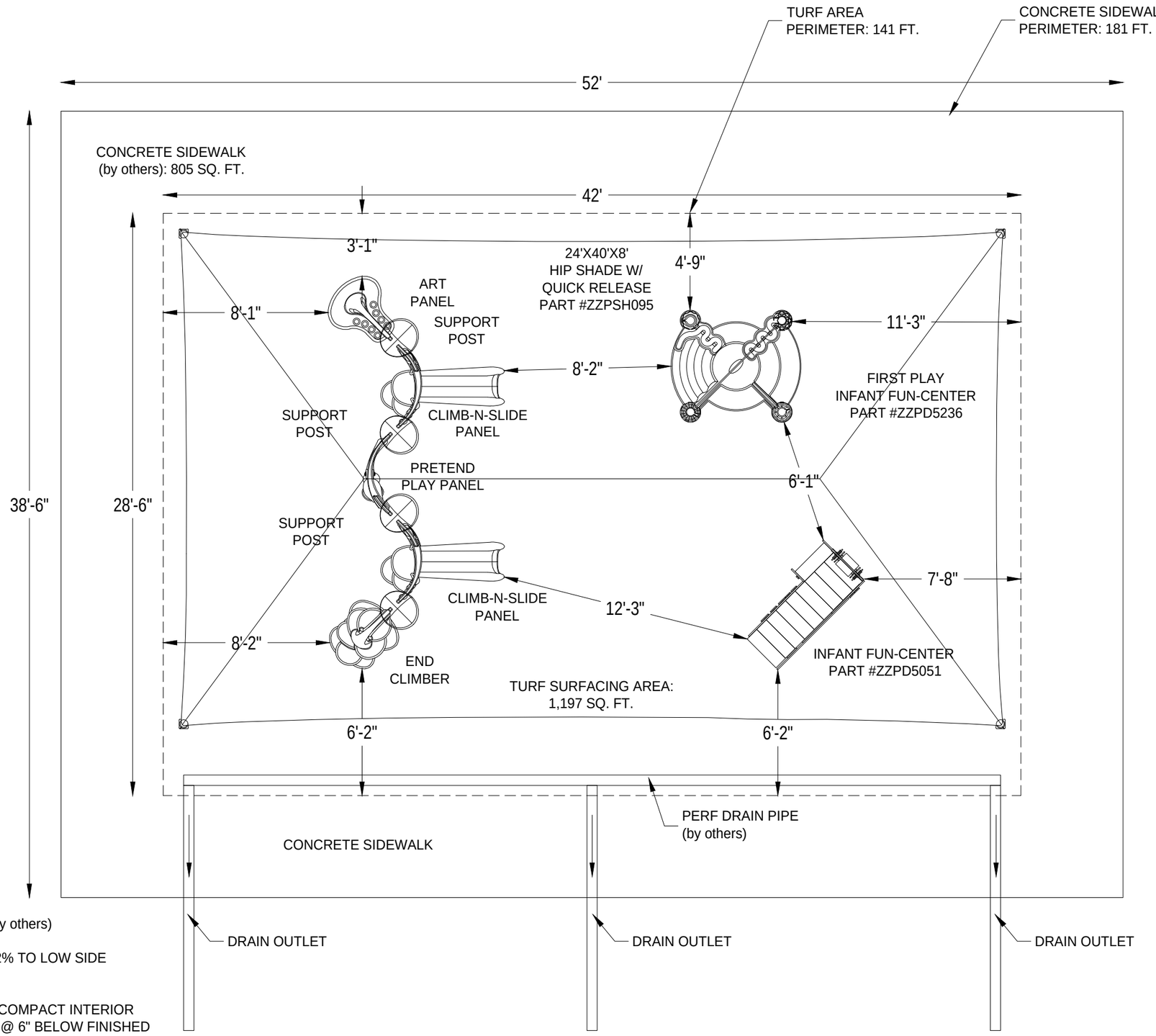
Client Responsibility **Critical Activities**	**Point of Contact**	**Sched Comp Date**	**Actual Comp Date**	**Notes**
A. Required for Facility Delivery:				
Keying Plan Meeting				
Telecommunication install				
Client provided equipment SELF installed				
Client provided equipment KTR installed				
Intrusion Detection Systems Test				
Secure Network Installations				
Attend Training				
B. Required for Contract Close-out:				
Planned Staff Move-in				
Planned on-site registration				
Planned Fact and Fee date				
Planned Open House				
Ribbon-cutting ceremony				

1

CCSD/PM Responsibility **Critical Activities**	**Point of Contact**	**Sched Comp Date**	**Actual Comp Date**	**Notes**
A. Required for Facility Delivery:				
Coordinate Final Utility Connections				
Generator Performance Verification				
Transformer Performance Verification				
DALT Verification				
1st Season TABs Verification				
ACATS Performance Verification				
Elevator Certification				
Crane Certification				
Boiler Certification				
Fire Alarm/Sprinkler Test				
Keying plan to contractor				
Lockset Cores installed				
Training Coordinated/Scheduled with FMS				
O&Ms to FMS				
Client walk-thru Inspection				
Pre-Final Inspection				
OSF Inspection				
Final Inspection				
Substantial Completion				
B. Required for Contract Close-out:				
Substantial Completion Letter to Contractor				
Acceptance Letter to Client				
Closeout permits (e.g., NPDES)				
Contractor Evaluations Complete				
Finalize Outstanding Contract Mods				
Inform CCSD of Substantial Completion				
Assist PM with AE Evaluation				
Warranty documentation to FMS				
As-Builts to FMS				
2nd Season TABs Report Review				
Annual Elevator Maintenance Complete				

Appendix H: Playground Requirements

2



NOTES:

- SITE PREP (by others)

- GRADE @ 1-2% TO LOW SIDE WITH DRAINS

-EXCAVATE & COMPACT INTERIOR OF SIDEWALK @ 6" BELOW FINISHED SIDEWALK HEIGHT (by others)

***PLAYGROUND SUPERVISION REQUIRED**

PLAYWORLD

PLAYWORLD PREFERRED
11515 Vanstory Drive, Suite 100
Huntersville, NC 28078
1-800-459-7241

EQUIPMENT SIZE:
8'8" X 19'3" X 5'

USE ZONE:
42' X 28'6"

AREA:
1,197 SqFt.

PERIMETER:
SEE DWG.

FALL HEIGHT:
2 FT.

USER CAPACITY:
15+

AGE GROUP:
6-23 mos.

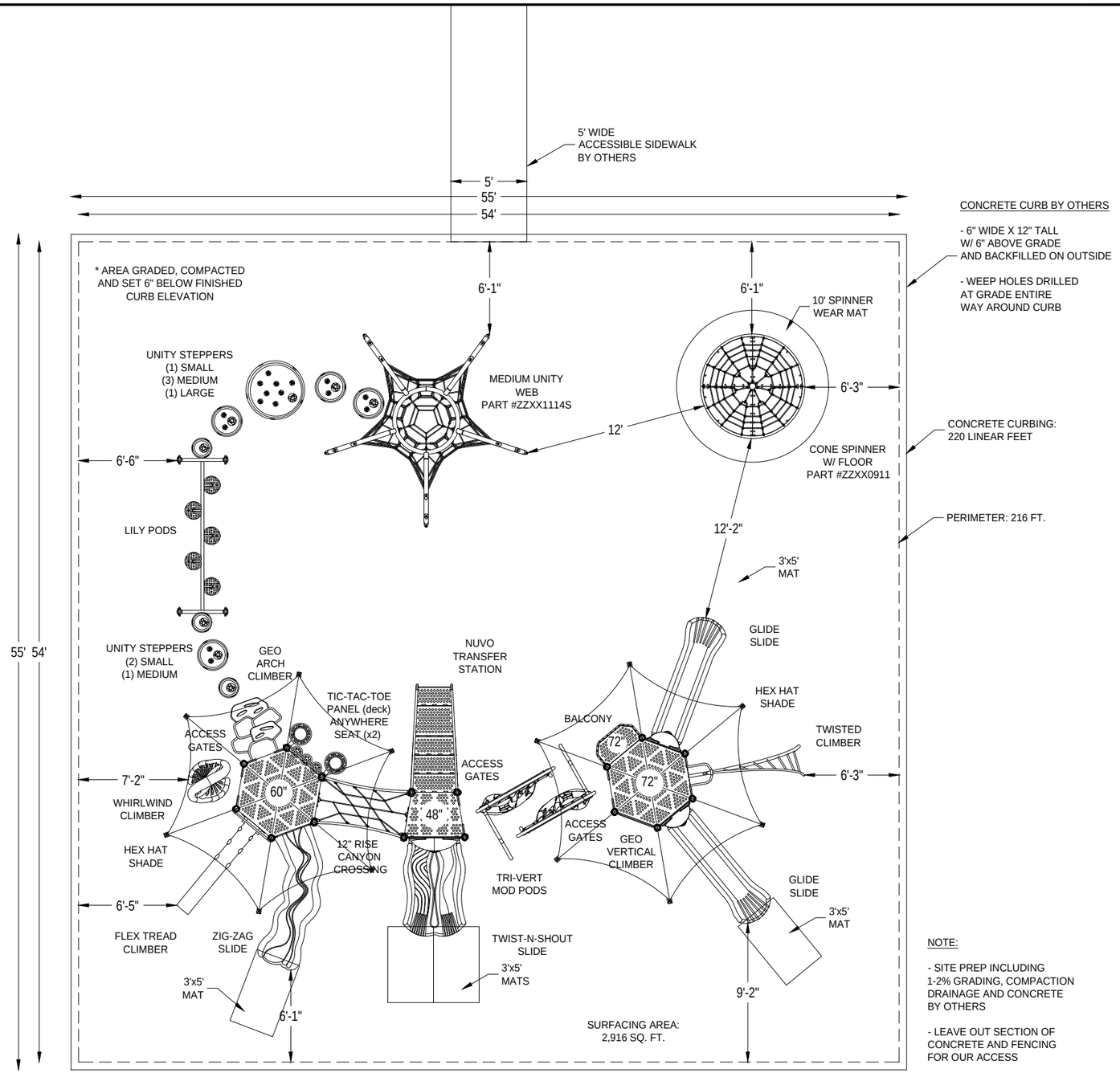
ADA SCHEDULE	Total Elevated Play Activities: 0	Total Ground-Level Play Activities: 13	
	Accessible Elevated Activities	Accessible Ground-Level Activities	Accessible Ground-Level Play Types
Required	0	0	0
Provided	0	13	3

✓ ASTM F1487-17
✓ CPSC #325

PROJECT NO:	SCALE:
20-2622A	**3/16"=1'-0"**
DRAWN BY: **CHIP ZECHMAN**	Paper Size **B**
DATE: **23-JUNE-2020**	

CCSD CAPITAL STANDARD - 0-2 YEARS

CHARLESTON COUNTY SCHOOL DISTRICT



NOTE:

- SITE PREP INCLUDING 1-2% GRADING, COMPACTION DRAINAGE AND CONCRETE BY OTHERS

- LEAVE OUT SECTION OF CONCRETE AND FENCING FOR OUR ACCESS

***PLAYGROUND SUPERVISION REQUIRED**

PLAYWORLD

PLAYWORLD PREFERRED
11515 Vanstory Drive, Suite 100
Huntersville, NC 28078
1-800-459-7241

EQUIPMENT SIZE:
42' X 42' X 19'

USE ZONE:
54' X 54'

AREA:
2,916 SqFt.

PERIMETER:
216 Ft.

FALL HEIGHT:
8 Ft.

USER CAPACITY:
90+

AGE GROUP:
5-12

ADA SCHEDULE

Total Elevated Play Activities: **13**

Total Ground-Level Play Activities: **13**

	Accessible Elevated Activities	Accessible Ground-Level Activities	Accessible Ground-Level Play Types
Required	7	4	3
Provided	13	13	4

✓ ASTM F1487-17
✓ CPSC #325

PROJECT NO:
20-1227A

SCALE:
1/8"=1'-0"

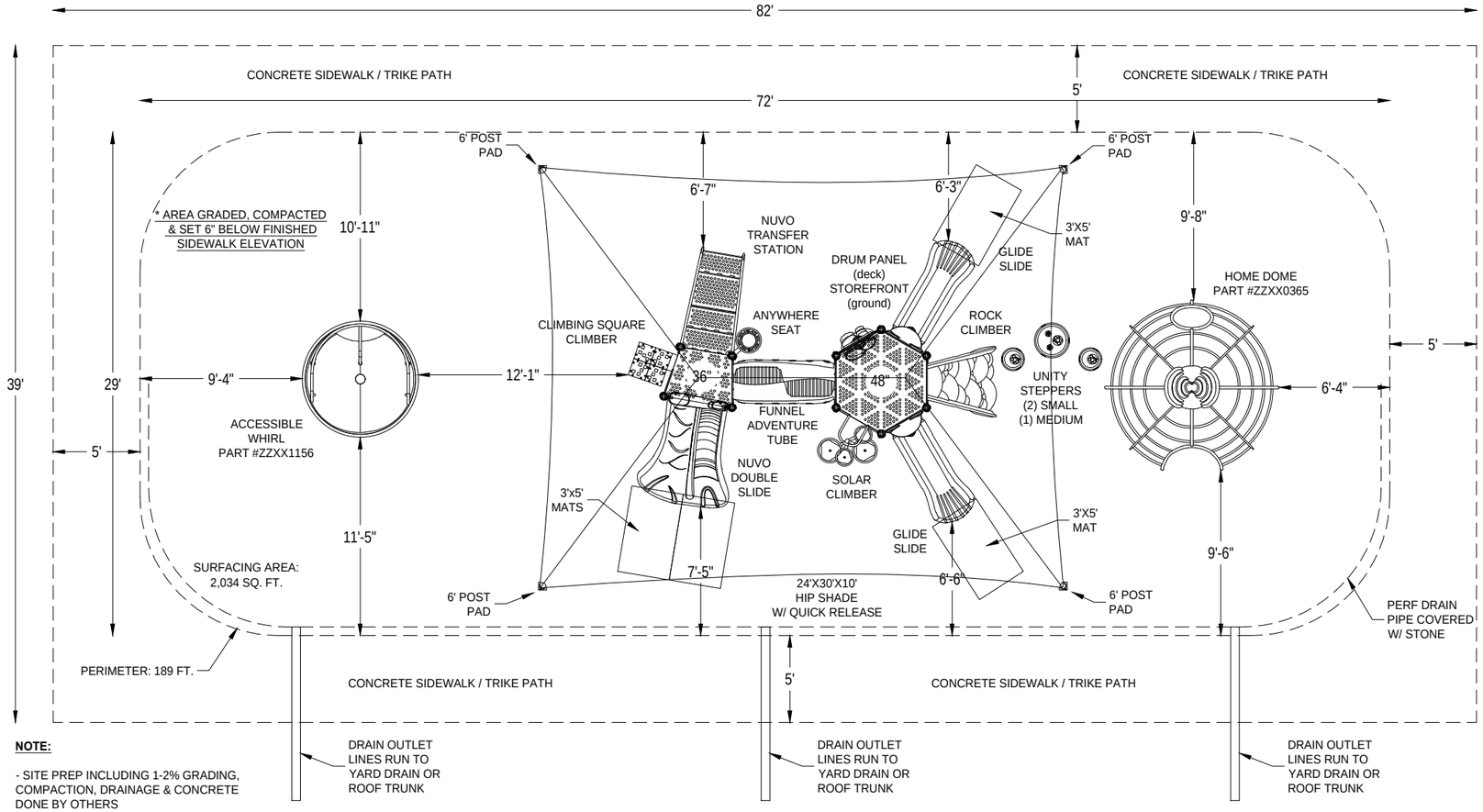
DRAWN BY:
CHIP ZECHMAN

Paper Size
B

DATE:
15-APR-2020

CCSD CAPITAL SPEC - SCHOOL AGE

CHARLESTON COUNTY SCHOOL DISTRICT



NOTE:

- SITE PREP INCLUDING 1-2% GRADING, COMPACTION, DRAINAGE & CONCRETE DONE BY OTHERS
- LEAVE OUT SECTION OF CONCRETE AND FENCING FOR OUR ACCESS

***PLAYGROUND SUPERVISION REQUIRED**

PLAYWORLD

PLAYWORLD PREFERRED
11515 Vanstory Drive, Suite 100
Huntersville, NC 28078
1-800-459-7241

EQUIPMENT SIZE:
37'7" X 16'4" X 10'

USE ZONE:
72' X 29'

AREA:
2,034 SqFt.

PERIMETER:
189 Ft.

FALL HEIGHT:
5 Ft.

USER CAPACITY:
52+

AGE GROUP:
5-12

ADA SCHEDULE	Total Elevated Play Activities: 8		
	Total Ground-Level Play Activities: 7		
	Accessible Elevated Activities	Accessible Ground-Level Activities	Accessible Ground-Level Play Types
Required	4	3	3
Provided	8	7	4

✓ ASTM F1487-17
✓ CPSC #325

PROJECT NO:
20-1226A

SCALE:
1/8"=1'-0"

DRAWN BY:
CHIP ZECHMAN

DATE:
15-APR-2020

Paper Size
B

CCSD CAPITAL SPEC - KINDERGARTEN

CHARLESTON COUNTY SCHOOL DISTRICT

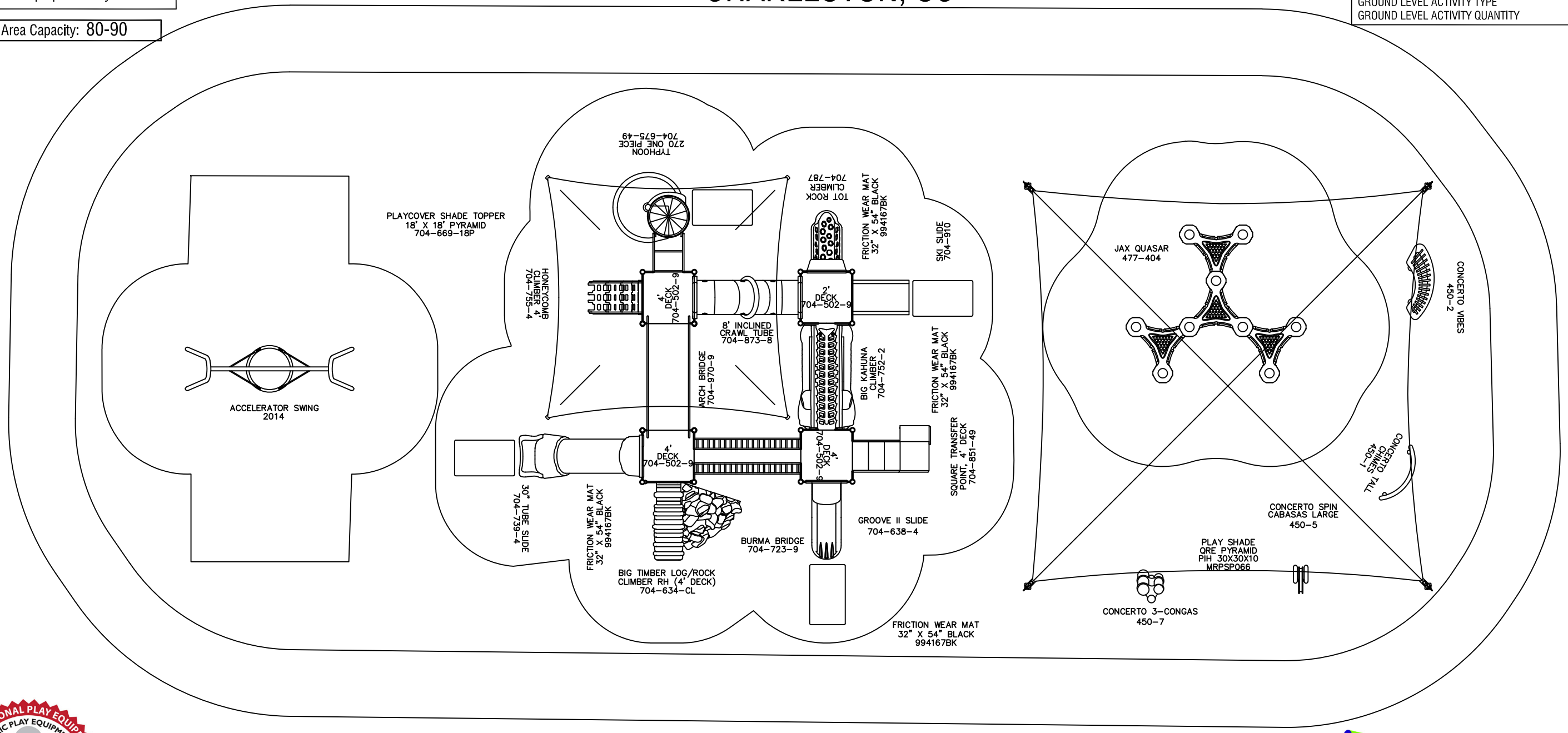
AREA: 4377 sq ft
PERIMETER: 271 ft
The information provided is for estimation purposes only.

Play Area Capacity: 80-90

CHARLESTON COUNTY STANDARD PLAYGROUND
CHARLESTON, SC

2-12 PLAY AREA

ELEVATED PLAY ACTIVITIES - TOTAL	10		
ELEVATED PLAY ACTIVITIES ACCESSIBLE BY TRANSFER	10	REQ'D	5
ELEVATED PLAY ACTIVITIES ACCESSIBLE BY RAMP	0	REQ'D	0
GROUND LEVEL ACTIVITY TYPE	3	REQ'D	3
GROUND LEVEL ACTIVITY QUANTITY	8	REQ'D	3



To promote safe and proper equipment use by children, Miracle recommends the installation of either a Miracle safety sign or other appropriate safety signage near each playsystem's main entry point(s) to inform parents and supervisors of the age appropriateness of the playsystem and general rules for safe play.

To verify product certification, visit www.ipema.org

THE PLAY COMPONENTS IDENTIFIED IN THIS PLAN ARE IPEMA CERTIFIED. THE USE AND LAYOUT OF THESE COMPONENTS CONFORM TO THE REQUIREMENTS OF ASTM F1487.

AN ENERGY ABSORBING PROTECTIVE SURFACE IS REQUIRED UNDER & AROUND ALL PLAY SYSTEMS.

CD225459

GROUND SPACE: 95' X 33'
PROTECTIVE AREA: 97' X 43'

✓ COMPLIES TO CPSC
✓ COMPLIES TO ASTM
✓ COMPLIES TO ADA

DESIGNED FOR AGES 2-12

ADDITIONAL GROUND LEVEL ACCESSIBLE ITEMS NEEDED FOR ADA COMPLIANCE

TYPE:	QUANTITY:
0	0

DATE: 3/17/2020

SCALE: 1/8"=1'-0"

TRIP

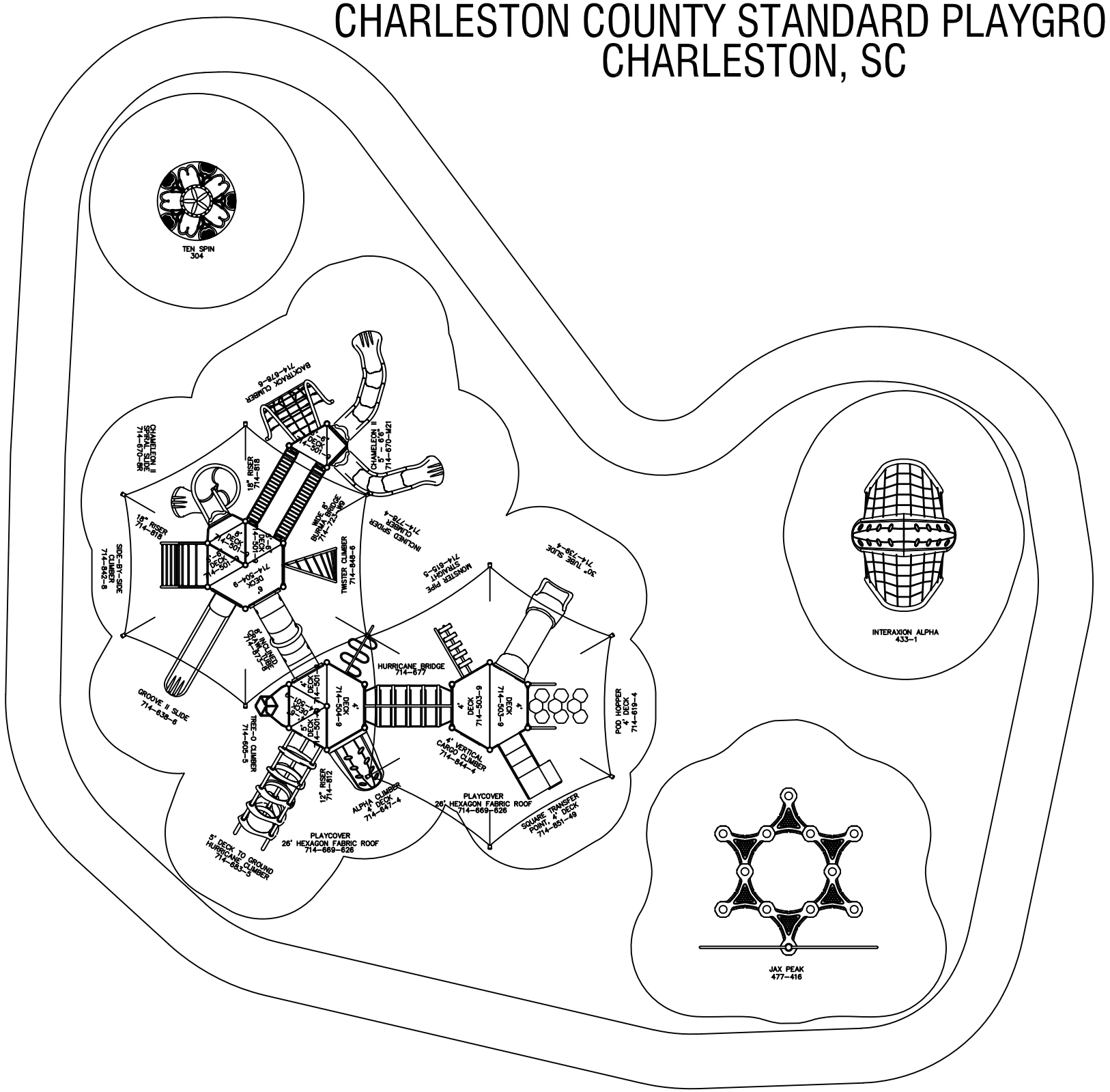
AREA: 5351 sq ft
PERIMETER: 304 ft
The information provided is for estimation purposes only.

Play Area Capacity: 145-155

CHARLESTON COUNTY STANDARD PLAYGROUND
CHARLESTON, SC

5-12 PLAY AREA

ELEVATED PLAY ACTIVITIES - TOTAL	18		
ELEVATED PLAY ACTIVITIES ACCESSIBLE BY TRANSFER	18	REQ'D	9
ELEVATED PLAY ACTIVITIES ACCESSIBLE BY RAMP	0	REQ'D	0
GROUND LEVEL ACTIVITY TYPE	2	REQ'D	3
GROUND LEVEL ACTIVITY QUANTITY	3	REQ'D	6



To verify product certification, visit www.ipema.org

To promote safe and proper equipment use by children, Miracle recommends the installation of either a Miracle safety sign or other appropriate safety signage near each playsystem's main entry point(s) to inform parents and supervisors of the age appropriateness of the playsystem and general rules for safe play.

Miracle

THE PLAY COMPONENTS IDENTIFIED IN THIS PLAN ARE IPEMA CERTIFIED. THE USE AND LAYOUT OF THESE COMPONENTS CONFORM TO THE REQUIREMENTS OF ASTM F1487.

AN ENERGY ABSORBING PROTECTIVE SURFACE IS REQUIRED UNDER & AROUND ALL PLAY SYSTEMS.

CD225460

GROUND SPACE: 74' X 74'
PROTECTIVE AREA: 87' X 87'

✓ COMPLIES TO CPSC
✓ COMPLIES TO ASTM
✓ COMPLIES TO ADA

DESIGNED FOR AGES 5-12

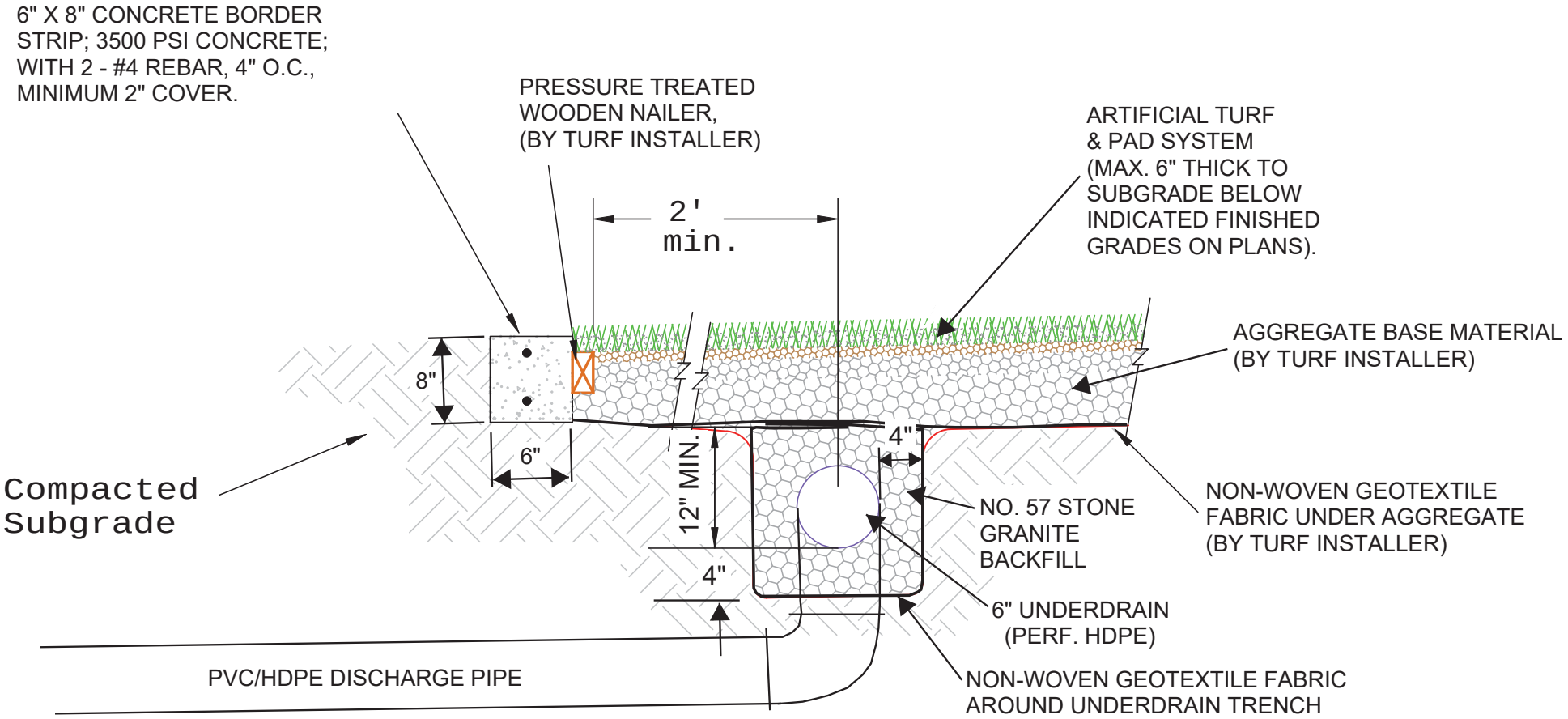
ADDITIONAL GROUND LEVEL ACCESSIBLE ITEMS NEEDED FOR ADA COMPLIANCE

TYPE:	QUANTITY:
1	3

DATE: 3/17/2020

SCALE: 1"=12'-0"

TRIP



ARTIFICIAL TURF WITH UNDERDRAIIN DETAIL

NOT TO SCALE

THIS IS SAMPLE FROM OTHER PROJECTS. IT THE RESPONSIBILITY OF THE CIVIL ENGINEER TO DESIGN A SYSTEM THAT WORKS FOR THE PARTICULAR SITE CONDITIONS.

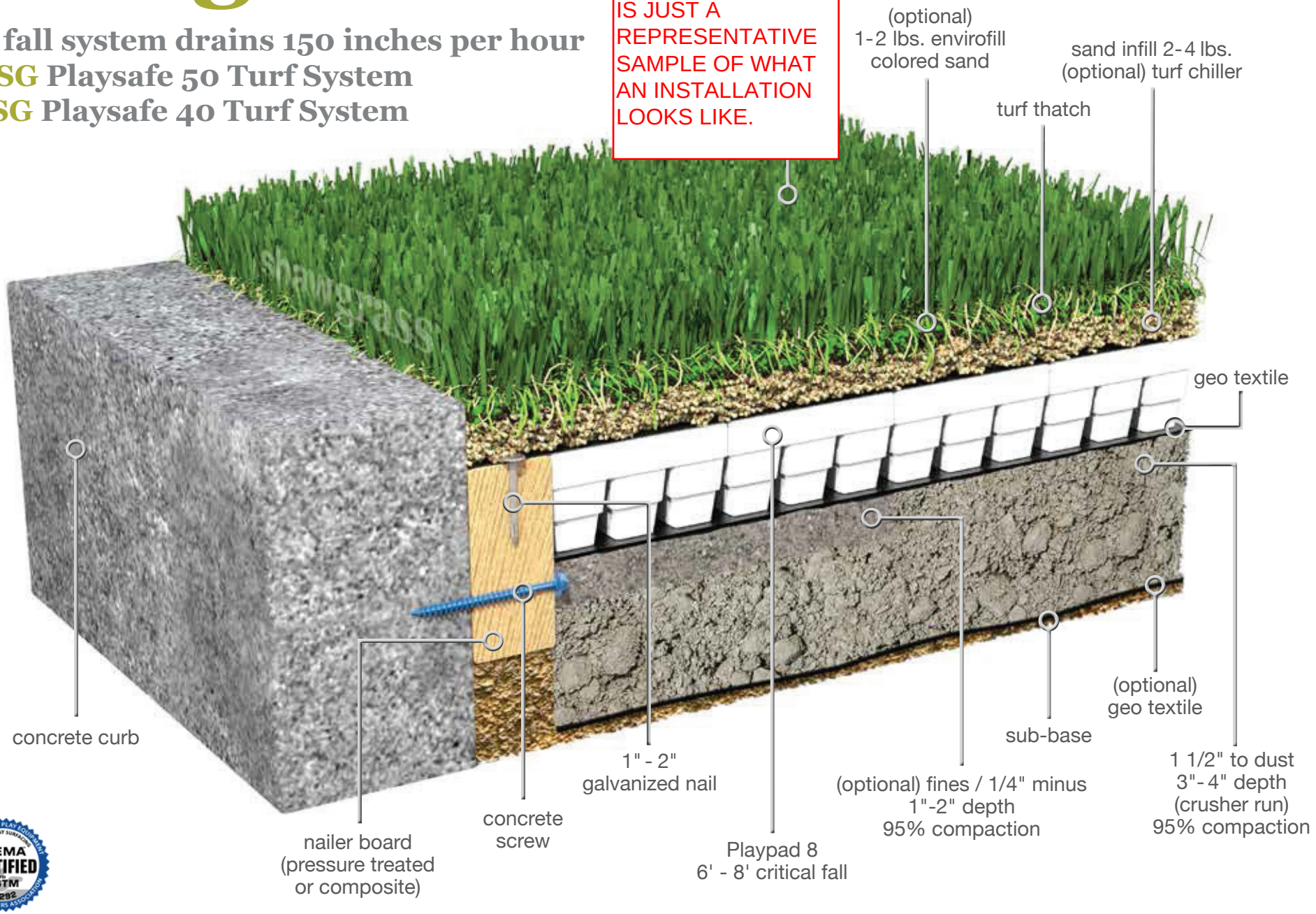
shawgrass®

THIS IS NOT AN ENDORSEMENT OF SHAWGRASS. THIS IS JUST A REPRESENTATIVE SAMPLE OF WHAT AN INSTALLATION LOOKS LIKE.

6-8' fall system drains 150 inches per hour

054SG Playsafe 50 Turf System

139SG Playsafe 40 Turf System



IPEMA CERTIFIED to ASTM F1292

- For “high use” commercial playgrounds
- IPEMA Certified.
- Wheelchair accessible (ASTM F 1951).
- Water permeable: The turf, pad and sand infill drain at a rate of 150 inches per hour (ASTM F 1551).
- Turf system can be installed over concrete, asphalt, or crushed stone bases with positive drainage.
- During the spring, summer and fall seasons all synthetic surfaces can get hot. Shaw’s Turf Chiller™ sand infill, when hydrated by rain, dew or irrigation, can provide up to 50 degree lower surface temperatures that last for days compared to standard synthetic surfaces.
- Sand infill: We recommend a minimum of 3 pounds per square foot by combining two (2) pounds of Turf Chiller™ sand with one (1) pound of clean silica sand to lower costs. Turf Chiller™ offers antimicrobial protection to help prevent the growth of bacteria, mold/mildew and reduce odors.

shawgrass®

054SG Play Safe 50 Turf System
139SG Play Safe 40 Turf System
For 6’-8’ critical fall heights (ASTM F 1292)

- **Additional ASTM testing available upon request:**

Impact Attenuation (ASTM F 1292)

Wheelchair Accessibility (ASTM F 1951)

Rainfall Drainage Capacity (ASTM F 1551)

Grab Tear Strength (ASTM D 5034)

Pill Flammability (ASTM D 2859)

Static COF-James Machine (ASTM D 2047)

Appendix I: Sample Project Specific Owner's Project Requirements

CCSD OWNER PROJECT REQUIREMENTS
PROJECT TITLE:
LOCATION:
DATE APPROVED:
GENERATED BY: CAPITAL CONSTRUCTION PROGRAM/FACILITIES MANAGEMENT
"Documents any Project Specific Deviations to the CCSD Design Requirement. See 2.1.2 Paragraph 4"

NUMBER	DATE OF CHANGE	PARAGRAPH	EXPLANATION FOR DEVIATION	APPROVED
1	4/20/2020	Div. 08	Access control (power over Ethernet) will be provided and installed as an integrated package that functions seamlessly with the door hardware and provided by one vendor. The devices will be fully compatible with the door hardware specified in this document. The door preparation at the factory will be coordinated by the access control vendor. Exit devices with panic hardware shall use a motorized latch release system. The card reader will be integrated into the door handle unless there is a structural reason to mount it beside the door. CCSD will review the design package for access control as a separate design and shop plan submittal to ensure compliance with our existing systems.	Y

Appendix J: Design Requirements Change Log

CCSD Design Requirements Major Change Summary Log 2020

This log summarizes major revisions to the CCSD Design Requirements Release #07 October 2020. All sections in the Design Requirements document should be reviewed for complete updates on the Design Requirements

No	Section	Topic/Issue	Change to Requirements
1	Div. 23	Notification of DOAS Start-up	Notification language added
2	Appendix A	Visionaire vVSX Area Light with LED Array	Visionaire added under Lighting Basis of Design. "Visionaire - exterior lighting"
3	Div. 14	Conditioned Elevator Machinery Rooms	Air -conditioned machine room language added
4	Div. 10	Fire Code / Hanging Wall Art in Hallways	Language added: Tack strips: shall be ¼ inch cork with metal trim on all sides. Allow one foot of tack strip in hallway between classrooms for each student not to exceed covering a total of 20% of the wall surface
5	Div. 10	Operable Walls	Language Added: Panel walls shall be factory primed (with manufacturers recommended primer for steel) and painted with an erasable marker paint OR factory primed with 2 coats of pre-catalyzed water based semi-gloss epoxy. Total DFT (dry film thickness) minimum shall be 5 mils or 1.5 mils per coat.
6	Div. 32	Landscaping Prior to Turnover on NC Project	Language on biweekly grass cutting added
7	Div. 23	Mechanical Cooling Failure	Language Added: DOAS shall have a temp and humidity sensor that calculate dewpoint installed in the discharge air duct that will shut down the unit and send an alarm to the BAS if unit fails to meet dewpoints.
8	Appendix A	Solution Dyed Carpet	Language added
9	Div. 22	Water Fountain Filters	Currently Reads: All interior water coolers shall include two separate units - one standard height and one handicap. The handicap water cooler shall have a water bottle filler on it. All water coolers shall have filters that meet NSF/ANSI 42 and 53.
10	Div. 26	Exterior Lights	Language added
11	Div. 10	Reserved Parking	Titled Signs deleted.
12	Div. 11 & Appendix A	MS and HS Gym Scoreboards	Changes made to Division 11 and Appendix A
13	Appendix A	Classroom Door Locks	Changed to ML2057
14	Div. 22	Toilets and sinks	Deleted Verbiage: [Optional: Specify hands free, hard wired, electronic flush valves and mixing faucets throughout the building for all water closet flush valves, lavatories, and hand washing sinks.]
15	Div. 08	Vision lights for classrooms	Director of Security to be consulted on all glazing for interior classroom doors
16	Div. 23	HVAC Equipment Labeling	MEP design drawings shall contain a note telling contractor not to install electrical disconnects on the equipment identification tag.
17	Div. 10	Exterior Building Number Signage	Added language in Division 10 with specifications for exterior building numbering scheme
18	Div. 01 and Appendix F	Asbestos/Lead Free Documentation	Language added to Division 01 and Asbestos/Lead Free Warranty Form is located in Appendix F
19	Div. 8	Master Keys / Locksets	Increase number of master keys required from 15 to 25 / Locksets provided with red construction cores
20	Div. 11	Medical Equipment	Owner will supply the equipment (AED & STB) - Cabinets to be furnished by Contractor
21	Div. 11	Construction and FF&E Budget	Chart updated for allowable and not allowed Construction and FF&E Budget Items
22	Div. 23	HVAC Equipment Tags	All HVAC equipment to have a 6"x4" black label with 1" white letters identifying the unit name, building number and schedule number. AE schedule to be coordinated with Owner labeling convention
23	Div. 10	Building Number Signage	Adding 4 digit sign to right corner of every building - New Sign specifications and installation requirements
24	Div. 09	Flooring by Functional Use	Updates to flooring requirements for specific areas
25	Div. 32	Playgrounds	Update to materials requirements for playgrounds
26	Div. 01 & Appendix F	Asbestos/Lead Free Documentation	AE/Contractor shall provide a notarized letter to Owner stating that no asbestos or lead containing materials were used in the design or construction of the Project
27	Div. 10 & Appendix E	Emergency Elevator Signage	Updated language for signs in Elevator on what to do in case of an emergency
28	Part 1 - Project Phases Section 2.6 CCA & Appendix G	Red Zone Review & Checklist	Requirement for a Red Zone Review Conference and Red Zone Review Checklist provided in Appendix for Completion
29	Div. 23	Controls Integration Meeting	Requirement to have a Controls Integration meeting after equipment has been sized and selected
30	Div. 09	Stairwell Flooring	Added visual contrasting strip to rubber stair treads in Stairwells (landings and risers)
31	Div. 10 & Appendix D	Interior Signage Standards	Appendix D has new standards for creation of interior signage
32	Div. 32	Fire Truck Access Lanes	Requirements for Access lane that cross play areas
33	Part 1 Section 2.2	Door Hardware	AE required to meet with Owner to coordinate door hardware
34	Part 1 Section 2.2	Security Plan	AE to provide plan that addresses classroom security including camera locations, access control and site fencing and consult with CCSD security on size of vision lights on classroom doors.
35	Div. 07	Roofing	Added fluid applied to modified bitumen for low sloped roof type. Added Canopies shall be factory coated and not field painted
36	Div. 23	HVAC Equipment Start-up notification	DOAS shall have a duct sensor (temp or humidity) installed that will shut down the unit and send an alarm to the BAS if unit fails to meet dewpoints
37	Div. 23	Equipment Start-up Notification	Provide 48-hour notice of system start-ups of major HVAC equipment to CCSD HVAC shop Foreman.
38	Div. 26	LED performance	LED light fixtures shall have been available commercially for a minimum of three years.
39	Div. 26	Line Voltage sensors	Change from Dual technology sensors to Line voltage occupancy sensors in the ceiling shall control lighting in classrooms and conference rooms.
40	Div. 32	Canopy Lighting	Canopy lighting is required on all entrances, bus loop and car rider loop structures. The conduit and lights shall be run below the roof deck and secured to the structure and not screwed through the roof.
41	Div. 32	Landscaping	Requirement for biweekly grass cutting until project is turned over to Owner
42	Div. 32	Storm Drainage	Retention ponds to be designed with a fore bay
43	Div.01	Wall System Warranty	Metal wall systems and assemblies to have a 20 year coastal finish warranty
44	Div. 07	Roof Hatches	Requirement for Safety rail system around roof hatches. AE to submit plan to Owner for approval
45	Div. 08	FRP Doors	FRP Doors cannot be field painted
46	Div. 08	Aluminum Storefront Doors	Requirement if Blade Stop frame is provided
47	Div. 08	Skylights	Skylights require fall protection
48	Div. 08	Finish Hardware	Requires training and certification of training provided as a submittal

49	Div. 08	Finish Hardware	Change to mullion requirements on double door and foyer entrances
50	Div. 09	Flooring	Can only be selected from approved Owner List
51	Div. 09	Acoustical Ceiling Tile	White is the only color approved for ceiling tile. For wall panel colors - coordinate with Owner
52	Div. 09	Paint	Changes highlighted in yellow
53	Division 10	Security Signage	Adding door locations for first responders
54	Division 10	Operable Wall Panels	Additional requirements including must be factory primed
55	Division 10	Accordion Folding Partitions	Must have minimum STC rating of 45
56	Div. 10	Toilet Partitions	Mounting and bracing requirements
57	Div. 22	Water Coolers	New Filter Requirements/ new hydrant requirement and Tankless water heater preference
58	Div. 32	Athletic Fields	New Requirement for qualifications and installations of athletic Fields
59	Appendix H	Playground Standards	New Requirements for Playground Standards by school type
60	Appendix A	Basis of Design Manufacturers	Added ICP and Rheem/RUUD to list for Packaged Roof top Air Cooled Heat Pumps and Air to Air Split Systems and Heat Pumps. Added new DOAS equipment providers
61	Div. 23	Tempering / Conditioning of Corridors and Aria	First floor corridors to be tempered to 76 degrees / Multi-story buildings to have conditioned corridors and Atria above the first floor
62	Div. 27	Communications Section	Entire Section Revised - Complete review necessary
63	Div. 23	Indoor Environmental Quality	Indoor Occupied Cooling Set point lowered from 74 degrees to 73 degrees.
64	Div. 23	MERV 13 Filtration	MERV 13 filter media at a minimum of 2 inch thickness is required on all new equipment selections for new construction and major renovations.
65	Appendix I	OPR for Project Specific Requirements	Sample OPR included as Appendix I
66	Section 2 - Project Phases	CAD Drawing Standards	Requirement on Standard for execution of CAD drawings
67	Div. 23	Conditioned Elevator Machinery Rooms	Added to 23 as well as Division 14
68	Div. 14	Two Way Communication	Language added re: two way communication in safe refuge areas
69	Sec 2.3 Design Development	Hardware Selection	Meeting between Architect and CCSD regarding hardware selection moved from SD to DD phase

Appendix ‘B’

Geotechnical Report

GEOTECHNICAL ENGINEERING REPORT

HURSEY MONTESSORI SCHOOL
NORTH CHARLESTON, SOUTH CAROLINA
MAY 4, 2021
INSIGHT GROUP NO. 21-0042

Prepared for:
Red Iron Architects
4591 Durant Avenue
North Charleston, SC 29405

Prepared by:
Insight Group, LLC
3359 Meeting Street, Suite 101
North Charleston, South Carolina

INSIGHT GROUP

May 4, 2021

Red Iron Architects
4591 Durant Avenue
North Charleston, SC 29405

Attn: Ms. Emma Souder
843-834-2677
emma@red-ironarchitects.com

Re: Geotechnical Engineering Report
Hursey Montessori School
North Charleston, South Carolina
Insight Group Number: 21-0042

Dear Ms. Souder,

The purpose of this report is to present geotechnical recommendations for design and construction of the Hursey Montessori School project in North Charleston, South Carolina. This report presents our understanding of the proposed improvements, the site and subsurface conditions, and recommendations.

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

Sincerely,
Insight Group, LLC

Christina L. Olsen

Christina L. Olsen, P.E.
Geotechnical Consultant

SOUTH CAROLINA
INSIGHT GROUP, LLC
No. 5937
CERTIFICATE OF AUTHORIZATION

SOUTH CAROLINA
LICENSED PROFESSIONAL ENGINEER
No. 27816
BRYAN T. SHIVER

Bryan T. Shiver, P.E.
Geotechnical Consultant

APPENDICES

Exhibit A	Site and Test Location Plans
Exhibit B	Testing Logs
Exhibit C	Ground Motion Hazard Analysis

1 EXECUTIVE SUMMARY

Insight Group has completed the geotechnical investigation for the Hursey Montessori School project in North Charleston, South Carolina. The following geotechnical considerations were identified during our investigation:

- The field tests indicate that subsurface soils consist of loose to medium dense sands to a depth of 23 feet. Following the sands are soft to firm clays to 27 feet then medium dense to dense sands overlaying the Cooper Marl Formation (CMF), which was encountered at approximately 43 feet below existing grade.

- Insight Group has evaluated a shallow foundation system for the site. Static post-construction settlement is expected to be 1 inch or less across the site with differential settlement up to ½ inch over 50 feet.

- According to IBC, the liquefaction potential at the site classifies the site as Site Class F. However, IBC allows for an exception to the Site Class F designation if the fundamental period of the structure is less than 0.5 seconds based on ASCE 7-16. Considering this exception, the site can classify as a Site Class D for determining seismic design parameters. However, the structural engineer should verify that the site class exemption provided by this code is available for the proposed structure.

- Insight Group has performed a site-specific seismic hazard analysis for the project per the requirements in ASCE 7-16 Section 11.4.8. The analysis is outlined in Section 5 of the report.

This executive summary is a brief outline and should not be utilized in design or construction without reading the report in its entirety. The subsequent sections of this report constitute our fully developed findings, conclusions and recommendations.

2 INTRODUCTION

Insight Group has completed the geotechnical evaluation for the Hursey Montessori School project in North Charleston, South Carolina in general accordance with our proposal dated February 10, 2021. The purpose of this report is to provide geotechnical information and recommendations for design and construction of the project.

Insight Group evaluated the subsurface conditions with seven Cone Penetration Tests (CPT) and two Seismic Cone Penetration Tests (SCPT) extending from 32 to 49 feet below existing grade. Hand Auger Borings (HAB) were performed adjacent to the SCPT/CPT tests and at eight locations within proposed pavement areas to depths of 4 feet. Testing locations were provided by Red Iron Architects based on conversations with the civil and structural engineers. CPT sounding records and HAB logs are attached in Exhibit B and the test location plan is attached in Exhibit A. The CPT soundings were conducted in general accordance with ASTM D5778.

3 PROJECT INFORMATION

3.1 Site Location and Current Condition

The project site is located at 3795 Spruill Avenue in North Charleston, SC. Approximate coordinates are 32.86330, -79.98013. The site currently consists of the abandoned Ronald McNair School and associated pavement and landscaped areas.

3.2 Project Description

We understand that the existing Ronal McNair School is scheduled for demolition and will be replaced with the new three-story Hursey Montessori School with associated parking and drive areas. The new school will be approximately 60,000 square feet and occupy a different configuration than the current Ronald McNair School. We understand that a retaining wall may be necessary along the eastern side of the new school due to site constraints between the new school and Spruill Avenue.

The structural loads for the proposed development are unknown at this time, however, we have assumed the following typical loads for three story structures: column loads up to 200 kips and wall loads up to 6 kips per linear foot. If final loads exceed these values, Insight Group should be notified to update these recommendations.

Based on the civil plan provided by Red Iron on 5/3/2021, existing grades within the majority of the proposed building footprint range from 30 to 35 feet. At the southern corner of the proposed building footprint existing grades range from 24 to 35 feet. Based on this information we are assuming that fill heights may range up to 11 feet to achieve finished grade. If final grading plans differ from our assumption, further review will be necessary.

4 GEOTECHNICAL CONDITIONS

4.1 Soil Profile

The field investigation indicates the subsurface conditions can be generalized by the following soil profile:

Table 1. Generalized Subsurface Conditions

Layer	Depth (feet)		Approximate Layer Thickness (feet)	Description
	from	to		
1	0	23	23	Loose to medium dense sand to silty sand
2	23	27	5	Soft to firm clay with varying amounts of sand and silt
3	27	43	16	Medium dense to dense sand to silty sand
4	43	45[1]	2	Stiff sandy silt (Cooper Marl Formation[2])

1. Termination of deepest testing.
2. The Ashley Formation, locally called Cooper Marl Formation, is a relatively uniform and well-studied geologic stratum that underlies the Charleston, SC area. The Cooper Marl Formation was formed during the Oligocene and Eocene Epochs and is typically comprised of stiff silts and clays. The layer is generally 200 to 300 feet thick in the region.

We observed topsoil to be between 3 inches and 8 inches at the test locations across the site.

4.2 Existing Pavement

Coring was performed for tests located within existing pavement areas. The pavement sections encountered consisted of asphalt concrete, concrete and graded aggregate base at varying thicknesses. The following table summarized the results of the pavement coring. The individual conditions at each test location can be seen on the HAB logs in Exhibit B.

Table 2. Pavement Core Results

Test	Surface Course Type	Surface Course Thickness (in)	Base Course Type	Base Course Thickness (in)
HAB-11	Asphalt Concrete	1.0	Graded Aggregate Base Course	5.0
HAB-12	Asphalt Concrete	2.0	Graded Aggregate Base Course	5.0
HAB-13	Asphalt Concrete	2.0	Graded Aggregate Base Course	8.0
HAB-14	Concrete	4.0	None	--
HAB-15	Asphalt Concrete	4.0	Graded Aggregate Base Course	6.0

4.3 Groundwater

The estimated groundwater depths at the time testing are listed in Table 3. Groundwater was not encountered at the HAB locations.

Table 3. Estimated Groundwater Depths at Time of Testing

Test	Estimated Groundwater Depth (ft)	Test	Estimated Groundwater Depth (ft)
SCPT-01	10.0	CPT-06	14.0
CPT-02	13.5	CPT-07	12.5
CPT-03	15.0	CPT-08	12.5
CPT-04	12.0	CPT-09	12.5
CPT-05	13.0		

Groundwater levels can fluctuate and should be measured prior to commencing construction to determine its effect on site work and excavations.

5 SEISMIC HAZARD

The International Building Code (IBC) requires that structures be designed to account for seismic hazard local to the project site. The seismic hazard is defined by standardized maps compiled by National Earthquake Hazards Reduction Program (NEHRP) and United States Geological Survey (USGS). These maps provide base seismic design parameters, which must be modified to account for the generalized soil conditions at the site. These soil conditions, called the Site Soil Classification, define the Seismic Site Class. With the Seismic Site Class determined, the seismic design parameters for the site can be calculated in accordance with IBC and ASCE procedures.

Seismic Site Class designation ranges from A to F. The designation varies based on the stiffness of the upper 100 feet of the soil profile at the site, with A being stiffest and E containing thick deposits of very soft soils. Site Class F is a special case determined by the liquefaction potential of the subsurface soils.

5.1 Liquefaction Potential

In addition to ground shaking, deformations associated with liquefaction is a principle hazard to be considered in seismic design of structures. We have evaluated the potential for liquefaction and soil strength loss during the design seismic event (acceleration of PGA_M).

Due to the encountered soil conditions, Insight Group has applied an in-depth liquefaction testing and analysis protocol for this site and utilized measured downhole shear wave velocity (Vs) measurements. We applied Vs data to evaluate liquefaction potential independently of the CPT tip resistance using relationships per Stokoe/Andrus[1], Kayen et. al[2], NCEER[3], as well as effective aging properties using the measured-to-estimated Vs method. In several layers, the Vs measurements indicate higher small-strain stiffness and therefore more resistance to liquefaction than the CPT tip resistance alone. Table 4 summarizes our liquefaction hazard calculations.

[1] Stokoe, Kenneth H. and Andrus, Ronald D., "Liquefaction Resistance of Soils from Shear-Wave Velocity," Journal of Geotechnical and Geoenvironmental Engineering 126 (2000): 1015 – 1025.

[2] Kayen, R., Moss, R.E.S., Thompson, E.M., Seed, R.B., Cetin, K.O., Der Kiureghian, A., Tanaka, Y. and Tokimatsu, K., "Shear-Wave Velocity-Based Probabilistic and Deterministic Assessment of Seismic Soil Liquefaction Potential," Journal of Geotechnical and Geoenvironmental Engineering 139 (2013): 407-419.

[3] Youd, T.L.., Idriss, I.M. et. al, "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils," Journal of Geotechnical and Geoenvironmental Engineering 127 (2001): 817-833.

Table 4. Liquefaction Settlement

Test Name	Total Estimated Liquefaction Settlement (in)	Linear Distance between Tests (ft)		Differential Settlement (in/linear foot)
SCPT1	0.6			--
CPT2	0.7	107	SCPT1 to CPT2	0.0009
CPT3	2.2	189	CPT2 to CPT3	0.0079
CPT4	1.8	143	CPT3 to CPT4	0.0028
CPT5	2.1	134	CPT4 to CPT5	0.0022
CPT6	2.2	192	CPT5 to CPT6	0.0005
CPT7	2.4	75	CPT6 to CPT7	0.0027
SCPT8	2.3	80	CPT7 to SCPT8	0.0013
CPT9	3.1	100	SCPT8 to CPT9	0.0080
average	*1.93*	---	---	*0.003*
min	*0.60*	---	---	*0.001*
max	*3.10*	---	---	*0.008*

The risk framework of the International Building Code allows structures in Risk Categories I/II/III to be damaged during a seismic event but requires avoidance of total collapse. Based on typical structural design in the Charleston area, we do not expect ground improvement will be required to mitigate the liquefaction hazard. However, the project structural engineer should review our recommendations.

5.2 Seismic Site Class and Design Parameters

According to IBC, the liquefaction potential at the site classifies the site as Site Class F. However, IBC allows for an exception to the Site Class F designation based on ASCE 7-16 Section 20.3.1 which states "*for sites where liquefaction potential is present, seismic design parameters may be based on the otherwise-determined site classification rather than Site Class F, provided the fundamental period of the structure is less than 0.5 seconds*".

Based on an average shear wave velocity of 979 ft/s obtained at the site, a Site Soil Classification of Site Class D – "Stiff Soil" would be appropriate for determining the seismic design parameters. Insight Group should be notified if the structure's period is planned to exceed 0.5 seconds. In such a case, the site would not meet the ASCE 7-16 exception and would classify as a Site Class F, requiring a site-specific seismic response analysis be performed to determine seismic design parameters.

5.2.1 Ground Motion Hazard Analysis

Based on the ASCE exception, the seismic design parameters for the site can be obtained through mapped values based on a Site Class D Site Soil Classification. However, per ASCE 7-16 Section 11.4.8, structures on Site Class D sites with an S_1 value greater than or equal to 0.2 require a ground motion hazard analysis be performed to determine seismic design parameters. The Site Class D mapped values indicate that the site has an S_1 value is greater than 0.2. Therefore, a ground motion hazard analysis is required for the site.

A probabilistic seismic hazard analysis was performed per the method described in ASCE 7-16 Section 21.2 using commercial software EZ-Frisk using attenuation relations that represent regional and local geology. The results of the seismic hazard analysis can be found in Exhibit C and are summarized in Table 5.

Table 5. Ground Motion Hazard Analysis Results

Item	Value
S_{DS} – Design Spectral Acceleration at Short Period	1.032 g
S_{D1} – Design Spectral Acceleration at 1-s Period	0.625 g
PGA_M – MCE Geo-Mean PGA	1.043 g

6 GEOTECHNICAL RECOMMENDATIONS

6.1 Earthwork

Earthwork should generally proceed in the following order:

1. Clear and grub large vegetation
2. Remove existing structures, pavements and other deleterious material
3. Strip topsoil and other organic materials and remove and backfill root balls
4. Verification of the stability of stripped subgrade by Geotechnical Engineer
5. Place fill per the grading plan
6. Verification of compaction and stability of fill by Geotechnical Engineer

6.1.1 Site Drainage

The long-term saturation of on-site soils will lead to severe degradation of the subgrade. Therefore, developing and implementing a comprehensive site drainage plan prior to major construction activities will be key to successful earthwork operations. Site drainage can be accomplished with the excavation of a series temporary/permanent detention ponds, drainage

ditches, and/or swales across the project site. These drainage systems can be incorporated into the final site grading plans.

6.1.2 Site Preparation

After implementation of site drainage, the initial step in site preparation should be to remove existing structures, pavement, trees, topsoil, organics, and other deleterious material from within the proposed construction area footprint. Stripping should extend a minimum of 5 feet outside the construction area footprint. Voids remaining from the clearing/stripping operation should be backfilled with properly compacted Controlled Fill.

After stripping and subgrade repair is completed, the near surface should be densified with a vibratory roller. After densification, structural areas should be evaluated by Insight Group. Depending on the grading plans, the evaluation may include proofrolling with a loaded tandem axle dump truck or other similar approved construction equipment. Insight Group should monitor proofrolling operations. Areas that pump or rut excessively should be undercut and reworked or replaced with Controlled Fill.

Due to the clean sandy nature of the upper soils, some rutting of the sands may occur during proofrolling, especially if the soils are dry of optimum. This rutting is not necessarily indicative of instability, just a function of the rounded uniformity of the sand particles. Insight Group will take this into consideration when evaluating proofrolls.

6.1.3 Material Types

Materials used for site grading should meet be USCS classification SP, SP-SM, SP-SW, SW, or SM and have less than 35% passing the #200 sieve, and be free of organic matter and other deleterious debris.

The near surface soils consist of sand to silty sand and may be used as borrow material for site development. We do not expect large quantities of borrow material to be generated from the site, however, Insight Group can provide further consultation regarding characterization and treatment of on-site materials for use as structural fill if needed.

6.1.4 Compaction Specifications

We recommend the following compaction specifications be utilized for the project:

Table 7. Compaction Specifications

ITEM	DESCRIPTION
Fill Lift Thickness	➢ Smooth drum/sheepsfoot rollers: fill lifts shall have a maximum of 10 inches in loose thickness ➢ Jumping jack/plate compactor: fill lifts shall have a maximum of 2 to 4 inches in loose thickness
Compaction Requirements[1,2]	➢ Controlled Fill: 95% of the material's maximum Modified Proctor dry density (ASTM D1557) ➢ General (Onsite) Fill: 95% of the material's maximum Standard Proctor dry density (ASTM D698)
Moisture Content	Workable levels, generally within the range of ±2% of optimum moisture content value.

1. Fill should be tested for moisture content and compaction during placement. If the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. Asphalt concrete and base course materials for pavements should meet SCDOT compaction specifications.

6.1.5 Earthwork Quality Control

The earthwork efforts should be monitored under the direction of Insight Group. This monitoring should include documentation of adequate removal of vegetation and topsoil, proof-rolling and mitigation of areas delineated by the proof-roll to require mitigation.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by Insight Group prior to placement of additional lifts. Each lift of fill should be tested for density and water content at a frequency of at least one test for every 2,500 square feet of compacted fill in building areas and 5,000 square feet in pavement areas. One density and water content test for every 50 linear feet of compacted utility trench backfill.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. In the event unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of Insight Group into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer of Record's evaluation of subsurface conditions, including assessing variations and associated design changes.

6.2 Lateral Earth Pressures

We understand that a retaining wall may be necessary along the eastern side of the new school due to site constraints between the new school and Spruill Avenue. The retaining wall should be designed for earth pressures at least equal to those indicated in the following table. Additionally, once final site grading plans are available, Insight Group should review the plans to verify slope stability of the area. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. The wall restraint condition will determine the appropriate earth pressures for design. Active pressure can be used when the top of wall is free to move 0.002H to 0.004H. At rest earth pressure is used when there is no wall movement. The recommended design lateral earth pressure coefficients do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls or surcharge pressures.

Table 8. Estimated Soil Parameters & Lateral Earth Pressure Coefficients along Eastern Portion of New School

			Estimated Soil Parameters			Lateral Earth Pressure Coefficients		
Layer	Soil Type	Depth / Approx. Elevation (ft)	Total/Effective Unit Weight (pcf)	Cohesion (psf)	Friction Angle (deg)	At Rest (k_o)	Active (k_a)	Passive (k_p)
--	Controlled Fill	--	120 / 57.6	--	32	0.47	0.31	3.25
1	Loose Sand to Silty Sand	0 to 7 / +30 to +23	110 / 47.6	--	30	0.50	0.33	3.00
2	Medium Dense Sand to Silty Sand	7 to 20 / +23 to +10	120 / 57.6	--	34	0.44	0.28	3.54

1. Elevations estimated from civil plan provided by Red Iron Architects on 5/3/2021.

6.3 Foundation Recommendations

6.3.1 Shallow Foundations

Following proper site preparation, the proposed structure can be supported by shallow spread footing foundations bearing on in-situ or properly compacted Controlled Fill. The following table presents a summary of our foundation analysis and recommendations.

Table 9. Shallow Foundation Design Parameters

Design Parameter	Value	
Assumed Column Load	200 kips	
Assumed Wall Load	6 kips/linear foot	
Maximum Footing Size Used in Analysis	10'x10' column	3' wide wall
Estimated total static settlement	1 inch or less	
Estimated differential static settlement	½ inch over 50 feet	
Allowable Bearing Pressure	2,000 psf	

6.3.2 Foundation Quality Control

The base of all foundation excavations should be free of water and loose material prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Should the soils at bearing level become excessively dry, disturbed or saturated, or frozen, the affected soil should be removed prior to placing concrete. Place a lean concrete mud-mat over the bearing soils if the excavations must remain open overnight or for an extended period. It is recommended that Insight Group be retained to observe and test the soil foundation bearing materials.

If debris or unsuitable bearing soils are encountered in footing excavations, the excavation could be extended deeper to suitable soils. The footing could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. As an alternative, the footings could also bear on properly compacted Controlled Fill extending down to the suitable soils. Overexcavation for compacted structural fill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of overexcavation depth below footing base elevation. The overexcavation should then be backfilled up to the footing base elevation with Controlled Fill material placed in lifts of 8 inches or less in loose thickness 6 inches or less if compacted with hand guided equipment) and compacted to at least 95 percent of the material's modified effort maximum dry density (ASTM D1557).

6.3.3 Floor Slabs

Provided site preparation recommendations herein are followed, ground level slabs can be designed as slab-on-grade on grade with a subgrade reaction (k) of 200 psi/in.

The use of a vapor retarder should be considered below floor slabs that will be covered with wood, tile, carpet or other moisture sensitive materials. For additional floor slab recommendations refer to the ACI Design Manual.

7 PAVEMENTS

7.1 Subgrade Preparation

We recommend the moisture content and density of the top 12 inches of the subgrade be evaluated prior to commencement of paving operations. Areas not in compliance with the required ranges of moisture or density should be moisture-conditioned and recompacted. Attention should be paid to high traffic areas that were previously rutted and disturbed and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the materials with properly compacted fills.

The Graded Aggregate Base Course (GABC) should be compacted to 100% of its modified Proctor as determined by ASTM D1557. The Asphalt Concrete should be compacted to SCDOT specifications.

7.2 Design Considerations and Pavement Sections

Traffic counts and vehicle types were not available at the time of this report. We have provided typical pavement loading for a multi-family development. Table 10 shows the recommended minimum pavement sections.

Table 10. Minimum Pavement Sections

Pavement Section	Minimum Section Thickness (in)		
	Light Duty[1]	Heavy Duty Asphalt[2]	Heavy Duty Concrete[3,4]
SCDOT Asphalt Type	C	C	---
Surface Course	2	3	---
Intermediate Course SCDOT Type C	---	---	---
Portland Cement Concrete	---	---	6
Graded Aggregate Base	6	8	4
Total Thickness	8	11	10

1. Passenger car drive and parking areas
2. Main entrance, truck drive and truck loading unloading areas
3. Recommended for turning aprons and dumpster pad
4. Concrete pavement should have a minimum 4,000 psi compressive strength, 4-inch maximum slump and 5% to 7%

Minimum section thickness is based upon assumed traffic amounts, Insight Group should be notified once the traffic requirements are determined to review and revise these estimates as needed.

8 LIMITATIONS OF REPORT

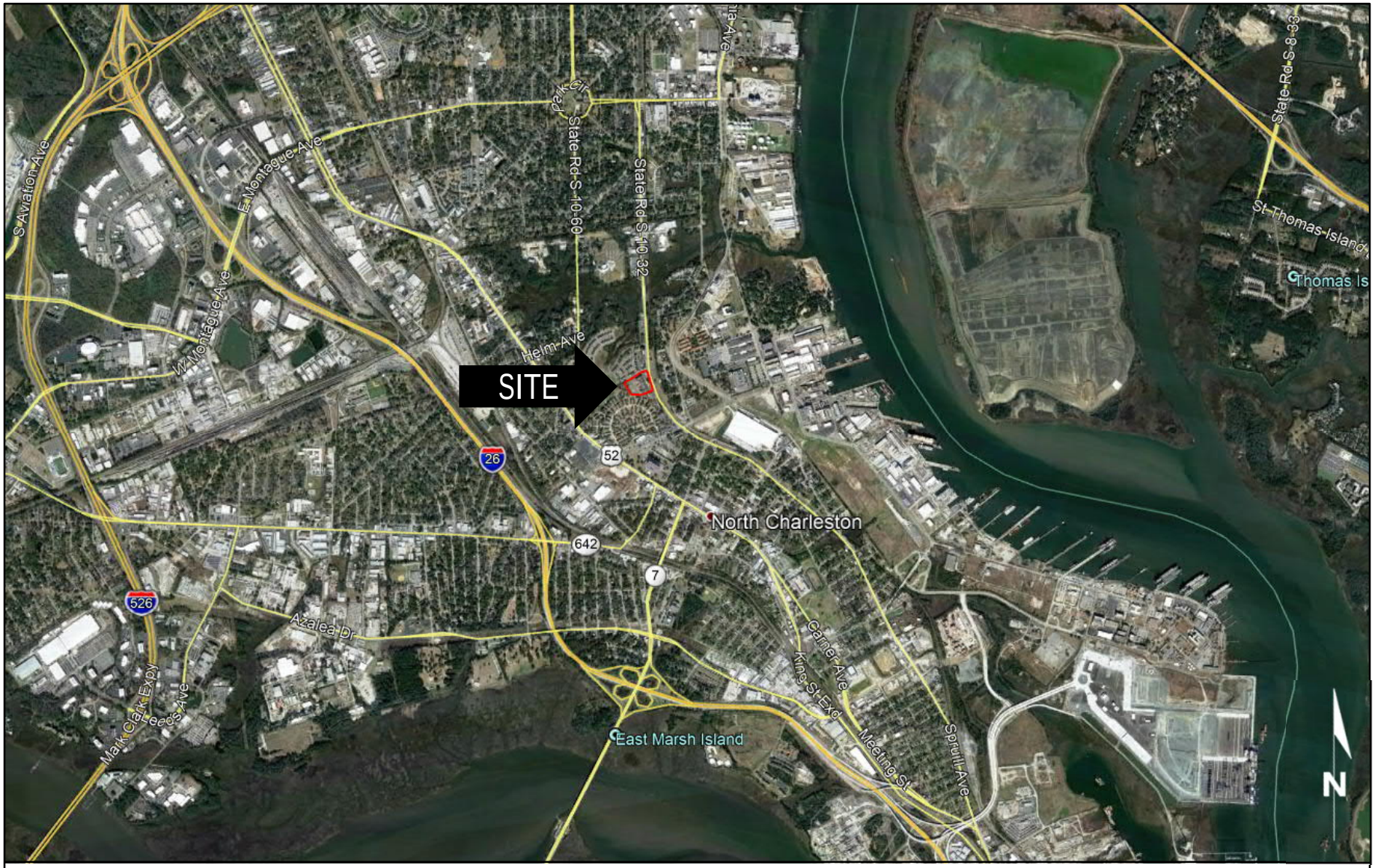
These services and this report have been performed in accordance with the local standard of practice. These recommendations apply only to the specific project referenced herein. Conclusions and recommendations are based on the observations and collected measurements. Subsurface tests were performed at discrete locations; subsurface conditions can vary between test locations. Insight Group should review final plans and specifications for construction to ensure that the recommendations contained herein remain valid.

APPENDICES

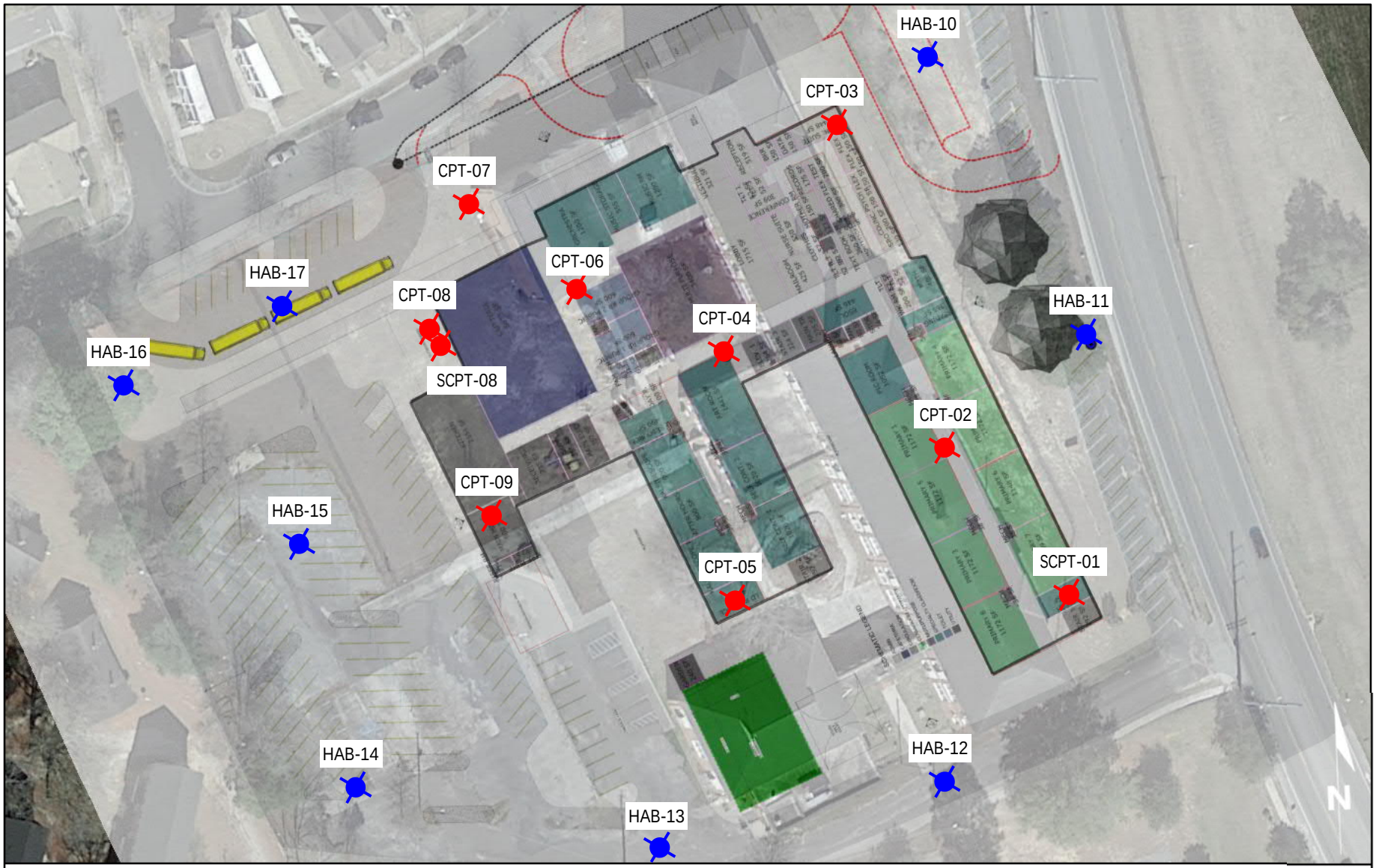
Exhibit A	Site and Test Location Plans
Exhibit B	Testing Logs
Exhibit C	Ground Motion Hazard Analysis

EXHIBIT A

Site and Test Location Plans



Legend	INSIGHT GROUP 3359 Meeting St. N. Charleston, SC 29405 Phone: (843) 779 9824 InsightGrp.com	Project Name: Hursey Montessori Project Number: 21-0042 Date: 5/4/2021	Site Location Hursey Montessori School Geotechnical Engineering Report North Charleston South Carolina	Exhibit A



Legend

- Cone Penetration Test (CPT)
- Hand Auger Boring (HAB)

INSIGHT GROUP
3359 Meeting St. N. Charleston, SC 29405
Phone: (843) 779 9824 InsightGrp.com

Project Name: Hursey Montessori

Project Number: 21-0042

Date: 5/4/2021

Test Location Plan

Hursey Montessori School
Geotechnical Engineering Report

North Charleston South Carolina

Exhibit

A

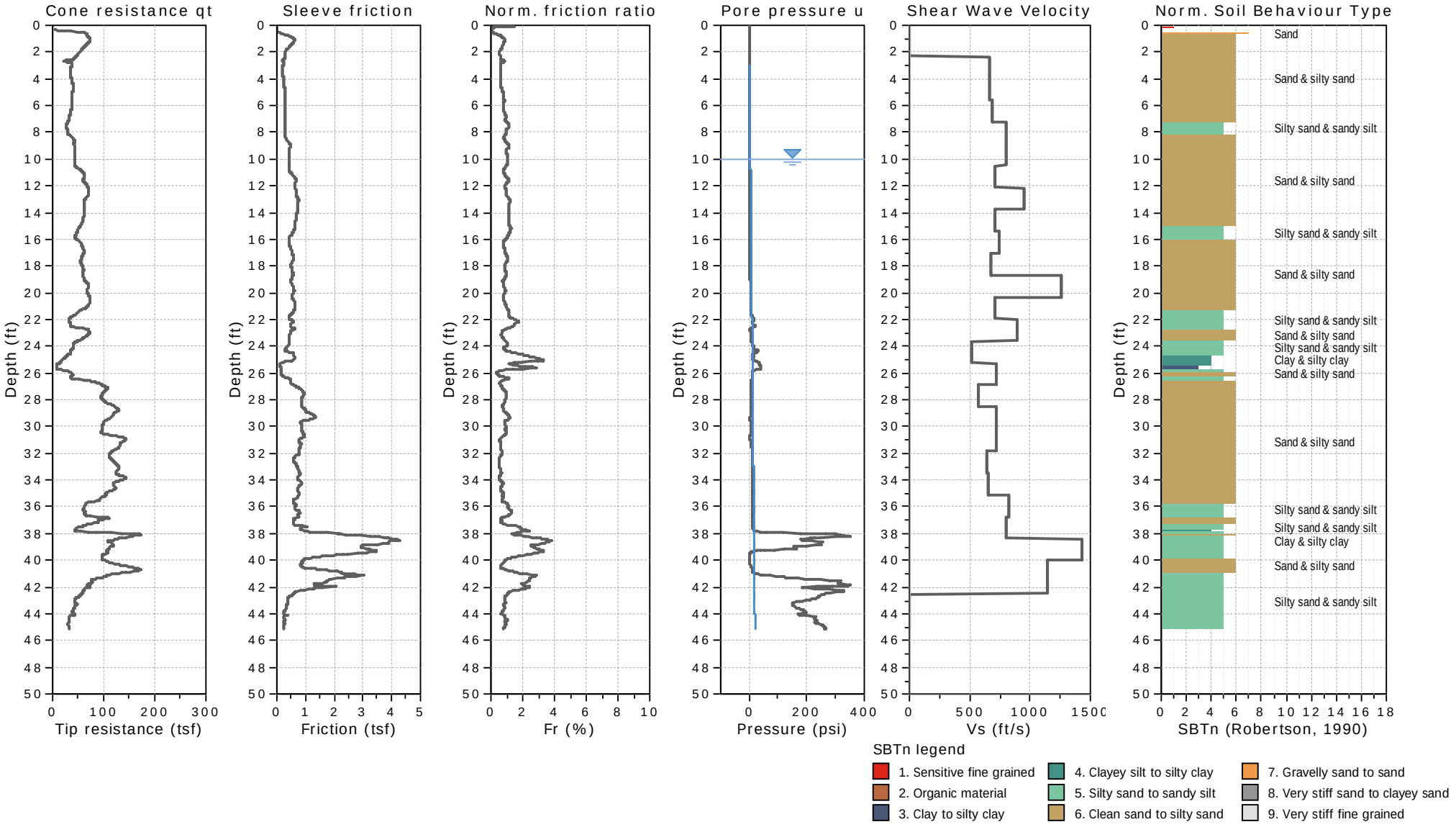
EXHIBIT B

Testing Logs

INSIGHT GROUP
Geotechnical, Environmental and Construction Consultants
3359 Meeting Street, Suite 101
North Charleston, SC
www.InsightGrp.com

Project: 21-0042 Hursey Montessori School
Location: North Charleston, SC

CPT: SCPT-01
Total depth: 31.96 ft, Date: 4/15/2021
Coords: lat 32.862935° lon -79.979516°
Cone Type: Pagani
Cone Operator: M. Hess



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3359 Meeting Street, Suite 101
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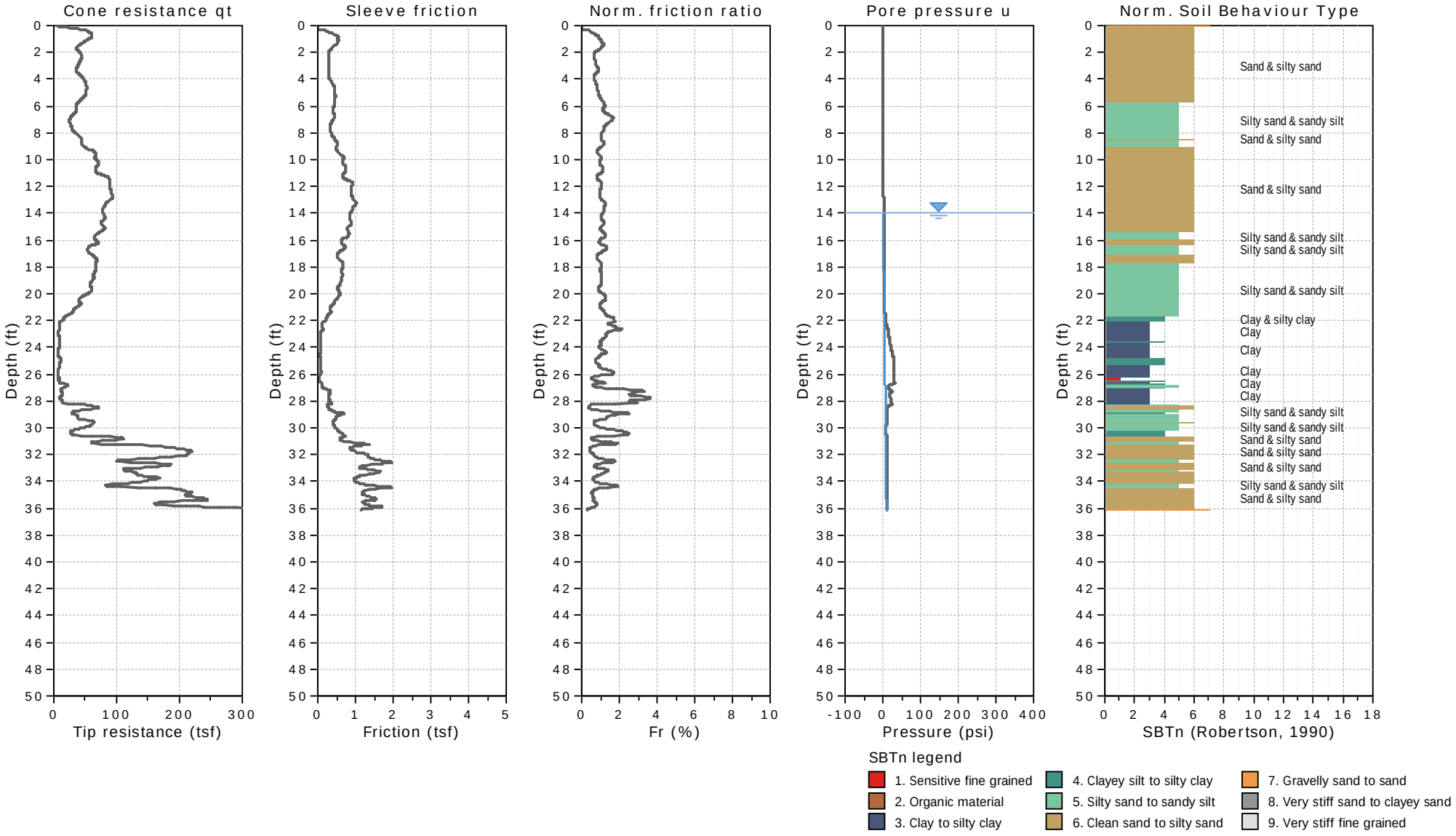
Project: 21-0042 Hursey Montessori School
Location: North Charleston, SC

CPT: CPT-02
Total depth: 36.15 ft, Date: 4/14/2021
Coords: lat 32.86316° lon -79.979741°
Cone Type: Pagani
Cone Operator: M. Hess



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Project: 21-0042 Hursey Montessori School
Location: North Charleston, SC

CPT: CPT-03
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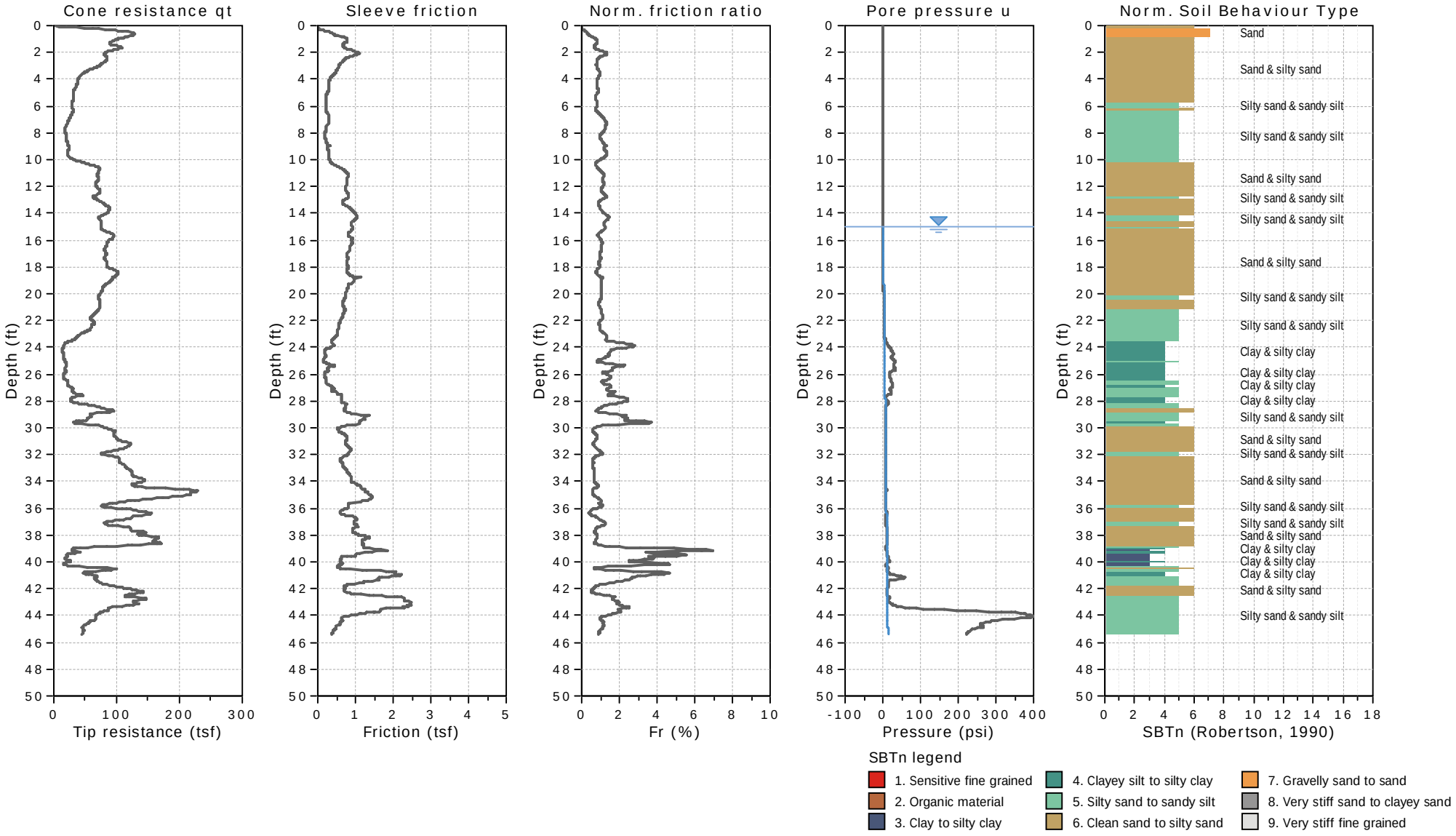
Coords: lat 32.86365° lon -79.979934°
Cone Type: Pagani
Cone Operator: M. Hess



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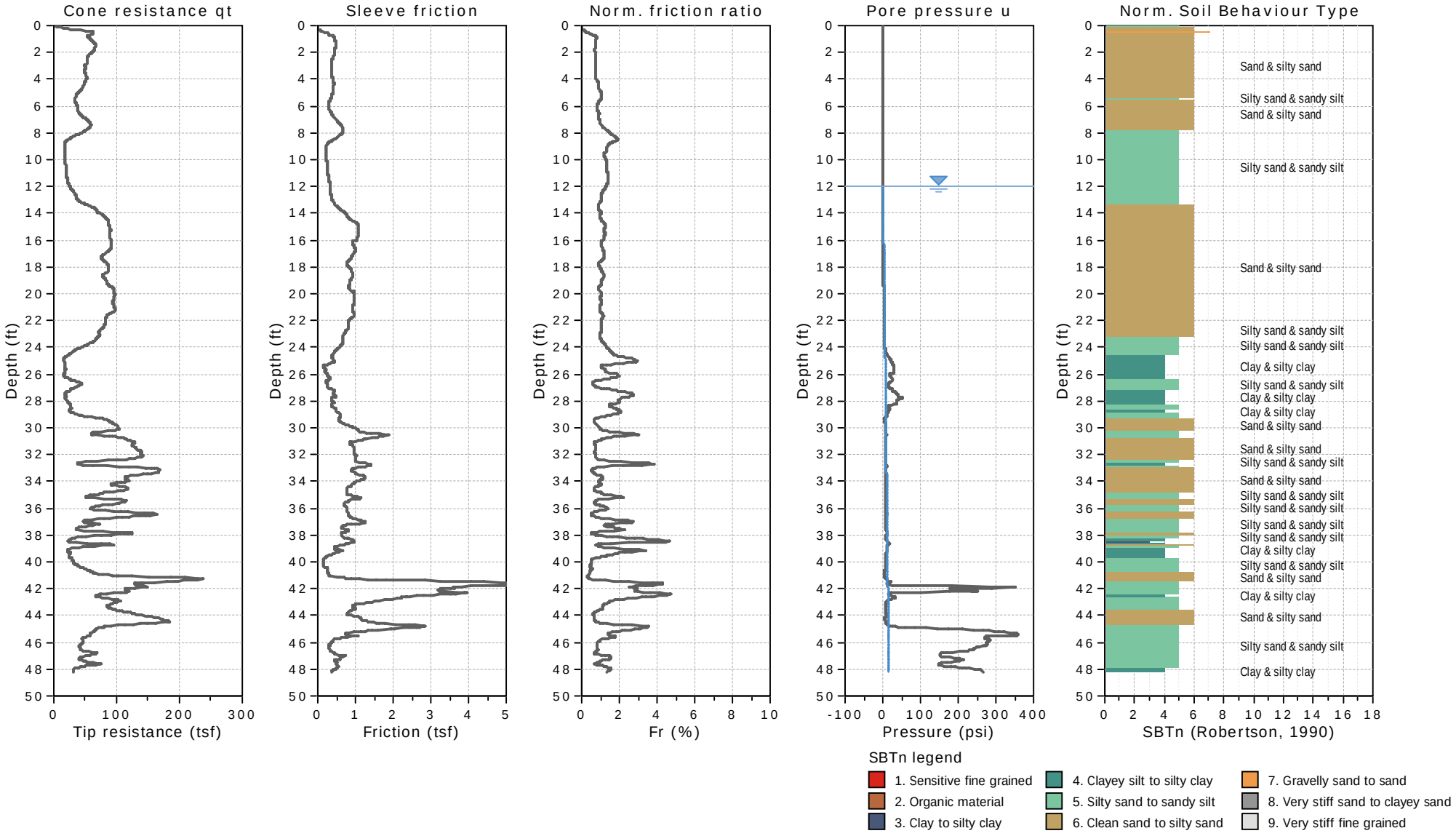
Project: 21-0042 Hursey Montessori School
Location: North Charleston, SC

CPT: CPT-04
Total depth: 48.20 ft, Date: 4/15/2021
Coords: lat 32.863296° lon -79.980134°
Cone Type: Pagani
Cone Operator: M. Hess



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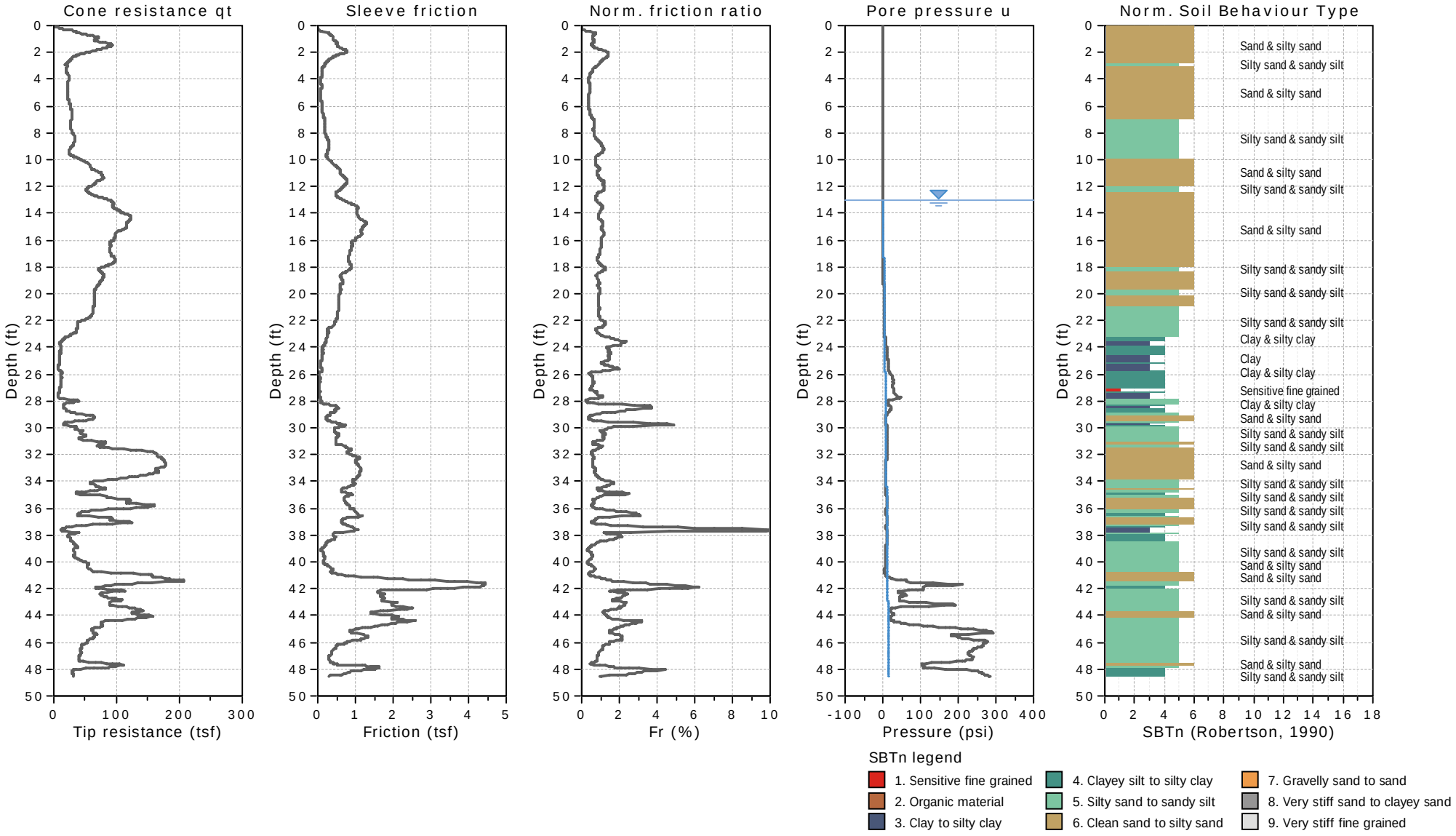
Project: 21-0042 Hursey Montessori School
Location: North Charleston, SC

CPT: CPT-05
Total depth: 48.59 ft, Date: 4/15/2021
Coords: lat 32.862928° lon -79.980122°
Cone Type: Pagani
Cone Operator: M. Hess



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Project: 21-0042 Hursey Montessori School
Location: North Charleston, SC

CPT: CPT-06
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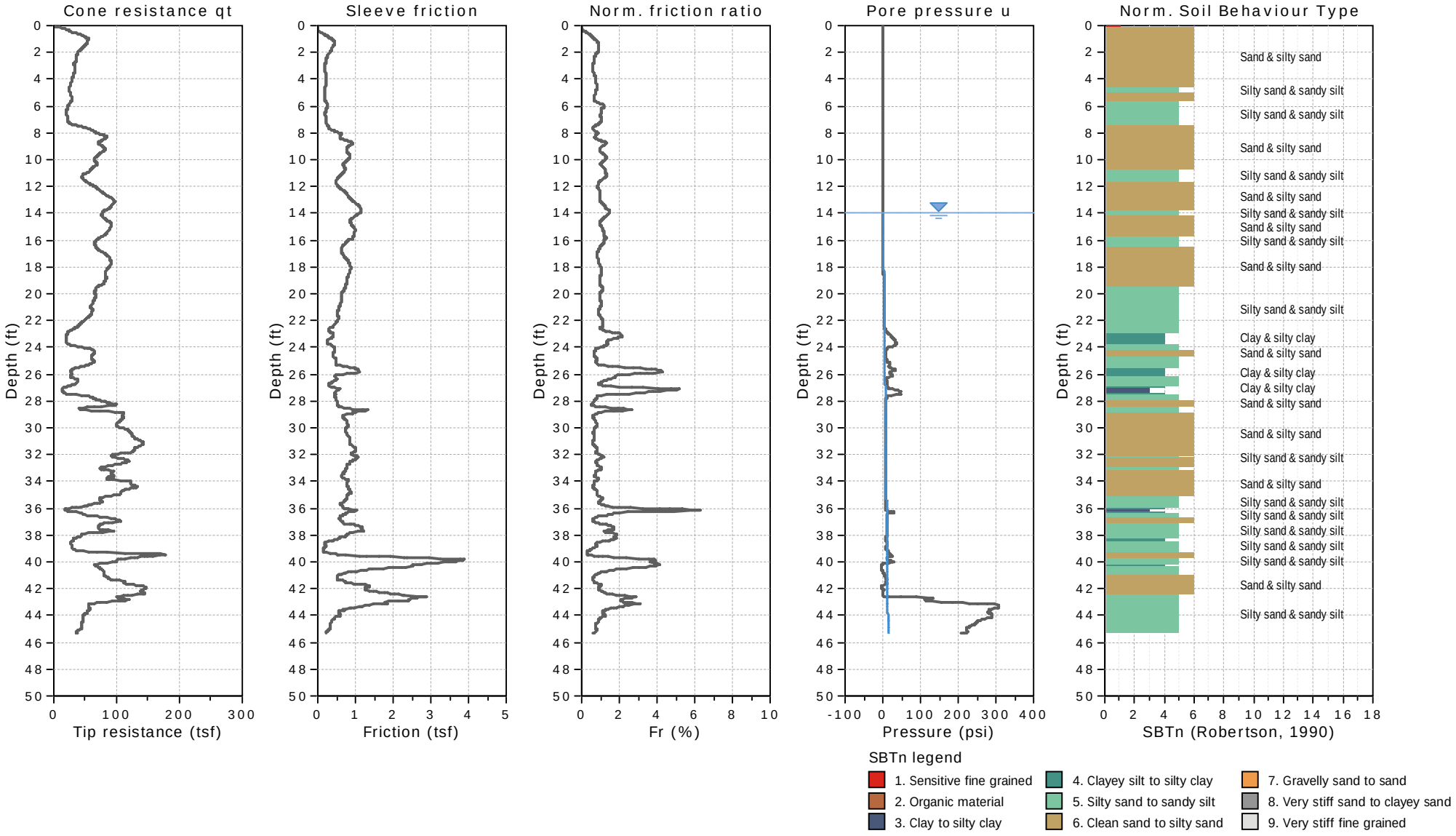
Coords: lat 32.8634° lon -79.980402°
Cone Type: Pagani
Cone Operator: M. Hess



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Project: 21-0042 Hursey Montessori School
Location: North Charleston, SC

CPT: CPT-07
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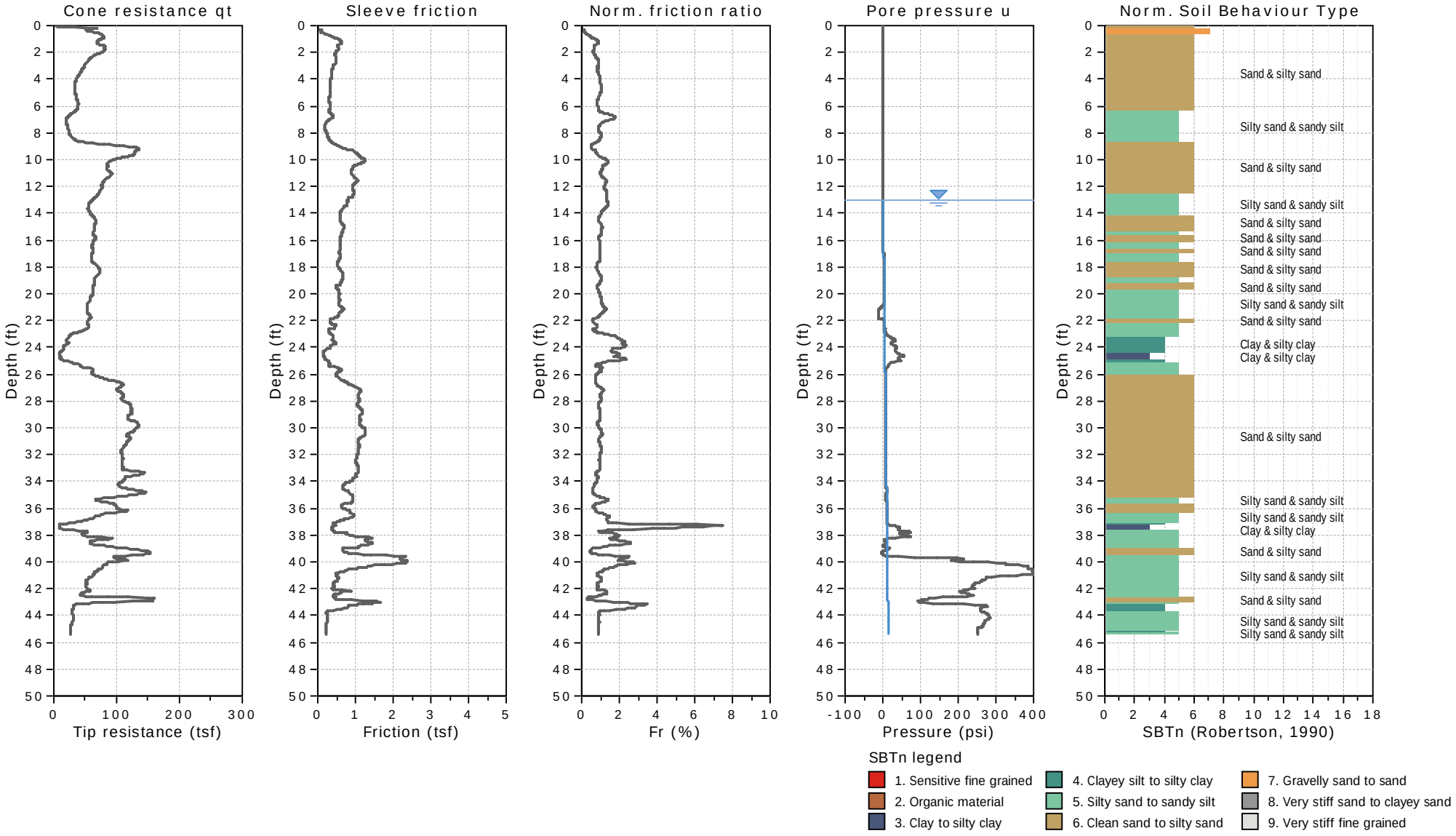
Coords: lat 32.863531° lon -79.980592°
Cone Type: Pagani
Cone Operator: M. Hess



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Project: 21-0042 Hursey Montessori School
Location: North Charleston, SC

CPT: CPT-08
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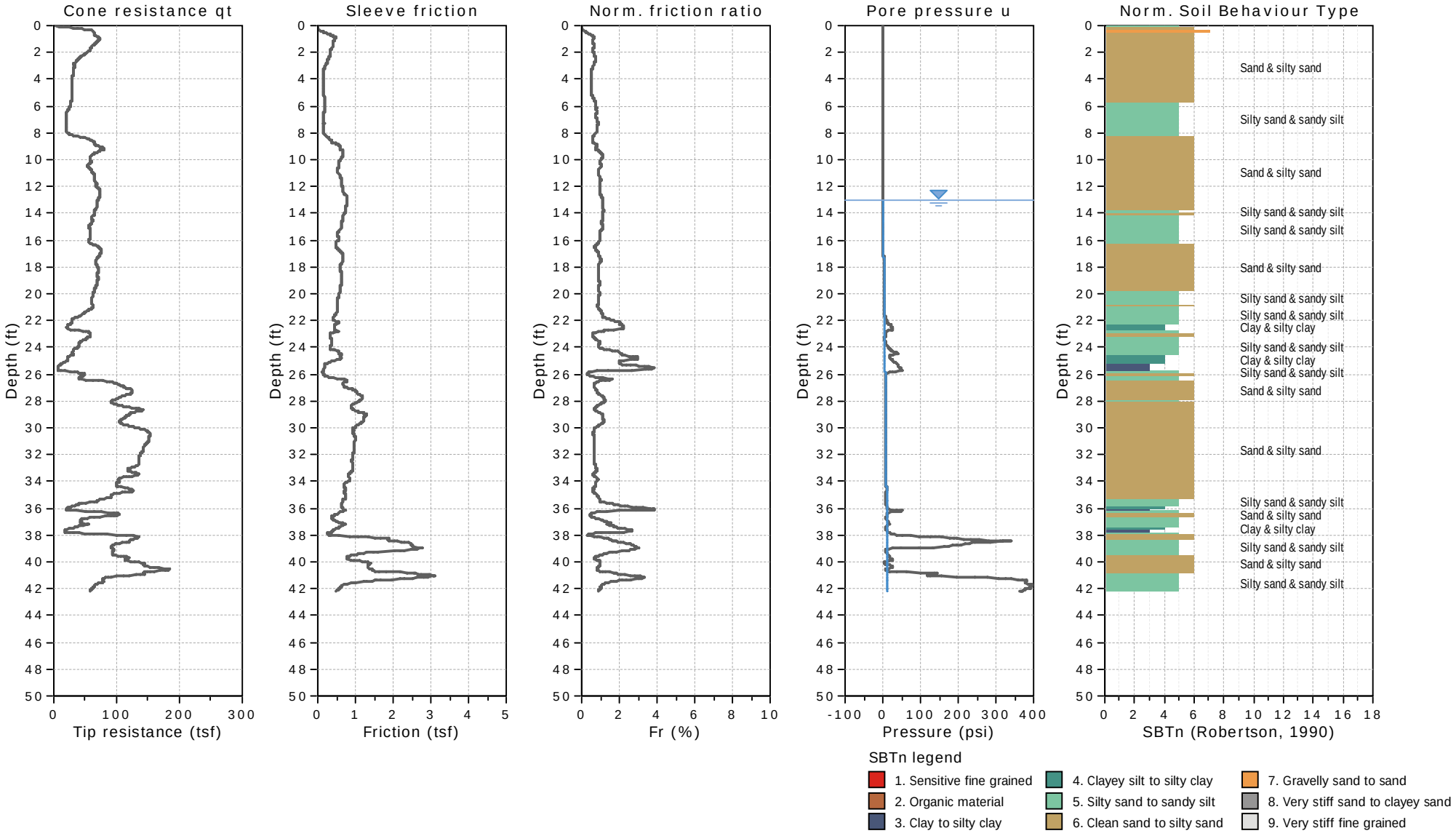
Coords: lat 32.863339° lon -79.980658°
Cone Type: Pagani
Cone Operator: M. Hess



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3359 Meeting Street, Suite 101
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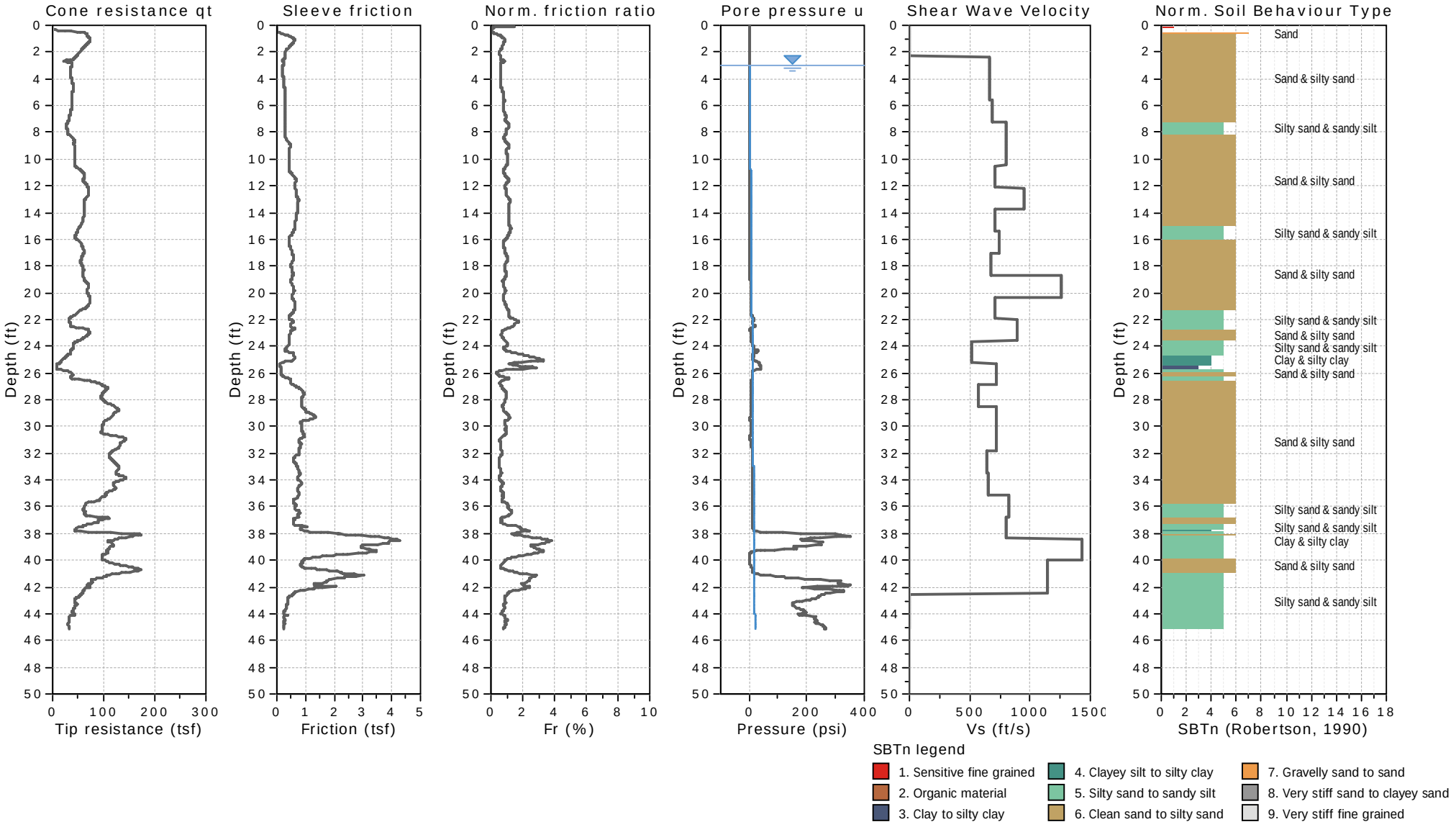
Project: 21-0042 Hursey Montessori School
Location: North Charleston, SC

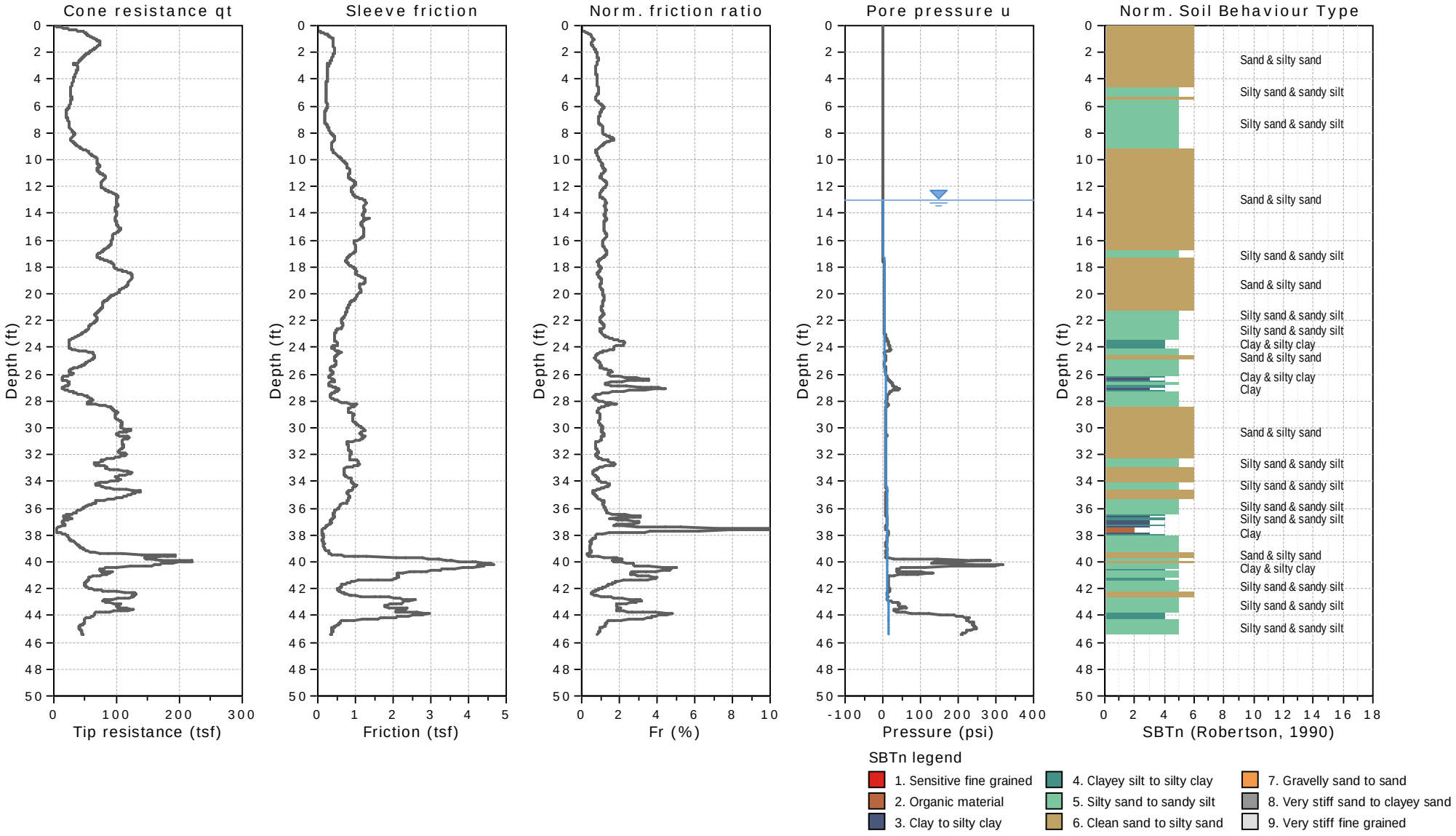
CPT: SCPT-08
Total depth: 45.14 ft, Date: 4/23/2021
Coords: lat 32.863315° lon -79.980645°
Cone Type: Pagani
Cone Operator: M. Hess



INSIGHT GROUP
Geotechnical, Environmental and Construction Consultants
3359 Meeting Street, Suite 101
North Charleston, SC
www.InsightGrp.com

Project: 21-0042 Hursey Montessori School
Location: North Charleston, SC

CPT: CPT-09
Total depth: 45.44 ft, Date: 4/15/2021
Coords: lat 32.863052° lon -79.980555°
Cone Type: Pagani
Cone Operator: M. Hess



BORING NUMBER HAB at SCPT-01

Insight Group, LLC
3359 Meeting Street Road, Suite 101
North Charleston, SC 29405

INSIGHT GROUP NUMBER: 21-0042

PROJECT: Hursey Montessori School
North Charleston, SC

CLIENT: Red Iron Architects

CLIENT LOCATION: North Charleston, SC

DATE STARTED 4/14/21 **COMPLETED** 4/14/21

DRILLER M. Hess

GROUND WATER LEVELS:

DRILL METHOD Hand Auger

Water Note: Groundwater not encountered at time of testing

RIG N/A **LOGGED BY** M. Hess

NOTES Latitude: 32.86293463, Longitude: -79.97951568

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				*3" of Topsoil*
0.3				Brown, weak cemented, fine grained, **POORLY GRADED SAND WITH SILT (SP-SM)**
1		SP-SM		
2				
3				
4				
4.0				Terminated at 4 feet

BORING NUMBER HAB at CPT-02

Insight Group, LLC
3359 Meeting Street Road, Suite 101
North Charleston, SC 29405

INSIGHT GROUP NUMBER: 21-0042

PROJECT: Hursey Montessori School
North Charleston, SC

CLIENT: Red Iron Architects

CLIENT LOCATION: North Charleston, SC

DATE STARTED 4/14/21 **COMPLETED** 4/14/21

DRILLER M. Hess

GROUND WATER LEVELS:

DRILL METHOD Hand Auger

Water Note: Groundwater not encountered at time of testing

RIG N/A **LOGGED BY** M. Hess

NOTES Latitude: 32.86316006, Longitude: -79.9797413

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				*3" of Topsoil*
0.3				
		SP-SM		Brown to yellowish brown, weak cemented, fine grained, **POORLY GRADED SAND WITH SILT (SP-SM)**
1				
2				
3				
4				
4.0				Terminated at 4 feet

BORING NUMBER HAB at CPT-03

Insight Group, LLC
3359 Meeting Street Road, Suite 101
North Charleston, SC 29405

INSIGHT GROUP NUMBER: 21-0042

PROJECT: Hursey Montessori School
North Charleston, SC

CLIENT: Red Iron Architects

CLIENT LOCATION: North Charleston, SC

DATE STARTED 4/14/21 **COMPLETED** 4/14/21

DRILLER M. Hess

GROUND WATER LEVELS:

DRILL METHOD Hand Auger

Water Note: Groundwater not encountered at time of testing

RIG N/A **LOGGED BY** M. Hess

NOTES Latitude: 32.86364955, Longitude: -79.97993375

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				*3" of Topsoil*
				0.3
				Brown to light brown, weak cemented, fine grained, **POORLY GRADED SAND WITH SILT (SP-SM)**
1				
2		SP-SM		
3				
4				4.0
				Terminated at 4 feet

BORING NUMBER HAB at CPT-04

Insight Group, LLC
3359 Meeting Street Road, Suite 101
North Charleston, SC 29405

INSIGHT GROUP NUMBER: 21-0042

PROJECT: Hursey Montessori School
North Charleston, SC

CLIENT: Red Iron Architects

CLIENT LOCATION: North Charleston, SC

DATE STARTED 4/14/21 **COMPLETED** 4/14/21

DRILLER M. Hess

GROUND WATER LEVELS:

DRILL METHOD Hand Auger

Water Note: Groundwater not encountered at time of testing

RIG N/A **LOGGED BY** M. Hess

NOTES Latitude: 32.863296, Longitude: -79.980134

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				*3" of Topsoil*
0.3				
		SP-SM		Dark brown to yellowish brown, **POORLY GRADED SAND WITH SILT (SP-SM)**
1				
2				
3				
4				
4.0				Terminated at 4 feet

BORING NUMBER HAB at CPT-05

Insight Group, LLC
3359 Meeting Street Road, Suite 101
North Charleston, SC 29405

INSIGHT GROUP NUMBER: 21-0042

PROJECT: Hursey Montessori School
North Charleston, SC

CLIENT: Red Iron Architects

CLIENT LOCATION: North Charleston, SC

DATE STARTED 4/14/21 **COMPLETED** 4/14/21

DRILLER M. Hess

GROUND WATER LEVELS:

DRILL METHOD Hand Auger

Water Note: Groundwater not encountered at time of testing

RIG N/A **LOGGED BY** M. Hess

NOTES Latitude: 32.86292772, Longitude: -79.98012219

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				*3" of Topsoil*
0.3				Brown to yellowish brown, **POORLY GRADED SAND WITH SILT (SP-SM)**
1		SP-SM		
2				
3				
4				
4.0				Terminated at 4 feet

BORING NUMBER HAB at CPT-06

Insight Group, LLC
3359 Meeting Street Road, Suite 101
North Charleston, SC 29405

INSIGHT GROUP NUMBER: 21-0042

PROJECT: Hursey Montessori School
North Charleston, SC

CLIENT: Red Iron Architects

CLIENT LOCATION: North Charleston, SC

DATE STARTED 4/14/21 **COMPLETED** 4/14/21

DRILLER M. Hess

GROUND WATER LEVELS:

DRILL METHOD Hand Auger

Water Note: Groundwater not encountered at time of testing

RIG N/A **LOGGED BY** M. Hess

NOTES Latitude: 32.86340046, Longitude: -79.98040185

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				*3" of Topsoil*
0.3				Brown to yellowish brown, **POORLY GRADED SAND WITH SILT (SP-SM)**
1		SP-SM		
2				
3				
4				
4.0				Terminated at 4 feet

BORING NUMBER HAB at CPT-07

Insight Group, LLC
3359 Meeting Street Road, Suite 101
North Charleston, SC 29405

INSIGHT GROUP NUMBER: 21-0042

PROJECT: Hursey Montessori School
North Charleston, SC

CLIENT: Red Iron Architects

CLIENT LOCATION: North Charleston, SC

DATE STARTED 4/14/21 **COMPLETED** 4/14/21

DRILLER M. Hess

GROUND WATER LEVELS:

DRILL METHOD Hand Auger

Water Note: Groundwater not encountered at time of testing

RIG N/A **LOGGED BY** M. Hess

NOTES Latitude: 32.86353142, Longitude: -79.98059193

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				*3" of Topsoil*
0.3				
		SP-SM		Yellowish brown, **POORLY GRADED SAND WITH SILT (SP-SM)**
1				
2				
3				
4				
4.0				Terminated at 4 feet

BORING NUMBER HAB at CPT-08

Insight Group, LLC
3359 Meeting Street Road, Suite 101
North Charleston, SC 29405

INSIGHT GROUP NUMBER: 21-0042

PROJECT: Hursey Montessori School
North Charleston, SC

CLIENT: Red Iron Architects

CLIENT LOCATION: North Charleston, SC

DATE STARTED 4/14/21 **COMPLETED** 4/14/21

DRILLER M. Hess

GROUND WATER LEVELS:

DRILL METHOD Hand Auger

Water Note: Groundwater not encountered at time of testing

RIG N/A **LOGGED BY** M. Hess

NOTES Latitude: 32.86333894, Longitude: -79.98065807

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				*3" of Topsoil*
0.3				
		SP-SM		Dark brown, **POORLY GRADED SAND WITH SILT (SP-SM)**
1				
2				
3				
4				
4.0				Terminated at 4 feet

BORING NUMBER HAB at CPT-09

Insight Group, LLC
3359 Meeting Street Road, Suite 101
North Charleston, SC 29405

INSIGHT GROUP NUMBER: 21-0042

PROJECT: Hursey Montessori School
North Charleston, SC

CLIENT: Red Iron Architects

CLIENT LOCATION: North Charleston, SC

DATE STARTED 4/14/21 **COMPLETED** 4/14/21

DRILLER M. Hess

GROUND WATER LEVELS:

DRILL METHOD Hand Auger

Water Note: Groundwater not encountered at time of testing

RIG N/A **LOGGED BY** M. Hess

NOTES Latitude: 32.86305195, Longitude: -79.98055516

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				*4" of Topsoil*
				0.3
				Yellowish brown, **POORLY GRADED SAND WITH SILT (SP-SM)**
1				
2		SP-SM		
3				
4				4.0
				Terminated at 4 feet

BORING NUMBER HAB-10

Insight Group, LLC
3359 Meeting Street Road, Suite 101
North Charleston, SC 29405

INSIGHT GROUP NUMBER: 21-0042

PROJECT: Hursey Montessori School
North Charleston, SC

CLIENT: Red Iron Architects

CLIENT LOCATION: North Charleston, SC

DATE STARTED 4/14/21 **COMPLETED** 4/14/21

DRILLER M. Hess

GROUND WATER LEVELS:

DRILL METHOD Hand Auger

Water Note: Groundwater not encountered at time of testing

RIG N/A **LOGGED BY** M. Hess

NOTES Latitude: 32.86375752, Longitude: -79.97976281

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				*8" of Topsoil*
0.7				
		SP-SM		Reddish brown to brown, **POORLY GRADED SAND WITH SILT (SP-SM)**
1				
2				
3				
4				
4.0				Terminated at 4 feet

BORING NUMBER HAB-11

Insight Group, LLC
3359 Meeting Street Road, Suite 101
North Charleston, SC 29405

INSIGHT GROUP NUMBER: 21-0042

PROJECT: Hursey Montessori School
North Charleston, SC

CLIENT: Red Iron Architects

CLIENT LOCATION: North Charleston, SC

DATE STARTED 4/14/21 **COMPLETED** 4/14/21

DRILLER M. Hess

GROUND WATER LEVELS:

DRILL METHOD Hand Auger

Water Note: Groundwater not encountered at time of testing

RIG N/A **LOGGED BY** M. Hess

NOTES Latitude: 32.86331484, Longitude: -79.97947121

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				
			0.1	1" of Asphalt
				5" of Graded Aggregate Base Course
			0.5	
		SP-SM		Yellowish brown, **POORLY GRADED SAND WITH SILT (SP-SM)**
1				
2				
3				
4			4.0	
				Terminated at 4 feet

BORING NUMBER HAB-12

Insight Group, LLC
3359 Meeting Street Road, Suite 101
North Charleston, SC 29405

INSIGHT GROUP NUMBER: 21-0042

PROJECT: Hursey Montessori School
North Charleston, SC

CLIENT: Red Iron Architects

CLIENT LOCATION: North Charleston, SC

DATE STARTED 4/14/21 **COMPLETED** 4/14/21

DRILLER M. Hess

GROUND WATER LEVELS:

DRILL METHOD Hand Auger

Water Note: Groundwater not encountered at time of testing

RIG N/A **LOGGED BY** M. Hess

NOTES Latitude: 32.86265931, Longitude: -79.97974785

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				2" of Asphalt
				0.2
				5" of Graded Aggregate Base Course
				0.6
				Yellowish brown, **POORLY GRADED SAND WITH SILT (SP-SM)**
1				
2		SP-SM		
3				
4				4.0
				Terminated at 4 feet

BORING NUMBER HAB-13

Insight Group, LLC
3359 Meeting Street Road, Suite 101
North Charleston, SC 29405

INSIGHT GROUP NUMBER: 21-0042

PROJECT: Hursey Montessori School
North Charleston, SC

CLIENT: Red Iron Architects

CLIENT LOCATION: North Charleston, SC

DATE STARTED 4/14/21 **COMPLETED** 4/14/21

DRILLER M. Hess

GROUND WATER LEVELS:

DRILL METHOD Hand Auger

Water Note: Groundwater not encountered at time of testing

RIG N/A **LOGGED BY** M. Hess

NOTES Latitude: 32.86255534, Longitude: -79.98025589

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				2" of Asphalt
			0.2	8" of Graded Aggregate Base Course
			0.8	Yellowish brown, **POORLY GRADED SAND WITH SILT (SP-SM)**
1				
2		SP-SM		
3				
4			4.0	Terminated at 4 feet

BORING NUMBER HAB-14

Insight Group, LLC
3359 Meeting Street Road, Suite 101
North Charleston, SC 29405

INSIGHT GROUP NUMBER: 21-0042

PROJECT: Hursey Montessori School
North Charleston, SC

CLIENT: Red Iron Architects

CLIENT LOCATION: North Charleston, SC

DATE STARTED 4/14/21 **COMPLETED** 4/14/21

DRILLER M. Hess

GROUND WATER LEVELS:

DRILL METHOD Hand Auger

Water Note: Groundwater not encountered at time of testing

RIG N/A **LOGGED BY** M. Hess

NOTES Latitude: 32.86264431, Longitude: -79.98079864

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				4" of Concrete
				0.3
				Dark brown to yellowish brown, **POORLY GRADED SAND WITH SILT (SP-SM)**
1				
2		SP-SM		
3				
4				4.0
				Terminated at 4 feet

BORING NUMBER HAB-15

Insight Group, LLC
3359 Meeting Street Road, Suite 101
North Charleston, SC 29405

INSIGHT GROUP NUMBER: 21-0042

PROJECT: Hursey Montessori School
North Charleston, SC

CLIENT: Red Iron Architects

CLIENT LOCATION: North Charleston, SC

DATE STARTED 4/14/21 **COMPLETED** 4/14/21

DRILLER M. Hess

GROUND WATER LEVELS:

DRILL METHOD Hand Auger

Water Note: Groundwater not encountered at time of testing

RIG N/A **LOGGED BY** M. Hess

NOTES Latitude: 32.86301335, Longitude: -79.98090606

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				4" of Asphalt
				0.3
				6" of Graded Aggregate Base Course
				0.8
				Dark brown, **POORLY GRADED SAND WITH SILT (SP-SM)**
1				
2		SP-SM		
3				
4				4.0
				Terminated at 4 feet

BORING NUMBER HAB-16

Insight Group, LLC
3359 Meeting Street Road, Suite 101
North Charleston, SC 29405

INSIGHT GROUP NUMBER: 21-0042

PROJECT: Hursey Montessori School
North Charleston, SC

CLIENT: Red Iron Architects

CLIENT LOCATION: North Charleston, SC

DATE STARTED 4/14/21 **COMPLETED** 4/14/21

DRILLER M. Hess

GROUND WATER LEVELS:

DRILL METHOD Hand Auger

Water Note: Groundwater not encountered at time of testing

RIG N/A **LOGGED BY** M. Hess

NOTES Latitude: 32.86325363, Longitude: -79.981215

DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				*8" of Topsoil*
0.7				
		SP-SM		Dark brown to light brown, **POORLY GRADED SAND WITH SILT (SP-SM)**
1				
2				
3				
4				
4.0				Terminated at 4 feet

BORING NUMBER HAB-17

Insight Group, LLC
3359 Meeting Street Road, Suite 101
North Charleston, SC 29405

INSIGHT GROUP NUMBER: 21-0042

PROJECT: Hursey Montessori School
North Charleston, SC

CLIENT: Red Iron Architects

CLIENT LOCATION: North Charleston, SC

DATE STARTED 4/14/21 **COMPLETED** 4/14/21

DRILLER M. Hess

GROUND WATER LEVELS:

DRILL METHOD Hand Auger

Water Note: Groundwater not encountered at time of testing

RIG N/A **LOGGED BY** M. Hess

NOTES Latitude: 32.86336871, Longitude: -79.98093206

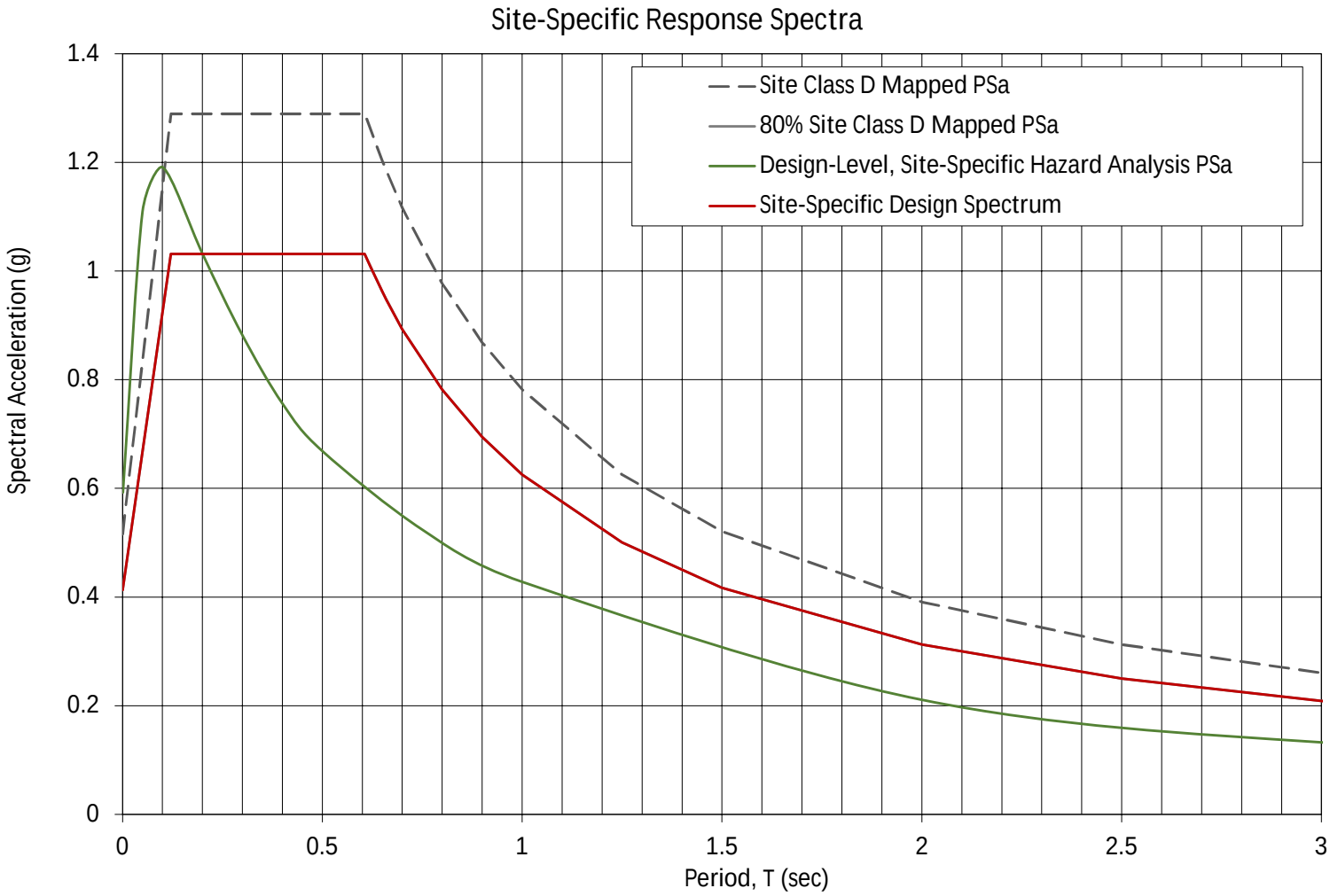
DEPTH (ft)	SAMPLE TYPE NUMBER	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0				*8" of Topsoil*
0.7				
		SP-SM		Light brown to grayish brown, **POORLY GRADED SAND WITH SILT (SP-SM)**
1				
2				
3				
4				
4.0				Terminated at 4 feet

EXHIBIT C

Ground Motion Hazard Analysis

Site-Specific Seismic Design Parameters

S_{DS} Short Period Design Spectral Accel. (g)	S_{D1} 1-Sec Period Design Spectral Accel. (g)	T_0 (sec)	T_S (sec)	PGA 2/3 MCE_R Peak Ground Accel. (g)	PGA_M MCE_G PGA (g)	C_{RS} Risk Coefficient at Short Periods	C_{R1} Risk Coefficient at Period 1-Sec	Damping
1.032	0.625	0.12	0.61	0.413	1.043	0.851	0.887	5%



	Site-Specific Design Spectrum	
	T (sec)	Sa (g)
	0.00	0.413
T_0	0.12	1.032
T_S	0.61	1.032
	0.62	1.009
	0.66	0.947
	0.70	0.893
	0.80	0.782
	0.90	0.695
	1.00	0.625
	1.25	0.500
	1.50	0.417
	2.00	0.313
	2.50	0.250
	3.00	0.208
	4.00	0.156

IBC and ASCE Design Codes outline two site-specific ground motion procedures for seismic design:

1. Site Response Analysis (ASCE 7-16 21.1)
2. Ground Motion Hazard Analysis (ASCE 7-16 21.2)

These results are of the ground motion hazard analysis, probabilistic method.

DESIGN HORIZONTAL ACCELERATION RESPONSE SPECTRA AT GROUND SURFACE
Project: New Malcolm Hursey Elementary
Location: North Charleston, South Carolina
Insight Group Project: 21-0042
Date: April 23, 2021

INSIGHT GROUP

Appendix ‘C’

Ashrae 90.1 and Comcheck

COMcheck Software Version 4.1.5.3

Envelope Compliance Certificate

Section 1: Project Information

Energy Code: **2009 IECC**
Project Title: MALCOLM C. HURSEY MONTESSORI SCHOOL AT THE RON MCNAIR CAMPUS BUILDING NO. 0734
Project Type: New Construction

Construction Site:
3910 Verde Avenue
North Charleston, SC 29405

Owner/Agent:
Amy Cario
Charleston County School District
3999 Bridge View Dr.
Charleston, SC 29405
(843)566-1803
amy_cario@charleston.k12.sc.us

Designer/Contractor:
Emma Souder
Red Iron Architects LLC
4591 Durant Avenue
North Charleston, SC 29405
843-834-2677
emma@red-ironarchitects.com

Building Location (for weather data): North Charleston, South Carolina
Climate Zone: 3a
Vertical Glazing / Wall Area Pct.: **14%**

Building Use: Activity Type(s)	Floor Area
1-First Floor (School/University) : Nonresidential	61216
2-Second Floor (School/University) : Nonresidential	39015
3-Third Floor (School/University) : Nonresidential	19189

Section 2: Envelope Assemblies and Requirements Checklist

Envelope PASSES: Design 1% better than code.

Envelope Assemblies:

Component Name/Description	Gross Area or Perimeter	Cavity R-Value	Cont. R-Value	Proposed U-Factor	Budget U-Factor(a)
Roof 1: Insulation Entirely Above Deck: High Albedo Roof Required, [Bldg. Use 1 - First Floor]	22201	---	20.0	0.048	0.048
Roof 1 copy 1: Insulation Entirely Above Deck: High Albedo Roof Required, [Bldg. Use 2 - Second Floor]	19826	---	20.0	0.048	0.048
Roof 1 copy 2: Insulation Entirely Above Deck: High Albedo Roof Required, [Bldg. Use 3 - Third Floor]	19189	---	20.0	0.048	0.048
Floor 1: Slab-On-Grade:Unheated, [Bldg. Use 1 - First Floor]	1674	---	---	---	---
Exterior Wall 1: Concrete Block:12", Partially Grouted, Cells Empty,Normal Density , Furring: None, [Bldg. Use 1 - First Floor]	10404	---	13.0	0.064	0.123
Window 3: Metal Frame with Thermal Break:Fixed, Perf. Specs.: Product ID pending ID, SHGC 0.28, [Bldg. Use 1 - First Floor] (b)	1469	---	---	0.410	0.650
Door 1: Insulated Metal, Swinging, [Bldg. Use 1 - First Floor]	226	---	---	0.900	0.700
Door 2: Glass (> 50% glazing):Metal Frame, Entrance Door, Perf. Specs.: Product ID Pending ID, SHGC 0.28, [Bldg. Use 1 - First Floor] (b)	271	---	---	0.410	0.900
Exterior Wall 2: Concrete Block:8", Partially Grouted, Cells Empty,Normal Density , Furring: None, [Bldg. Use 1 - First Floor]	18092	---	13.0	0.065	0.123
Window 2: Metal Frame with Thermal Break:Fixed, Perf. Specs.: Product ID Pending ID, SHGC 0.28, [Bldg. Use 1 - First Floor] (b)	1969	---	---	0.410	0.650
Door 3: Insulated Metal, Swinging, [Bldg. Use 1 - First Floor]	113	---	---	0.900	0.700
Door 4: Glass (> 50% glazing):Metal Frame, Entrance Door, Perf. Specs.: Product ID Pending ID, SHGC 0.28, [Bldg. Use 1 - First Floor] (b)	728	---	---	0.410	0.900
Exterior Wall 3: Steel-Framed, 16" o.c., [Bldg. Use 2 - Second Floor]	3928	0.0	13.0	0.063	0.084

Window 1: Metal Frame with Thermal Break:Fixed, Perf. Specs.: Product ID Pending ID, SHGC 0.28, [Bldg. Use 2 - Second Floor] (b)	614	---	---	0.410	0.650
Exterior Wall 2 copy 1: Concrete Block:8", Partially Grouted, Cells Empty,Normal Density , Furring: None, [Bldg. Use 2 - Second Floor]	18092	---	13.0	0.065	0.123
Window 2 copy 1: Metal Frame with Thermal Break:Fixed, Perf. Specs.: Product ID Pending ID, SHGC 0.28, [Bldg. Use 2 - Second Floor] (b)	1976	---	---	0.410	0.650
Exterior Wall 2 copy 2: Concrete Block:8", Partially Grouted, Cells Empty,Normal Density , Furring: None, [Bldg. Use 3 - Third Floor]	11605	---	13.0	0.065	0.123
Window 2 copy 2: Metal Frame with Thermal Break:Fixed, Perf. Specs.: Product ID Pending ID, SHGC 0.28, [Bldg. Use 3 - Third Floor] (b)	1272	---	---	0.410	0.650
Door 6: Insulated Metal, Swinging, [Bldg. Use 3 - Third Floor]	24	---	---	0.900	0.700

(a) Budget U-factors are used for software baseline calculations ONLY, and are not code requirements.

(b) Fenestration product performance must be certified in accordance with NFRC and requires supporting documentation.

Air Leakage, Component Certification, and Vapor Retarder Requirements:

- ❑ 1. All joints and penetrations are caulked, gasketed or covered with a moisture vapor-permeable wrapping material installed in accordance with the manufacturer's installation instructions.
- ❑ 2. Windows, doors, and skylights certified as meeting leakage requirements.
- ❑ 3. Component R-values & U-factors labeled as certified.
- ❑ 4. No roof insulation is installed on a suspended ceiling with removable ceiling panels.
- ❑ 5. 'Other' components have supporting documentation for proposed U-Factors.
- ❑ 6. Insulation installed according to manufacturer's instructions, in substantial contact with the surface being insulated, and in a manner that achieves the rated R-value without compressing the insulation.
- ❑ 7. Stair, elevator shaft vents, and other outdoor air intake and exhaust openings in the building envelope are equipped with motorized dampers.
- ❑ 8. Cargo doors and loading dock doors are weather sealed.
- ❑ 9. Recessed lighting fixtures installed in the building envelope are Type IC rated as meeting ASTM E283, are sealed with gasket or caulk.
- ❑ 10. Building entrance doors have a vestibule equipped with self-closing devices.
  Exceptions:
  - ❑ Building entrances with revolving doors.
  - ❑ Doors not intended to be used as a building entrance.
  - ❑ Doors that open directly from a space less than 3000 sq. ft. in area.
  - ❑ Doors used primarily to facilitate vehicular movement or materials handling and adjacent personnel doors.
  - ❑ Doors opening directly from a sleeping/dwelling unit.

Section 3: Compliance Statement

Compliance Statement: The proposed envelope design represented in this document is consistent with the building plans, specifications and other calculations submitted with this permit application. The proposed envelope system has been designed to meet the 2009 IECC requirements in COM*check* Version 4.1.5.3 and to comply with the mandatory requirements in the Requirements Checklist.

Emma Souder, AIA		11.12.2021
Name - Title	Signature	Date

COMcheck Software Version 4.1.2.1

Mechanical Compliance Certificate

Section 1: Project Information

Energy Code: **2009 IECC**
Project Title: Malcolm C Hursey Montessori School
Project Type: New Construction

Construction Site:
Charleston, SC

Owner/Agent:
Charleston County School District

Designer/Contractor:
Coleman Owens, III, P.E.
Owens and Associates, Inc
1007 Lake Hunter Circle
Mount Pleasant, SC 29464
843-849-6457
cole@owensmep.com

Section 2: General Information

Building Location (for weather data): Mount Pleasant, South Carolina
Climate Zone: 3a

Section 3: Mechanical Systems List

Quantity	System Type & Description
8	BLOWER COIL #1 (Single Zone) : Heating: 1 each - Hydronic or Steam Coil, Hot Water, Capacity = 18 kBtu/h No minimum efficiency requirement applies Cooling: 1 each - Hydronic Coil, Capacity = 18 kBtu/h, No Economizer, Economizer exception: Filtration Requirements No minimum efficiency requirement applies Fan System: FAN SYSTEM 1 | CR -- Compliance (Motor nameplate HP method) : Passes Fans: FAN 1 Supply, Constant Volume, 600 CFM, 0.5 motor nameplate hp
9	BLOWER COIL #2 (Single Zone) : Heating: 1 each - Hydronic or Steam Coil, Hot Water, Capacity = 24 kBtu/h No minimum efficiency requirement applies Cooling: 1 each - Hydronic Coil, Capacity = 24 kBtu/h, No Economizer, Economizer exception: Filtration Requirements No minimum efficiency requirement applies Fan System: FAN SYSTEM 11 | CR -- Compliance (Motor nameplate HP method) : Passes Fans: FAN 1 Supply, Constant Volume, 600 CFM, 0.5 motor nameplate hp FAN 3 Supply, Constant Volume, 1000 CFM, 1.0 motor nameplate hp FAN 4 Supply, Constant Volume, 1200 CFM, 1.0 motor nameplate hp FAN 5 Supply, Constant Volume, 1600 CFM, 1.0 motor nameplate hp FAN 6 Supply, Constant Volume, 2000 CFM, 1.0 motor nameplate hp FAN 7 Supply, Constant Volume, 3000 CFM, 5.0 motor nameplate hp FAN 8 Supply, Constant Volume, 4000 CFM, 5.0 motor nameplate hp FAN 9 Supply, Single-Zone VAV, 6000 CFM, 5.0 motor nameplate hp
7	BLOWER COIL #3 (Single Zone) : Heating: 1 each - Hydronic or Steam Coil, Hot Water, Capacity = 36 kBtu/h No minimum efficiency requirement applies Cooling: 1 each - Hydronic Coil, Capacity = 30 kBtu/h, No Economizer, Economizer exception: Filtration Requirements No minimum efficiency requirement applies Fan System: FAN SYSTEM 11 | CR -- Compliance (Motor nameplate HP method) : Passes

Fans:
FAN 1 Supply, Constant Volume, 600 CFM, 0.5 motor nameplate hp
FAN 3 Supply, Constant Volume, 1000 CFM, 1.0 motor nameplate hp
FAN 4 Supply, Constant Volume, 1200 CFM, 1.0 motor nameplate hp
FAN 5 Supply, Constant Volume, 1600 CFM, 1.0 motor nameplate hp
FAN 6 Supply, Constant Volume, 2000 CFM, 1.0 motor nameplate hp
FAN 7 Supply, Constant Volume, 3000 CFM, 5.0 motor nameplate hp
FAN 8 Supply, Constant Volume, 4000 CFM, 5.0 motor nameplate hp
FAN 9 Supply, Single-Zone VAV, 6000 CFM, 5.0 motor nameplate hp

23 BLOWER COIL #4 (Single Zone) :
Heating: 1 each - Hydronic or Steam Coil, Hot Water, Capacity = 48 kBtu/h
No minimum efficiency requirement applies
Cooling: 1 each - Hydronic Coil, Capacity = 36 kBtu/h, No Economizer, Economizer exception: Filtration Requirements
No minimum efficiency requirement applies
Fan System: FAN SYSTEM 11 | CR -- Compliance (Motor nameplate HP method) : Passes

Fans:
FAN 1 Supply, Constant Volume, 600 CFM, 0.5 motor nameplate hp
FAN 3 Supply, Constant Volume, 1000 CFM, 1.0 motor nameplate hp
FAN 4 Supply, Constant Volume, 1200 CFM, 1.0 motor nameplate hp
FAN 5 Supply, Constant Volume, 1600 CFM, 1.0 motor nameplate hp
FAN 6 Supply, Constant Volume, 2000 CFM, 1.0 motor nameplate hp
FAN 7 Supply, Constant Volume, 3000 CFM, 5.0 motor nameplate hp
FAN 8 Supply, Constant Volume, 4000 CFM, 5.0 motor nameplate hp
FAN 9 Supply, Single-Zone VAV, 6000 CFM, 5.0 motor nameplate hp

19 BLOWER COIL #5 (Single Zone) :
Heating: 13 each - Hydronic or Steam Coil, Hot Water, Capacity = 64 kBtu/h
No minimum efficiency requirement applies
Cooling: 1 each - Hydronic Coil, Capacity = 48 kBtu/h, No Economizer, Economizer exception: Filtration Requirements
No minimum efficiency requirement applies
Fan System: FAN SYSTEM 11 | CR -- Compliance (Motor nameplate HP method) : Passes

Fans:
FAN 1 Supply, Constant Volume, 600 CFM, 0.5 motor nameplate hp
FAN 3 Supply, Constant Volume, 1000 CFM, 1.0 motor nameplate hp
FAN 4 Supply, Constant Volume, 1200 CFM, 1.0 motor nameplate hp
FAN 5 Supply, Constant Volume, 1600 CFM, 1.0 motor nameplate hp
FAN 6 Supply, Constant Volume, 2000 CFM, 1.0 motor nameplate hp
FAN 7 Supply, Constant Volume, 3000 CFM, 5.0 motor nameplate hp
FAN 8 Supply, Constant Volume, 4000 CFM, 5.0 motor nameplate hp
FAN 9 Supply, Single-Zone VAV, 6000 CFM, 5.0 motor nameplate hp

6 BLOWER COIL #6 (Single Zone) :
Heating: 1 each - Hydronic or Steam Coil, Hot Water, Capacity = 36 kBtu/h
No minimum efficiency requirement applies
Cooling: 1 each - Hydronic Coil, Capacity = 36 kBtu/h, No Economizer, Economizer exception: Filtration Requirements
No minimum efficiency requirement applies
Fan System: FAN SYSTEM 11 | CR -- Compliance (Motor nameplate HP method) : Passes

Fans:
FAN 1 Supply, Constant Volume, 600 CFM, 0.5 motor nameplate hp
FAN 3 Supply, Constant Volume, 1000 CFM, 1.0 motor nameplate hp
FAN 4 Supply, Constant Volume, 1200 CFM, 1.0 motor nameplate hp
FAN 5 Supply, Constant Volume, 1600 CFM, 1.0 motor nameplate hp
FAN 6 Supply, Constant Volume, 2000 CFM, 1.0 motor nameplate hp
FAN 7 Supply, Constant Volume, 3000 CFM, 5.0 motor nameplate hp
FAN 8 Supply, Constant Volume, 4000 CFM, 5.0 motor nameplate hp
FAN 9 Supply, Single-Zone VAV, 6000 CFM, 5.0 motor nameplate hp

5 BLOWER COIL #7 (Single Zone) :
Heating: 1 each - Hydronic or Steam Coil, Hot Water, Capacity = 48 kBtu/h
No minimum efficiency requirement applies
Cooling: 1 each - Hydronic Coil, Capacity = 48 kBtu/h, No Economizer, Economizer exception: Filtration Requirements
No minimum efficiency requirement applies
Fan System: FAN SYSTEM 11 | CR -- Compliance (Motor nameplate HP method) : Passes

Fans:
FAN 1 Supply, Constant Volume, 600 CFM, 0.5 motor nameplate hp
FAN 3 Supply, Constant Volume, 1000 CFM, 1.0 motor nameplate hp

FAN 4 Supply, Constant Volume, 1200 CFM, 1.0 motor nameplate hp
FAN 5 Supply, Constant Volume, 1600 CFM, 1.0 motor nameplate hp
FAN 6 Supply, Constant Volume, 2000 CFM, 1.0 motor nameplate hp
FAN 7 Supply, Constant Volume, 3000 CFM, 5.0 motor nameplate hp
FAN 8 Supply, Constant Volume, 4000 CFM, 5.0 motor nameplate hp
FAN 9 Supply, Single-Zone VAV, 6000 CFM, 5.0 motor nameplate hp

5 BLOWER COIL #8 (Single Zone) :
Heating: 1 each - Hydronic or Steam Coil, Hot Water, Capacity = 60 kBtu/h
No minimum efficiency requirement applies
Cooling: 1 each - Hydronic Coil, Capacity = 66 kBtu/h, No Economizer, Economizer exception: Filtration Requirements
No minimum efficiency requirement applies
Fan System: FAN SYSTEM 11 | CR -- Compliance (Motor nameplate HP method) : Passes

Fans:
FAN 1 Supply, Constant Volume, 600 CFM, 0.5 motor nameplate hp
FAN 3 Supply, Constant Volume, 1000 CFM, 1.0 motor nameplate hp
FAN 4 Supply, Constant Volume, 1200 CFM, 1.0 motor nameplate hp
FAN 5 Supply, Constant Volume, 1600 CFM, 1.0 motor nameplate hp
FAN 6 Supply, Constant Volume, 2000 CFM, 1.0 motor nameplate hp
FAN 7 Supply, Constant Volume, 3000 CFM, 5.0 motor nameplate hp
FAN 8 Supply, Constant Volume, 4000 CFM, 5.0 motor nameplate hp
FAN 9 Supply, Single-Zone VAV, 6000 CFM, 5.0 motor nameplate hp

4 BLOWER COIL #9 (Single Zone) :
Heating: 1 each - Hydronic or Steam Coil, Hot Water, Capacity = 96 kBtu/h
No minimum efficiency requirement applies
Cooling: 1 each - Hydronic Coil, Capacity = 98 kBtu/h, No Economizer, Economizer exception: Filtration Requirements
No minimum efficiency requirement applies
Fan System: FAN SYSTEM 11 | CR -- Compliance (Motor nameplate HP method) : Passes

Fans:
FAN 1 Supply, Constant Volume, 600 CFM, 0.5 motor nameplate hp
FAN 3 Supply, Constant Volume, 1000 CFM, 1.0 motor nameplate hp
FAN 4 Supply, Constant Volume, 1200 CFM, 1.0 motor nameplate hp
FAN 5 Supply, Constant Volume, 1600 CFM, 1.0 motor nameplate hp
FAN 6 Supply, Constant Volume, 2000 CFM, 1.0 motor nameplate hp
FAN 7 Supply, Constant Volume, 3000 CFM, 5.0 motor nameplate hp
FAN 8 Supply, Constant Volume, 4000 CFM, 5.0 motor nameplate hp
FAN 9 Supply, Single-Zone VAV, 6000 CFM, 5.0 motor nameplate hp

1 RTHP 11 (Single Zone) :
Cooling: 1 each - Single Package DX Unit, Capacity = 36 kBtu/h, Air-Cooled Condenser, Air Economizer
Proposed Efficiency = 14.00 SEER, Required Efficiency: 13.00 SEER
Fan System: FAN SYSTEM 1 | CR -- Compliance (Motor nameplate HP method) : Passes

Fans:
FAN 1 Supply, Constant Volume, 600 CFM, 0.5 motor nameplate hp

1 SSHP 12 (Single Zone) :
Cooling: 1 each - Split System, Capacity = 60 kBtu/h, Air-Cooled Condenser, Air Economizer
Proposed Efficiency = 14.00 SEER, Required Efficiency: 13.00 SEER
Fan System: FAN SYSTEM 1 | CR -- Compliance (Motor nameplate HP method) : Passes

Fans:
FAN 1 Supply, Constant Volume, 600 CFM, 0.5 motor nameplate hp

8 SSHP 13 (Single Zone) :
Cooling: 1 each - Split System, Capacity = 18 kBtu/h, Air-Cooled Condenser, Air Economizer
Proposed Efficiency = 20.00 SEER, Required Efficiency: 13.00 SEER
Fan System: FAN SYSTEM 1 | CR -- Compliance (Motor nameplate HP method) : Passes

Fans:
FAN 1 Supply, Constant Volume, 600 CFM, 0.5 motor nameplate hp

2 BLOWER COIL 10 (Single Zone) :
Heating: 1 each - Hydronic or Steam Coil, Hot Water, Capacity = 132 kBtu/h
No minimum efficiency requirement applies
Cooling: 1 each - Hydronic Coil, Capacity = 131 kBtu/h, Air Economizer
No minimum efficiency requirement applies
Fan System: FAN SYSTEM 11 | CR -- Compliance (Motor nameplate HP method) : Passes

Fans:

FAN 1 Supply, Constant Volume, 600 CFM, 0.5 motor nameplate hp
FAN 3 Supply, Constant Volume, 1000 CFM, 1.0 motor nameplate hp
FAN 4 Supply, Constant Volume, 1200 CFM, 1.0 motor nameplate hp
FAN 5 Supply, Constant Volume, 1600 CFM, 1.0 motor nameplate hp
FAN 6 Supply, Constant Volume, 2000 CFM, 1.0 motor nameplate hp
FAN 7 Supply, Constant Volume, 3000 CFM, 5.0 motor nameplate hp
FAN 8 Supply, Constant Volume, 4000 CFM, 5.0 motor nameplate hp
FAN 9 Supply, Single-Zone VAV, 6000 CFM, 5.0 motor nameplate hp

2 CONDENSING BOILERS:
Heating: Hot Water Boiler, Capacity 3000 kBtu/h, Gas, with Waterloop Heat Pump
Proposed Efficiency: 96.00 % Ec, Required Efficiency: 80.00 % Ec

2 AIR COOLED CHILLERS:
Cooling: Water Chiller, Capacity 241 tons, Condenser Air-Cooled, Rotary Screw or Scroll Chiller
Proposed Efficiency: 9.72 EER (Refer to mech. plans for proposed IPLV),
Required Efficiency: 9.562 EER (12.75 IPLV)

1 Water Heater 1:
Electric Storage Water Heater, Capacity: 150 gallons w/ Circulation Pump
Proposed Efficiency: 1.00 EF, Required Efficiency: 0.73 EF

1 Water Heater 2:
Electric Storage Water Heater, Capacity: 82 gallons w/ Circulation Pump
Proposed Efficiency: 1.00 EF, Required Efficiency: 0.82 EF

1 Water Heater 3:
Electric Storage Water Heater, Capacity: 50 gallons w/ Circulation Pump
Proposed Efficiency: 1.00 EF, Required Efficiency: 0.86 EF

1 Water Heater 4:
Electric Storage Water Heater, Capacity: 82 gallons w/ Circulation Pump
Proposed Efficiency: 1.00 EF, Required Efficiency: 0.82 EF

1 Water Heater 5:
Electric Storage Water Heater, Capacity: 50 gallons w/ Circulation Pump
Proposed Efficiency: 1.00 EF, Required Efficiency: 0.86 EF

1 Water Heater 6:
Gas Instantaneous Water Heater, Capacity: 0 gallons, Input Rating: 1000 kBtu/h w/ Circulation Pump
Proposed Efficiency: 96.00 % Et, Required Efficiency: 80.00 % Et

Section 4: Requirements Checklist

Requirements Specific To: BLOWER COIL #1 :

- ☐ 1. Balancing and pressure test connections on all hydronic terminal devices
- ☐ 2. Multiple boilers must have automatic controls that sequence operation with load
- ☐ 3. Single boiler >500 kBtu/h input capacity must have a multistaged or modulating burner
- ☐ 4. Two-pipe changeover heating/cooling controls must have:
  a) 15 degrees F deadband where boiler and chiller can not operate,
  b) allow operation in either heating or cooling for at least 4 hrs. and
  c) prevent difference between heating and cooling set points greater than 30 degrees F
  Exception(s):
  - ☐ Air/evap condenser and extensive outside-air filtration
- ☐ 5. Meets the condenser heat recovery requirement for service water heating
  Exception(s):
  - ☐ Facilities that employ condenser heat recovery for space heating with a heat recovery design exceeding 30% of the peak water-cooled condenser load at design conditions.
  - ☐ Facilities that provide 60% of their service water heating from site solar or site recovered energy or from other sources.
- ☐ 6. Chilled water pumping systems with multiple chillers must automatically reduce chilled water flow rates proportionately when chillers are not operating
- ☐ 7. Hot water pumping systems with multiple boilers automatically reduce hot water flow rates proportionately when boilers are not operating

Requirements Specific To: BLOWER COIL #2 :

- ☐ 1. Balancing and pressure test connections on all hydronic terminal devices
- ☐ 2. Multiple boilers must have automatic controls that sequence operation with load
- ☐ 3. Single boiler >500 kBtu/h input capacity must have a multistaged or modulating burner
- ☐ 4. Two-pipe changeover heating/cooling controls must have:

a) 15 degrees F deadband where boiler and chiller can not operate,
b) allow operation in either heating or cooling for at least 4 hrs. and
c) prevent difference between heating and cooling set points greater than 30 degrees F

Exception(s):

- ☐ Air/evap condenser and extensive outside-air filtration

☐ 5. Meets the condenser heat recovery requirement for service water heating

Exception(s):

- ☐ Facilities that employ condenser heat recovery for space heating with a heat recovery design exceeding 30% of the peak water-cooled condenser load at design conditions.
- ☐ Facilities that provide 60% of their service water heating from site solar or site recovered energy or from other sources.

☐ 6. Chilled water pumping systems with multiple chillers must automatically reduce chilled water flow rates proportionately when chillers are not operating

☐ 7. Hot water pumping systems with multiple boilers automatically reduce hot water flow rates proportionately when boilers are not operating

Requirements Specific To: BLOWER COIL #3 :

☐ 1. Balancing and pressure test connections on all hydronic terminal devices

☐ 2. Multiple boilers must have automatic controls that sequence operation with load

☐ 3. Single boiler >500 kBtu/h input capacity must have a multistaged or modulating burner

☐ 4. Two-pipe changeover heating/cooling controls must have:
a) 15 degrees F deadband where boiler and chiller can not operate,
b) allow operation in either heating or cooling for at least 4 hrs. and
c) prevent difference between heating and cooling set points greater than 30 degrees F

Exception(s):

- ☐ Air/evap condenser and extensive outside-air filtration

☐ 5. Meets the condenser heat recovery requirement for service water heating

Exception(s):

- ☐ Facilities that employ condenser heat recovery for space heating with a heat recovery design exceeding 30% of the peak water-cooled condenser load at design conditions.
- ☐ Facilities that provide 60% of their service water heating from site solar or site recovered energy or from other sources.

☐ 6. Chilled water pumping systems with multiple chillers must automatically reduce chilled water flow rates proportionately when chillers are not operating

☐ 7. Hot water pumping systems with multiple boilers automatically reduce hot water flow rates proportionately when boilers are not operating

Requirements Specific To: BLOWER COIL #4 :

☐ 1. Balancing and pressure test connections on all hydronic terminal devices

☐ 2. Multiple boilers must have automatic controls that sequence operation with load

☐ 3. Single boiler >500 kBtu/h input capacity must have a multistaged or modulating burner

☐ 4. Two-pipe changeover heating/cooling controls must have:
a) 15 degrees F deadband where boiler and chiller can not operate,
b) allow operation in either heating or cooling for at least 4 hrs. and
c) prevent difference between heating and cooling set points greater than 30 degrees F

Exception(s):

- ☐ Air/evap condenser and extensive outside-air filtration

☐ 5. Meets the condenser heat recovery requirement for service water heating

Exception(s):

- ☐ Facilities that employ condenser heat recovery for space heating with a heat recovery design exceeding 30% of the peak water-cooled condenser load at design conditions.
- ☐ Facilities that provide 60% of their service water heating from site solar or site recovered energy or from other sources.

☐ 6. Chilled water pumping systems with multiple chillers must automatically reduce chilled water flow rates proportionately when chillers are not operating

☐ 7. Hot water pumping systems with multiple boilers automatically reduce hot water flow rates proportionately when boilers are not operating

Requirements Specific To: BLOWER COIL #5 :

☐ 1. Balancing and pressure test connections on all hydronic terminal devices

☐ 2. Multiple boilers must have automatic controls that sequence operation with load

☐ 3. Single boiler >500 kBtu/h input capacity must have a multistaged or modulating burner

☐ 4. Two-pipe changeover heating/cooling controls must have:
a) 15 degrees F deadband where boiler and chiller can not operate,
b) allow operation in either heating or cooling for at least 4 hrs. and
c) prevent difference between heating and cooling set points greater than 30 degrees F

Exception(s):

- ☐ Air/evap condenser and extensive outside-air filtration

☐ 5. Meets the condenser heat recovery requirement for service water heating

Exception(s):

- ☐ Facilities that employ condenser heat recovery for space heating with a heat recovery design exceeding 30% of the peak water-cooled condenser load at design conditions.
- ☐ Facilities that provide 60% of their service water heating from site solar or site recovered energy or from other sources.

☐ 6. Chilled water pumping systems with multiple chillers must automatically reduce chilled water flow rates proportionately when chillers are not operating

☐ 7. Hot water pumping systems with multiple boilers automatically reduce hot water flow rates proportionately when boilers are not operating

Requirements Specific To: BLOWER COIL #6 :

☐ 1. Balancing and pressure test connections on all hydronic terminal devices

☐ 2. Multiple boilers must have automatic controls that sequence operation with load

☐ 3. Single boiler >500 kBtu/h input capacity must have a multistaged or modulating burner

☐ 4. Two-pipe changeover heating/cooling controls must have:
a) 15 degrees F deadband where boiler and chiller can not operate,
b) allow operation in either heating or cooling for at least 4 hrs. and
c) prevent difference between heating and cooling set points greater than 30 degrees F

Exception(s):

- ☐ Air/evap condenser and extensive outside-air filtration

☐ 5. Meets the condenser heat recovery requirement for service water heating

Exception(s):

- ☐ Facilities that employ condenser heat recovery for space heating with a heat recovery design exceeding 30% of the peak water-cooled condenser load at design conditions.
- ☐ Facilities that provide 60% of their service water heating from site solar or site recovered energy or from other sources.

☐ 6. Chilled water pumping systems with multiple chillers must automatically reduce chilled water flow rates proportionately when chillers are not operating

☐ 7. Hot water pumping systems with multiple boilers automatically reduce hot water flow rates proportionately when boilers are not operating

Requirements Specific To: BLOWER COIL #7 :

☐ 1. Balancing and pressure test connections on all hydronic terminal devices

☐ 2. Multiple boilers must have automatic controls that sequence operation with load

☐ 3. Single boiler >500 kBtu/h input capacity must have a multistaged or modulating burner

☐ 4. Two-pipe changeover heating/cooling controls must have:
a) 15 degrees F deadband where boiler and chiller can not operate,
b) allow operation in either heating or cooling for at least 4 hrs. and
c) prevent difference between heating and cooling set points greater than 30 degrees F

Exception(s):

- ☐ Air/evap condenser and extensive outside-air filtration

☐ 5. Meets the condenser heat recovery requirement for service water heating

Exception(s):

- ☐ Facilities that employ condenser heat recovery for space heating with a heat recovery design exceeding 30% of the peak water-cooled condenser load at design conditions.
- ☐ Facilities that provide 60% of their service water heating from site solar or site recovered energy or from other sources.

☐ 6. Chilled water pumping systems with multiple chillers must automatically reduce chilled water flow rates proportionately when chillers are not operating

☐ 7. Hot water pumping systems with multiple boilers automatically reduce hot water flow rates proportionately when boilers are not operating

Requirements Specific To: BLOWER COIL #8 :

☐ 1. Balancing and pressure test connections on all hydronic terminal devices

☐ 2. Integrated economizer is required for this location and system.

☐ 3. Multiple boilers must have automatic controls that sequence operation with load

☐ 4. Single boiler >500 kBtu/h input capacity must have a multistaged or modulating burner

☐ 5. Two-pipe changeover heating/cooling controls must have:
a) 15 degrees F deadband where boiler and chiller can not operate,
b) allow operation in either heating or cooling for at least 4 hrs. and
c) prevent difference between heating and cooling set points greater than 30 degrees F

Exception(s):

- ☐ Air/evap condenser and extensive outside-air filtration

☐ 6. Meets the condenser heat recovery requirement for service water heating
Exception(s):

☐ Facilities that employ condenser heat recovery for space heating with a heat recovery design exceeding 30% of the peak water-cooled condenser load at design conditions.

☐ Facilities that provide 60% of their service water heating from site solar or site recovered energy or from other sources.

☐ 7. Chilled water pumping systems with multiple chillers must automatically reduce chilled water flow rates proportionately when chillers are not operating

☐ 8. Hot water pumping systems with multiple boilers automatically reduce hot water flow rates proportionately when boilers are not operating

Requirements Specific To: BLOWER COIL #9 :

☐ 1. Balancing and pressure test connections on all hydronic terminal devices
☐ 2. Integrated economizer is required for this location and system.
☐ 3. Multiple boilers must have automatic controls that sequence operation with load
☐ 4. Single boiler >500 kBtu/h input capacity must have a multistaged or modulating burner
☐ 5. Two-pipe changeover heating/cooling controls must have:
a) 15 degrees F deadband where boiler and chiller can not operate,
b) allow operation in either heating or cooling for at least 4 hrs. and
c) prevent difference between heating and cooling set points greater than 30 degrees F
Exception(s):

☐ Air/evap condenser and extensive outside-air filtration

☐ 6. Meets the condenser heat recovery requirement for service water heating
Exception(s):

☐ Facilities that employ condenser heat recovery for space heating with a heat recovery design exceeding 30% of the peak water-cooled condenser load at design conditions.

☐ Facilities that provide 60% of their service water heating from site solar or site recovered energy or from other sources.

☐ 7. Chilled water pumping systems with multiple chillers must automatically reduce chilled water flow rates proportionately when chillers are not operating

☐ 8. Hot water pumping systems with multiple boilers automatically reduce hot water flow rates proportionately when boilers are not operating

Requirements Specific To: RTHP 11 :

☐ 1. Equipment minimum efficiency: Single Package Unit: 13.00 SEER
☐ 2. Integrated economizer is required for this location and system.
☐ 3. Cooling system provides a means to relieve excess outdoor air during economizer operation.

Requirements Specific To: SSHP 12 :

☐ 1. Equipment minimum efficiency: Split System: 13.00 SEER
☐ 2. Integrated economizer is required for this location and system.
☐ 3. Cooling system provides a means to relieve excess outdoor air during economizer operation.

Requirements Specific To: SSHP 13 :

☐ 1. Equipment minimum efficiency: Split System: 13.00 SEER
☐ 2. Integrated economizer is required for this location and system.
☐ 3. Cooling system provides a means to relieve excess outdoor air during economizer operation.

Requirements Specific To: BLOWER COIL 10 :

☐ 1. Balancing and pressure test connections on all hydronic terminal devices
☐ 2. Integrated economizer is required for this location and system.
☐ 3. Cooling system provides a means to relieve excess outdoor air during economizer operation.
☐ 4. Multiple boilers must have automatic controls that sequence operation with load
☐ 5. Single boiler >500 kBtu/h input capacity must have a multistaged or modulating burner
☐ 6. Two-pipe changeover heating/cooling controls must have:
a) 15 degrees F deadband where boiler and chiller can not operate,
b) allow operation in either heating or cooling for at least 4 hrs. and
c) prevent difference between heating and cooling set points greater than 30 degrees F
Exception(s):

☐ Air/evap condenser and extensive outside-air filtration

☐ 7. Meets the condenser heat recovery requirement for service water heating
Exception(s):

☐ Facilities that employ condenser heat recovery for space heating with a heat recovery design exceeding 30% of the peak water-cooled condenser load at design conditions.

☐ Facilities that provide 60% of their service water heating from site solar or site recovered energy or from other sources.

- ☐ 8. Chilled water pumping systems with multiple chillers must automatically reduce chilled water flow rates proportionately when chillers are not operating
- ☐ 9. Hot water pumping systems with multiple boilers automatically reduce hot water flow rates proportionately when boilers are not operating

Requirements Specific To: CONDENSING BOILERS :

- ☐ 1. Equipment minimum efficiency: Boiler Combustion Efficiency 80% Ec
- ☐ 2. Loop temperature controlled with 20 degrees F deadband where neither cooling tower/fluid cooler nor boiler can operate
- ☐ 3. Two-position valve on each heat pump having total heat pump system power >10hp
- ☐ 4. Newly purchased heating equipment meets the efficiency requirements
  - used equipment must meet 80% Et @ maximum capacity
- ☐ 5. Systems with multiple boilers have automatic controls capable of sequencing boiler operation
- ☐ 6. Hydronic heating systems comprised of a single boiler and >500 kBtu/h input design capacity include either a multistaged or modulating burner

Requirements Specific To: AIR COOLED CHILLERS :

- ☐ 1. Equipment minimum efficiency: Chiller: 9.562 EER (12.75 IPLV)
- ☐ 2. Hot gas bypass prohibited unless system has multiple steps of unloading or continuous capacity modulation
- ☐ 3. Hot gas bypass limited to 25% of total cooling capacity
- ☐ 4. Meets the condenser heat recovery requirement for service water heating

  Exception(s):

  - ☐ Facilities that employ condenser heat recovery for space heating with a heat recovery design exceeding 30% of the peak water-cooled condenser load at design conditions.
  - ☐ Facilities that provide 60% of their service water heating from site solar or site recovered energy or from other sources.
- ☐ 5. Chilled water pumping systems with multiple chillers must automatically reduce chilled water flow rates proportionately when chillers are not operating

Requirements Specific To: Water Heater 1 :

- ☐ 1. Water heating equipment meets minimum efficiency requirements: Electric Water Heater efficiency: 0.73 EF (448 SL, Btu/h (if > 12 kW))
- ☐ 2. All piping in circulating system insulated
- ☐ 3. Hot water storage temperature controls that allow setpoint of 90°F for non-dwelling units and 110°F for dwelling units.
- ☐ 4. Automatic time control of heat tapes and recirculating systems present
- ☐ 5. Controls will shut off operation of circulating pump between water heater/boiler and storage tanks within 5 minutes after end of heating cycle

Requirements Specific To: Water Heater 2 :

- ☐ 1. Water heating equipment meets minimum efficiency requirements: Electric Water Heater efficiency: 0.82 EF (336 SL, Btu/h (if > 12 kW))
- ☐ 2. All piping in circulating system insulated
- ☐ 3. Hot water storage temperature controls that allow setpoint of 90°F for non-dwelling units and 110°F for dwelling units.
- ☐ 4. Automatic time control of heat tapes and recirculating systems present
- ☐ 5. Controls will shut off operation of circulating pump between water heater/boiler and storage tanks within 5 minutes after end of heating cycle

Requirements Specific To: Water Heater 3 :

- ☐ 1. Water heating equipment meets minimum efficiency requirements: Electric Water Heater efficiency: 0.86 EF (267 SL, Btu/h (if > 12 kW))
- ☐ 2. All piping in circulating system insulated
- ☐ 3. Hot water storage temperature controls that allow setpoint of 90°F for non-dwelling units and 110°F for dwelling units.
- ☐ 4. Automatic time control of heat tapes and recirculating systems present
- ☐ 5. Controls will shut off operation of circulating pump between water heater/boiler and storage tanks within 5 minutes after end of heating cycle

Requirements Specific To: Water Heater 4 :

- ☐ 1. Water heating equipment meets minimum efficiency requirements: Electric Water Heater efficiency: 0.82 EF (336 SL, Btu/h (if > 12 kW))
- ☐ 2. All piping in circulating system insulated
- ☐ 3. Hot water storage temperature controls that allow setpoint of 90°F for non-dwelling units and 110°F for dwelling units.
- ☐ 4. Automatic time control of heat tapes and recirculating systems present
- ☐ 5. Controls will shut off operation of circulating pump between water heater/boiler and storage tanks within 5 minutes after end of heating cycle

Requirements Specific To: Water Heater 5 :

☐ 1. Water heating equipment meets minimum efficiency requirements: Electric Water Heater efficiency: 0.86 EF (267 SL, Btu/h (if > 12 kW))
☐ 2. All piping in circulating system insulated
☐ 3. Hot water storage temperature controls that allow setpoint of 90°F for non-dwelling units and 110°F for dwelling units.
☐ 4. Automatic time control of heat tapes and recirculating systems present
☐ 5. Controls will shut off operation of circulating pump between water heater/boiler and storage tanks within 5 minutes after end of heating cycle

Requirements Specific To: Water Heater 6 :

☐ 1. Water heating equipment meets minimum efficiency requirements: Gas Instantaneous Water Heater efficiency: 80.00 % Et
☐ 2. All piping in circulating system insulated
☐ 3. Automatic time control of heat tapes and recirculating systems present
☐ 4. Controls will shut off operation of circulating pump between water heater/boiler and storage tanks within 5 minutes after end of heating cycle

Generic Requirements: Must be met by all systems to which the requirement is applicable:

☐ 1. Plant equipment and system capacity no greater than needed to meet loads
Exception(s):
- ☐ Standby equipment automatically off when primary system is operating
- ☐ Multiple units controlled to sequence operation as a function of load

☐ 2. Minimum one temperature control device per system
☐ 3. Minimum one humidity control device per installed humidification/dehumidification system
☐ 4. Load calculations per ASHRAE/ACCA Standard 183.
☐ 5. Automatic Controls: Setback to 55°F (heat) and 85°F (cool); 7-day clock, 2-hour occupant override, 10-hour backup
Exception(s):
- ☐ Continuously operating zones

☐ 6. Outside-air source for ventilation; system capable of reducing OSA to required minimum
☐ 7. R-5 supply and return air duct insulation in unconditioned spaces
R-8 supply and return air duct insulation outside the building
R-8 insulation between ducts and the building exterior when ducts are part of a building assembly
Exception(s):
- ☐ Ducts located within equipment
- ☐ Ducts with interior and exterior temperature difference not exceeding 15°F.

☐ 8. Mechanical fasteners and sealants used to connect ducts and air distribution equipment
☐ 9. Ducts sealed - longitudinal seams on rigid ducts; transverse seams on all ducts; UL 181A or 181B tapes and mastics
☐ 10. Hot water pipe insulation: 1.5 in. for pipes <=1.5 in. and 2 in. for pipes >1.5 in.
Chilled water/refrigerant/brine pipe insulation: 1.5 in. for pipes <=1.5 in. and 1.5 in. for pipes >1.5 in.
Steam pipe insulation: 1.5 in. for pipes <=1.5 in. and 3 in. for pipes >1.5 in.
Exception(s):
- ☐ Piping within HVAC equipment.
- ☐ Fluid temperatures between 55 and 105°F.
- ☐ Fluid not heated or cooled with renewable energy.
- ☐ Piping within room fan-coil (with AHRI440 rating) and unit ventilators (with AHRI840 rating).
- ☐ Runouts <4 ft in length.

☐ 11. Operation and maintenance manual provided to building owner
☐ 12. Thermostatic controls have 5°F deadband
Exception(s):
- ☐ Thermostats requiring manual changeover between heating and cooling
- ☐ Special occupancy or special applications where wide temperature ranges are not acceptable and are approved by the authority having jurisdiction.

☐ 13. Hot water distribution systems >= 300 kBtu/h must have one of the following:
a) controls that reset supply water temperature by 25% of supply/return delta T
b) mechanical or electrical adjustable-speed pump drive(s)
c) two-way valves at all heating coils
d) multiple-stage pumps
e) other system controls that reduce pump flow by at least 50% based on load - calculations required
Exception(s):
- ☐ Where the supply temperature reset controls cannot be implemented without causing improper operation of heating, cooling, humidification, or dehumidification systems.
- ☐ Hydronic systems that use variable flow to reduce pumping energy.

- ☐ 14. Balancing devices provided in accordance with IMC 603.17
- ☐ 15. Demand control ventilation (DCV) present for high design occupancy areas (>40 person/1000 ft2 in spaces >500 ft2) and served by systems with any one of 1) an air-side economizer, 2) automatic modulating control of the outdoor air damper, or 3) a design outdoor airflow greater than 3000 cfm.

  Exception(s):

  - ☐ Systems with heat recovery.
  - ☐ Multiple-zone systems without DDC of individual zones communicating with a central control panel.
  - ☐ Systems with a design outdoor airflow less than 1200 cfm.
  - ☐ Spaces where the supply airflow rate minus any makeup or outgoing transfer air requirement is less than 1200 cfm.
- ☐ 16. Total cooling capacity without economizers must be less than 480 kBtu/h. This project lists 3488 kBtu/h capacity without economizers.
- ☐ 17. Motorized, automatic shutoff dampers required on exhaust and outdoor air supply openings

  Exception(s):

  - ☐ Gravity dampers acceptable in buildings <3 stories
- ☐ 18. Automatic controls for freeze protection systems present
- ☐ 19. Three-pipe systems not used
- ☐ 20. Exhaust air heat recovery included for systems 5,000 cfm or greater with more than 70% outside air fraction or specifically exempted

  Exception(s):

  - ☐ Hazardous exhaust systems, commercial kitchen and clothes dryer exhaust systems that the International Mechanical Code prohibits the use of energy recovery systems.
  - ☐ Systems serving spaces that are heated and not cooled to less than 60°F.
  - ☐ Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site solar energy.
  - ☐ Heating systems in climates with less than 3600 HDD.
  - ☐ Cooling systems in climates with a 1 percent cooling design wet-bulb temperature less than 64°F.
  - ☐ Systems requiring dehumidification that employ energy recovery in series with the cooling coil.
  - ☐ Laboratory fume hood exhaust systems that have either a variable air volume system capable of reducing exhaust and makeup air volume to 50 percent or less of design values or, a separate make up air supply meeting the following makeup air requirements: a) at least 75 percent of exhaust flow rate, b) heated to no more than 2°F below room setpoint temperature, c) cooled to no lower than 3°F above room setpoint temperature, d) no humidification added, e) no simultaneous heating and cooling.

Section 5: Compliance Statement

Compliance Statement: The proposed mechanical design represented in this document is consistent with the building plans, specifications and other calculations submitted with this permit application. The proposed mechanical systems have been designed to meet the 2009 IECC requirements in COM*check* Version 4.1.2.1 and to comply with the mandatory requirements in the Requirements Checklist.

Coleman C Owens, III		11/12/2021
Name - Title	Signature	Date

President Owens Associates

Section 6: Post Construction Compliance Statement

- ☐ HVAC record drawings of the actual installation, system capacities, calibration information, and performance data for each equipment provided to the owner.
- ☐ HVAC O&M documents for all mechanical equipment and system provided to the owner by the mechanical contractor.
- ☐ Written HVAC balancing and operations report provided to the owner.

The above post construction requirements have been completed.

Principal Mechanical Designer-Name	Signature	Date

COM*check* Software Version 4.1.1.0

Interior Lighting Compliance Certificate

Section 1: Project Information

Energy Code: **2009 IECC**
Project Title: new Hursey Elementary School
Project Type: New Construction

Construction Site:
3795 Spruill Avenue
North Charleston, SC 29405

Owner/Agent:
Charleston County School District
75 Calhoun Street
Charleston, SC 29401

Designer/Contractor:
J. Miles Jordan III PE
Critical Systems Engineering LLC
845 Lowcountry Blvd
Suite H
Mount Pleasant, SC 29464
843-972-4999

Section 2: Interior Lighting and Power Calculation

A Area Category	B Floor Area (ft2)	C Allowed Watts / ft2	D Allowed Watts (B x C)
School/University	119411	1.2	143293
		Total Allowed Watts =	143293

Section 3: Interior Lighting Fixture Schedule

A Fixture ID : Description / Lamp / Wattage Per Lamp / Ballast	B Lamps/ Fixture	C # of Fixtures	D Fixture Watt.	E (C X D)
School/University (119411 sq.ft.)				
LED 1: A: Other:	1	653	62	40486
LED 1 copy 1: B: Other:	1	242	37	8954
LED 1 copy 1: C: Other:	1	68	37	2516
LED 1 copy 1: D: Other:	1	245	20	4900
LED 1 copy 1: F: Other:	1	91	34	3094
LED 1 copy 1: G: Other:	1	75	10	750
LED 1 copy 2: H: Other:	1	19	59	1121
LED 1 copy 2: K: Other:	1	7	75	525
LED 1 copy 2: L: Other:	1	1	70	70
LED 1 copy 2: M: Other:	1	20	240	4800
LED 1 copy 2: N: Other:	1	4	11	44
LED 1 copy 2: P: Other:	1	7	25	175
LED 1 copy 2: R: Other:	1	6	34	204
LED 1 copy 2: S: Other:	1	8	56	448
LED 1 copy 2: T: Other:	1	384	15	5760
LED 1 copy 2: U: Other:	1	336	12	4032
LED 1 copy 3: X: Other:	1	16	68	1088
LED 1 copy 3: Y: Other:	1	2	20	40
LED 1 copy 3: Z: Other:	1	15	86	1290
LED 1 copy 3: AA: Other:	1	14	49	686
LED 1 copy 3: AB: Other:	1	50	10	500
LED 1 copy 3: AC: Other:	1	40	13	520
LED 1 copy 3: AD: Other:	1	100	6	600
LED 1 copy 3: AF: Other:	1	2	25	50
LED 1 copy 3: AG: Other:	1	1	134	134
LED 1 copy 3: AH: Other:	1	3	64	192

LED 1 copy 4: AK: Other:	1	12	25	300

Total Proposed Watts = 83279

Section 4: Requirements Checklist

Interior Lighting PASSES: Design 42% better than code.

Lighting Wattage:

[X] 1. Total proposed watts must be less than or equal to total allowed watts.

Allowed Watts	Proposed Watts	Complies
143293	83279	YES

Controls, Switching, and Wiring:

[X] 2. Daylight zones under skylights more than 15 feet from the perimeter have lighting controls separate from daylight zones adjacent to vertical fenestration.

[X] 3. Daylight zones have individual lighting controls independent from that of the general area lighting.

Exceptions:

[X] Contiguous daylight zones spanning no more than two orientations are allowed to be controlled by a single controlling device.

[X] Daylight spaces enclosed by walls or ceiling height partitions and containing two or fewer light fixtures are not required to have a separate switch for general area lighting.

[X] 4. Independent controls for each space (switch/occupancy sensor).

Exceptions:

[X]

❑ Areas designated as security or emergency areas that must be continuously illu[X]ated.

[X] Lighting in stairways or corridors that are elements of the means of egress.

[N/A] 5. Master switch at entry to hotel/motel guest room.

[N/A] 6. Individual dwelling units separately metered.

[N/A] 7. Medical task lighting or art/history display lighting claimed to be exempt from compliance has a control device independent of the control of the nonexempt lighting.

[X] 8. Each space required to have a manual control also allows for reducing the connected lighting load by at least 50 percent by either controlling all luminaires, dual switching of alternate rows of luminaires, alternate luminaires, or alternate lamps, switching the middle lamp luminaires independently of other lamps, or switching each luminaire or each lamp.

Exceptions:

[X] Only one luminaire in space.

[X] An occupant-sensing device controls the area.

[X] The area is a corridor, storeroom, restroom, public lobby or sleeping unit.

[X] Areas that use less than 0.6 Watts/sq.ft.

[X] 9. Automatic lighting shutoff control in buildings larger than 5,000 sq.ft.

Exceptions:

❑ Sleeping units, patient care areas; and spaces where automatic shutoff would endanger safety or security.

[X] 10. Photocell/astronomical time switch on exterior lights.

Exceptions:

❑ Lighting intended for 24 hour use.

[X] 11. Tandem wired one-lamp and three-lamp ballasted luminaires (No single-lamp ballasts).

Exceptions:

[X] Electronic high-frequency ballasts; Luminaires on emergency circuits or with no available pair.

Section 5: Compliance Statement

Compliance Statement: The proposed lighting design represented in this document is consistent with the building plans, specifications and other calculations submitted with this permit application. The proposed lighting system has been designed to meet the 2009 IECC requirements in COM*check* Version 4.1.1.0 and to comply with the mandatory requirements in the Requirements Checklist.

J. Miles Jordan III PE		11/08/2021
Name - Title	Signature	Date

COM*check* Software Version 4.1.1.0

Exterior Lighting Compliance Certificate

Section 1: Project Information

Energy Code: **2009 IECC**
Project Title: new Hursey Elementary School
Project Type: New Construction
Exterior Lighting Zone: 2 (Neighborhood business district)

Construction Site:
3795 Spruill Avenue
North Charleston, SC 29405

Owner/Agent:
Charleston County School District
75 Calhoun Street
Charleston, SC 29401

Designer/Contractor:
J. Miles Jordan III PE
Critical Systems Engineering LLC
845 Lowcountry Blvd
Suite H
Mount Pleasant, SC 29464
843-972-4999

Section 2: Exterior Lighting Area/Surface Power Calculation

A Exterior Area/Surface	B Quantity	C Allowed Watts / Unit	D Tradable Wattage	E Allowed Watts (B x C)	F Proposed Watts
Main entry	18 ft of door width	20	Yes	360	78
Other door (not main entry)	128 ft of door width	20	Yes	2560	796
Illuminated length of facade wall or surface	560 ft	2.5	No	1400	876
soffits (Entry canopy)	110 ft2	0.25	Yes	28	0
Parking area	92600 ft2	0.06	Yes	5556	5244
recessed (Entry canopy)	2042 ft2	0.25	Yes	511	884
Entry canopy	3588 ft2	0.25	Yes	897	1144
			Total Tradable Watts* =	9911	8146
			Total Allowed Watts =	11311	
			Total Allowed Supplemental Watts** =	600	

* Wattage tradeoffs are only allowed between tradable areas/surfaces.
** A supplemental allowance equal to 600 watts may be applied toward compliance of both non-tradable and tradable areas/surfaces.

Section 3: Exterior Lighting Fixture Schedule

A Fixture ID : Description / Lamp / Wattage Per Lamp / Ballast	B Lamps/ Fixture	C # of Fixtures	D Fixture Watt.	E (C X D)
Main entry (18 ft of door width): Tradable Wattage				
LED 1: OA: Other:	1	3	26	78
Other door (not main entry) (128 ft of door width): Tradable Wattage				
LED 1 copy 1: OA: Other:	1	26	26	676
LED 1 copy 1: OB: Other:	1	4	30	120
soffits (Entry canopy 110 ft2): Tradable Wattage				
Illuminated length of facade wall or surface (560 ft): Non-tradable Wattage				
LED 1 copy 1: OC: Other:	1	12	73	876
Entry canopy (3588 ft2): Tradable Wattage				
LED 1 copy 1: OD: Other:	1	22	52	1144
Parking area (92600 ft2): Tradable Wattage				
LED 1 copy 2: OF: Other:	1	28	138	3864
LED 1 copy 2: OG: Other:	1	5	276	1380
recessed (Entry canopy 2042 ft2): Tradable Wattage				

LED 1 copy 2: OH: Other:	1	17	52	884
			Total Tradable Proposed Watts =	8146

Section 4: Requirements Checklist

Lighting Wattage:

[X] 1. Within each non-tradable area/surface, total proposed watts must be less than or equal to total allowed watts. Across all tradable areas/surfaces, total proposed watts must be less than or equal to total allowed watts.

Compliance: Passes.

Controls, Switching, and Wiring:

[X] 2. All exemption claims are associated with fixtures that have a control device independent of the control of the nonexempt lighting.

[X] 3. Lighting not designated for dusk-to-dawn operation is controlled by either a a photosensor (with time switch), or an astronomical time switch.

[X] 4. Lighting designated for dusk-to-dawn operation is controlled by an astronomical time switch or photosensor.

[X] 5. All time switches are capable of retaining programming and the time setting during loss of power for a period of at least 10 hours.

Exterior Lighting Efficacy:

[X] 6. All exterior building grounds luminaires that operate at greater than 100W have minimum efficacy of 60 lumen/watt.

Exceptions:

- ❑ Lighting that has been claimed as exempt and is identified as such in Section 3 table above.
- ❑ Lighting that is specifically designated as required by a health or life safety statue, ordinance, or regulation.
- ❑ Emergency lighting that is automatically off during normal building operation.
- ❑ Lighting that is controlled by motion sensor.

Exterior Lighting PASSES: Design 23% better than code.

Section 5: Compliance Statement

Compliance Statement: The proposed exterior lighting design represented in this document is consistent with the building plans, specifications and other calculations submitted with this permit application. The proposed lighting system has been designed to meet the 2009 IECC requirements in COM*check* Version 4.1.1.0 and to comply with the mandatory requirements in the Requirements Checklist.

J. Miles Jordan III PE		11/08/2021
Name - Title	Signature	Date

Appendix ‘D’

Photometric Summary

New Hursey Elementary School
Photometric Analysis Summary

Project Number:	2152			Light Loss Factor:		0.75	
Revised:	12/14/2021			Classrm Calculation Height		30" aff	
	Non-Emergency					Emergency	
Room Description	Avg fc	Max fc	Min fc	Max/Min	Avg/Min	Avg/Max	Avg fc	Min fc
ART RM 144	70.5	76.2	60.2	1.3	1.2	0.9	4.2	0.1
BOOK STR 106S	33.4	40.4	23.4	1.7	1.4	0.8	Not Required	
BOYS T208	30.9	35.9	23.9	1.5	1.3	0.9	4.8	0.5
BOYS T306	32.8	41.8	23.8	1.8	1.4	0.8	3.6	0.8
CAFETERIA 156	72.5	79.5	67.5	1.2	1.1	0.9	3.4	0.7
TLT 149T	31.0	40.0	22.0	1.8	1.4	0.8	Not Required	
COLLABORATION 314	68.0	78.0	62.0	1.3	1.1	0.9	6.7	1.2
COMP LAB 204	75.0	83.0	70.0	1.2	1.1	0.9	6.0	0.4
CONF 102E	48.3	57.3	43.3	1.3	1.1	0.8	4.9	0.1
CONF 205	46.0	53.0	38.0	1.4	1.2	0.9	2.4	1.0
CONFERENCE 104H	50.1	57.1	42.1	1.4	1.2	0.9	4.0	1.0
CORRIDOR 104	31.4	38.4	25.4	1.5	1.2	0.8	4.1	0.8
CORRIDOR 156A	25.0	33.0	17.0	1.9	1.5	0.8	6.5	1.2
CORRIDOR 252A	31.0	36.0	24.0	1.5	1.3	0.9	3.4	0.9
CORRIDOR 253A	30.8	36.8	25.8	1.4	1.2	0.8	3.6	0.2
CORRIDOR CR100	33.3	39.3	24.3	1.6	1.4	0.8	2.7	0.9
CORRIDOR CR100A	35.6	45.6	25.6	1.8	1.4	0.8	4.2	0.4
CORRIDOR CR100B	25.6	32.6	17.6	1.9	1.5	0.8	5.3	0.3
CORRIDOR CR118	26.0	32.0	21.0	1.5	1.2	0.8	5.5	0.6
CORRIDOR CR200	33.3	42.3	27.3	1.5	1.2	0.8	3.6	0.4
CORRIDOR CR200A	29.5	35.5	24.5	1.4	1.2	0.8	2.9	0.8
CORRIDOR CR200B	33.9	41.9	26.9	1.6	1.3	0.8	2.8	0.3
CORRIDOR CR300	25.0	34.0	15.0	2.3	1.7	0.7	1.9	0.1
CORRIDOR CR300B	31.2	39.2	23.2	1.7	1.3	0.8	6.8	0.8
DAY PORTER C115	48.0	54.0	41.0	1.3	1.2	0.9	Not Required	
DISHWASHING 157B	65.2	73.2	58.2	1.3	1.1	0.9	1.8	1.2
DRY STOR 157C	29.4	37.4	21.4	1.7	1.4	0.8	Not Required	
ELEC 104B	29.3	39.3	19.3	2.0	1.5	0.7	5.0	0.5
ELEC 114	33.5	42.5	24.5	1.7	1.4	0.8	6.6	0.9
ELEC E221	25.4	32.4	15.4	2.1	1.6	0.8	3.0	0.2
ELEC E241	35.5	45.5	30.5	1.5	1.2	0.8	2.4	0.3
ELECTRICAL E163	26.1	31.1	17.1	1.8	1.5	0.8	2.2	0.1
ELECTRICAL E311	28.3	37.3	20.3	1.8	1.4	0.8	6.0	0.5
ELEV MACH RM 163	27.1	32.1	17.1	1.9	1.6	0.8	2.4	1.1
ESOL 302	71.1	80.1	61.1	1.3	1.2	0.9	6.0	1.1
FIRE PUMP RISER 162	31.2	38.2	25.2	1.5	1.2	0.8	3.7	0.2
G&T RM 229	73.6	82.6	64.6	1.3	1.1	0.9	1.9	0.2
GIRLS T212	29.6	37.6	20.6	1.8	1.4	0.8	4.8	0.6
GIRLS T308	33.4	39.4	23.4	1.7	1.4	0.8	5.2	0.1

New Hursey Elementary School
Photometric Analysis Summary

Project Number:	2152			Light Loss Factor:		0.75	
Revised:	12/14/2021			Classrm Calculation Height		30" aff	
	Non-Emergency					Emergency	
Room Description	Avg fc	Max fc	Min fc	Max/Min	Avg/Min	Avg/Max	Avg fc	Min fc
INSTRUMENT STOR 150B	34.4	40.4	25.4	1.6	1.4	0.9	Not Required	
JAN 157G	28.7	35.7	23.7	1.5	1.2	0.8	Not Required	
JAN C107	36.0	44.0	26.0	1.7	1.4	0.8	Not Required	
JAN C117	25.6	35.6	20.6	1.7	1.2	0.7	Not Required	
JAN C240	32.1	38.1	26.1	1.5	1.2	0.8	Not Required	
KALEIDOSCOPE 141	73.3	82.3	65.3	1.3	1.1	0.9	3.0	0.8
KALEIDOSCOPE 145	75.6	84.6	69.6	1.2	1.1	0.9	6.8	1.1
KALEIDOSCOPE 149	69.0	74.0	63.0	1.2	1.1	0.9	5.7	1.0
KILN 144A	35.5	44.5	29.5	1.5	1.2	0.8	Not Required	
KITCHEN 157	68.4	73.4	62.4	1.2	1.1	0.9	1.4	0.2
LANGUAGE 316	75.0	85.0	65.0	1.3	1.2	0.9	5.4	1.0
LAUNDRY 120	32.2	38.2	23.2	1.6	1.4	0.8	Not Required	
LD RESOURCE 223	69.0	77.0	60.0	1.3	1.2	0.9	3.4	0.2
LD RESOURCE 223	69.6	77.6	62.6	1.2	1.1	0.9	4.3	0.8
LIT COACH 201	68.1	78.1	60.1	1.3	1.1	0.9	1.8	1.0
LIT LIBRARY 202	34.0	43.0	25.0	1.7	1.4	0.8	2.6	0.5
LOBBY 100	31.0	39.0	22.0	1.8	1.4	0.8	2.1	1.2
LOCKER 157F	29.3	37.3	21.3	1.8	1.4	0.8	Not Required	
LOWER ES1 252	68.9	78.9	63.9	1.2	1.1	0.9	7.0	0.2
LOWER ES2 248	74.2	83.2	64.2	1.3	1.2	0.9	2.4	0.3
LOWER ES2 253	65.6	75.6	59.6	1.3	1.1	0.9	1.4	0.9
LOWER ES4 249	71.0	76.0	61.0	1.2	1.2	0.9	1.7	0.1
LOWER ES5 245	67.0	72.0	59.0	1.2	1.1	0.9	3.1	0.6
LOWER ES6 244	68.4	78.4	60.4	1.3	1.1	0.9	1.4	0.4
MAIN MECH 161	33.5	38.5	26.5	1.5	1.3	0.9	5.8	0.3
MATH 219	73.4	78.4	66.4	1.2	1.1	0.9	5.7	0.6
MECH M116	34.2	42.2	25.2	1.7	1.4	0.8	Not Required	
MECH M139	31.3	39.3	25.3	1.6	1.2	0.8	Not Required	
MEDIA CENTER 203	69.2	77.2	64.2	1.2	1.1	0.9	2.8	1.0
MEDIA STORAGE 203E	28.3	36.3	19.3	1.9	1.5	0.8	Not Required	
MENS T160	26.1	32.1	18.1	1.8	1.4	0.8	2.3	0.6
MS1 326	73.7	79.7	68.7	1.2	1.1	0.9	1.7	0.4
MS2 320	73.6	81.6	67.6	1.2	1.1	0.9	4.8	1.1
MS3 323	73.9	81.9	68.9	1.2	1.1	0.9	4.2	0.9
MS4 327	75.4	82.4	67.4	1.2	1.1	0.9	2.7	0.1
MS FLEXX 325	73.3	80.3	67.3	1.2	1.1	0.9	2.4	0.7
MTR D112	29.0	36.0	22.0	1.6	1.3	0.8	4.3	0.9
MULTIPURPOSE 151	75.8	82.8	68.8	1.2	1.1	0.9	6.6	0.4
MUSIC 154	66.0	71.0	57.0	1.2	1.2	0.9	1.2	0.1

New Hursey Elementary School
Photometric Analysis Summary

Project Number:	2152				Light Loss Factor:		0.75	
Revised:	12/14/2021				Classrm Calculation Height		30" aff	
	Non-Emergency						Emergency	
Room Description	Avg fc	Max fc	Min fc	Max/Min	Avg/Min	Avg/Max	Avg fc	Min fc
MUSIC LIB 152	28.2	38.2	23.2	1.6	1.2	0.7	Not Required	
NURSE SUITE 103	45.7	52.7	39.7	1.3	1.2	0.9	1.5	0.2
OFFIC 151C	52.9	58.9	45.9	1.3	1.2	0.9	Not Required	
OFFICE 102A	48.7	58.7	43.7	1.3	1.1	0.8	Not Required	
OFFICE 102B	54.5	59.5	44.5	1.3	1.2	0.9	Not Required	
OFFICE 104A	56.0	64.0	48.0	1.3	1.2	0.9	Not Required	
OFFICE 104D	54.5	63.5	45.5	1.4	1.2	0.9	Not Required	
OFFICE 104F	55.3	62.3	48.3	1.3	1.1	0.9	Not Required	
OFFICE 104G	48.1	58.1	39.1	1.5	1.2	0.8	Not Required	
OFFICE 104J	51.2	59.2	46.2	1.3	1.1	0.9	Not Required	
OFFICE 104K	46.8	54.8	39.8	1.4	1.2	0.9	Not Required	
OFFICE 156B	51.9	60.9	42.9	1.4	1.2	0.9	Not Required	
OFFICE 157H	45.9	52.9	36.9	1.4	1.2	0.9	Not Required	
OFFICE 206	48.0	56.0	38.0	1.5	1.3	0.9	Not Required	
OFFICE 215	52.0	62.0	42.0	1.5	1.2	0.8	Not Required	
OFFICE 239	55.0	63.0	49.0	1.3	1.1	0.9	Not Required	
OFFICE 309	48.2	58.2	41.2	1.4	1.2	0.8	Not Required	
ORCHESTRA 150	70.0	75.0	61.0	1.2	1.1	0.9	3.0	0.8
OT 140	72.7	82.7	66.7	1.2	1.1	0.9	3.5	0.6
PIC RM 124	72.5	77.5	66.5	1.2	1.1	0.9	6.5	1.2
PLATFORM 156C	27.1	33.1	21.1	1.6	1.3	0.8	5.3	1.2
PREP 317A	51.6	56.6	41.6	1.4	1.2	0.9	5.3	1.0
PRIMARY 126	75.4	85.4	67.4	1.3	1.1	0.9	3.9	0.4
PRIMARY 129	71.6	76.6	65.6	1.2	1.1	0.9	5.0	0.7
PRIMARY 130	71.3	77.3	63.3	1.2	1.1	0.9	4.1	0.5
PRIMARY 131	65.4	71.4	57.4	1.2	1.1	0.9	4.0	0.5
PRIMARY 132	74.3	80.3	66.3	1.2	1.1	0.9	6.2	0.3
PRIMARY 135	73.9	83.9	68.9	1.2	1.1	0.9	1.0	0.4
PRIMARY 136	71.9	79.9	62.9	1.3	1.1	0.9	3.7	0.8
PRIMARY 137	66.5	72.5	56.5	1.3	1.2	0.9	6.6	0.6
PROJECT 218	70.9	77.9	61.9	1.3	1.1	0.9	1.9	0.3
PROJECT RM 240	66.0	73.0	59.0	1.2	1.1	0.9	2.9	0.1
PT 123	72.1	79.1	67.1	1.2	1.1	0.9	4.1	1.1
RAMP 156B	25.0	33.0	18.0	1.8	1.4	0.8	6.6	1.2
READING 315	73.3	78.3	63.3	1.2	1.2	0.9	2.3	0.4
READING PART 207	67.4	77.4	58.4	1.3	1.2	0.9	4.0	0.2
RECEIVING 118	51.2	57.2	46.2	1.2	1.1	0.9	4.1	0.5
RECEPTION 102	48.9	53.9	40.9	1.3	1.2	0.9	2.4	0.4

New Hursey Elementary School
Photometric Analysis Summary

Project Number:	2152			Light Loss Factor:		0.75	
Revised:	12/14/2021			Classrm Calculation Height		30" aff	
	Non-Emergency					Emergency	
Room Description	Avg fc	Max fc	Min fc	Max/Min	Avg/Min	Avg/Max	Avg fc	Min fc
RECORDS 104C	31.8	39.8	26.8	1.5	1.2	0.8	Not Required	
RESOURCE 321	72.5	78.5	65.5	1.2	1.1	0.9	Not Required	
SCIENCE 317	70.0	79.0	60.0	1.3	1.2	0.9	2.0	0.3
SELF CONT. 148	73.5	80.5	66.5	1.2	1.1	0.9	6.4	1.0
SERVING 157A	52.1	57.1	42.1	1.4	1.2	0.9	4.3	0.9
SM GROUP 113S	46.9	53.9	37.9	1.4	1.2	0.9	Not Required	
SM GROUP 119	45.0	53.0	37.0	1.4	1.2	0.8	Not Required	
SPEECH 109	68.0	78.0	58.0	1.3	1.2	0.9	1.5	0.1
SRO 105	48.7	55.7	42.7	1.3	1.1	0.9	Not Required	
STAIR 1	29.5	36.5	24.5	1.5	1.2	0.8	6.9	0.6
STAIR 2	34.5	39.5	26.5	1.5	1.3	0.9	4.8	0.2
STORAG E103S	32.5	41.5	26.5	1.6	1.2	0.8	Not Required	
STORAGE 104S	27.6	34.6	17.6	2.0	1.6	0.8	Not Required	
STORAGE 108	28.2	38.2	22.2	1.7	1.3	0.7	Not Required	
STORAGE 144S	35.5	41.5	26.5	1.6	1.3	0.9	Not Required	
STORAGE 164	32.0	37.0	27.0	1.4	1.2	0.9	Not Required	
STORAGE 203S	35.0	40.0	30.0	1.3	1.2	0.9	Not Required	
STORAGE 207S	31.3	37.3	26.3	1.4	1.2	0.8	Not Required	
STORAGE 301	34.5	39.5	28.5	1.4	1.2	0.9	Not Required	
STORAGE 302A	30.1	35.1	25.1	1.4	1.2	0.9	Not Required	
STORAGE 317S	25.6	30.6	19.6	1.6	1.3	0.8	Not Required	
STORAGE S104D	34.8	41.8	29.8	1.4	1.2	0.8	Not Required	
STORAGE S118	31.3	36.3	21.3	1.7	1.5	0.9	Not Required	
STORAGE S151A	25.0	32.0	15.0	2.1	1.7	0.8	Not Required	
STORAGE S151B	31.6	36.6	23.6	1.6	1.3	0.9	Not Required	
STORAGE S151C	30.7	36.7	23.7	1.5	1.3	0.8	Not Required	
STORAGE S154	26.9	31.9	20.9	1.5	1.3	0.8	Not Required	
STORAGE S156A	35.0	45.0	27.0	1.7	1.3	0.8	Not Required	
STORAGE S156D	27.0	35.0	19.0	1.8	1.4	0.8	Not Required	
STORAGE S156E	35.9	40.9	28.9	1.4	1.2	0.9	Not Required	
SUPPLIMENTAL 216	66.6	75.6	56.6	1.3	1.2	0.9	2.7	0.6
TESTING 104E	47.0	56.0	41.0	1.4	1.1	0.8	Not Required	
TEXT BOOK 237	32.5	42.5	24.5	1.7	1.3	0.8	Not Required	
TEXT BOOK 331	26.0	36.0	21.0	1.7	1.2	0.7	Not Required	
TLT 124T	26.3	35.3	16.3	2.2	1.6	0.7	Not Required	
TLT 126T	32.6	37.6	24.6	1.5	1.3	0.9	Not Required	
TLT 129T	32.4	38.4	23.4	1.6	1.4	0.8	Not Required	
TLT 130T	25.7	31.7	19.7	1.6	1.3	0.8	Not Required	

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Room Description	Avg fc	Max fc	Min fc	Max/Min	Avg/Min	Avg/Max	Avg fc	Min fc
TLT 131T	29.7	38.7	23.7	1.6	1.3	0.8	Not Required	
TLT 132T	34.9	42.9	28.9	1.5	1.2	0.8	Not Required	
TLT 135T	35.0	41.0	27.0	1.5	1.3	0.9	Not Required	
TLT 136T	29.5	37.5	22.5	1.7	1.3	0.8	Not Required	
TLT 137T	30.2	40.2	21.2	1.9	1.4	0.8	Not Required	
TLT 141T	25.8	34.8	17.8	2.0	1.4	0.7	Not Required	
TLT 145T	27.0	37.0	18.0	2.1	1.5	0.7	Not Required	
TLT 148T	34.6	39.6	26.6	1.5	1.3	0.9	Not Required	
TLT 149T	29.0	37.0	24.0	1.5	1.2	0.8	Not Required	
TLT 153T	35.9	45.9	30.9	1.5	1.2	0.8	Not Required	
TLT 155T	29.3	39.3	24.3	1.6	1.2	0.7	Not Required	
TLT 157T	33.2	43.2	27.2	1.6	1.2	0.8	Not Required	
TLT 244AT	30.3	40.3	24.3	1.7	1.2	0.8	Not Required	
TLT 244T	29.1	34.1	20.1	1.7	1.4	0.9	Not Required	
TLT 245AT	27.2	32.2	20.2	1.6	1.3	0.8	Not Required	
TLT 245T	35.5	44.5	29.5	1.5	1.2	0.8	Not Required	
TLT 248T	29.7	34.7	24.7	1.4	1.2	0.9	Not Required	
TLT 249T	35.3	45.3	30.3	1.5	1.2	0.8	Not Required	
TLT 252T	27.6	32.6	18.6	1.8	1.5	0.8	Not Required	
TLT 253T	25.5	35.5	18.5	1.9	1.4	0.7	Not Required	
TLT T102C	33.4	43.4	26.4	1.6	1.3	0.8	Not Required	
TLT T102D	34.7	42.7	28.7	1.5	1.2	0.8	Not Required	
TLT T103A	32.8	41.8	27.8	1.5	1.2	0.8	Not Required	
TLT T103B	35.1	41.1	26.1	1.6	1.3	0.9	Not Required	
TLT T104A	25.0	34.0	15.0	2.3	1.7	0.7	Not Required	
TLT T104B	25.9	35.9	19.9	1.8	1.3	0.7	Not Required	
TLT T104D	31.4	36.4	24.4	1.5	1.3	0.9	Not Required	
TLT T121A	29.5	35.5	21.5	1.7	1.4	0.8	Not Required	
TLT T121B	26.0	34.0	17.0	2.0	1.5	0.8	Not Required	
TLT T203B	34.0	44.0	28.0	1.6	1.2	0.8	Not Required	
TLT T203C	33.4	39.4	25.4	1.6	1.3	0.8	Not Required	
TLT T209	33.7	41.7	28.7	1.5	1.2	0.8	Not Required	
TLT T211	25.8	32.8	18.8	1.7	1.4	0.8	Not Required	
TLT T303	31.2	38.2	25.2	1.5	1.2	0.8	Not Required	
TLT T304	28.1	38.1	18.1	2.1	1.6	0.7	Not Required	
TR 313	34.1	39.1	29.1	1.3	1.2	0.9	5.0	0.9
TR D118	31.5	38.5	22.5	1.7	1.4	0.8	5.0	0.2
TR D125	32.0	37.0	26.0	1.4	1.2	0.9	6.7	0.7

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Room Description	Avg fc	Max fc	Min fc	Max/Min	Avg/Min	Avg/Max	Avg fc	Min fc
TR D217	26.7	32.7	20.7	1.6	1.3	0.8	4.9	1.2
TR D243	34.0	42.0	27.0	1.6	1.3	0.8	1.0	0.2
UPPER ES1 222	75.6	80.6	69.6	1.2	1.1	0.9	2.0	0.8
UPPER ES2 224	74.5	83.5	66.5	1.3	1.1	0.9	6.2	0.2
UPPER ES3 228	68.1	77.1	63.1	1.2	1.1	0.9	6.3	1.2
UPPER ES4 235	72.7	81.7	64.7	1.3	1.1	0.9	4.4	0.9
UPPER ES5 231	73.4	80.4	66.4	1.2	1.1	0.9	2.4	0.2
VESTIBULE 100V	35.0	45.0	28.0	1.6	1.3	0.8	3.8	0.8
WOMENS T158	32.0	39.0	22.0	1.8	1.5	0.8	5.1	0.4
WORK RM 203D	51.8	59.8	41.8	1.4	1.2	0.9	6.1	0.5
WORK RM 305	50.0	60.0	42.0	1.4	1.2	0.8	5.8	0.2
WORK ROOM 110	50.4	58.4	44.4	1.3	1.1	0.9	4.2	1.2
WORK ROOM 121	47.7	53.7	42.7	1.3	1.1	0.9	6.6	0.3
WORK ROOM 213	53.3	62.3	47.3	1.3	1.1	0.9	1.1	0.4
Car Drop off	2.8	7.8	0.3	26.0	9.3	N/A	Not Required	
Front Parking and Drive	3.4	7.4	0.6	12.3	5.7	N/A	Not Required	
Rear Parking and Drive	4.9	13.7	0.1	137.0	49.0	N/A	Not Required	