SECTION 270000 – STRUCTURED CABLING SYSTEM

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 PURPOSE

A. This document defines the products and the execution requirements required to furnish and install a complete distribution system utilizing a structured cabling system.

B. All cables and related terminations, support and grounding hardware shall be furnished, installed, tested, and documented by the structured cabling contractor as detailed in this document.

C. The distribution system shall be all inclusive and represent a complete installation at the sites shown on the attached drawings and in the attached specifications. The Vendor shall be responsible for all parts, labor, and all other associated apparatus necessary to completely install, test and turnover for acceptance to the Customer the cabling system detailed herein.

D. Product specifications and general design considerations are provided in this document. Quantities of telecommunication outlets, typical installation details, cable routing and outlet types will be provided as an attachment to this document. The successful vendor shall meet or exceed all requirements for the cable system described in this document.

E. Refer to contract drawings for additional requirements to include color coding of faceplates, jacks and cables, labeling, installation, etc.

1.3 RELATED REQUIREMENTS

A. Drawings and general provision of Contract, including General and Supplementary Conditions, Division 1 Specification, and Electrical sections apply to work in this section.

B. Install raceways for auxiliary systems.

C. Interior conduit EMT, minimum 1" unless noted otherwise.

D. Conduit to extend from wall and floor outlets to above accessible ceiling and terminate with a bushing.

E. All conduits indicated as spare shall have nylon pullcord.

1.4 REFERENCE STANDARDS

A. ANSI/TIA/EIA-568B.1-Commercial building Telecommunications Cabling Standard, Part 1: General Requirements

B .ANSI/TIA/EIA-568-B.2-Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components.

C. ANSI/TIA/EIA-568-B.3- Optical Fiber Cabling Components Standard.

D. ANSI/TIA/EIA-569B-Commercial Building Standard for Telecommunications Pathways and spaces.

E. ANSI/TIA/EIA-606(A)-The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

F. ANSI-J-STD-607(A)- Commercial Building Grounding and Bonding Requirements for Telecommunications.

G. TIA-526-7-OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.

H. TIA-526-14A-OFSTP-14 Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.

I. ANSI/TIA/EIA-758(A)- Customer-Owned Outside Plant Telecommunications Cabling Standard.

J. TIA TSB-140 Additional Guidelines for Field Testing Length, Loss and Polarity of Optical

K. ANSI/TIA/EIA 568 B-2.10- 10GIG ETHERNET

L. Install Cabling in accordance with the most recent edition of BICSI publications.

1. BICSI-Telecommunications Distribution Methods Manual.
2. BICSI-Installation Transport Systems information Manual.
3. BICSI-Network Design Reference Design Manual.
4. BICSI-Outside Plant Design Reference Manual.

M. Federal, State and local codes, rules, regulations, and ordinances governing the work, are fully part of the specifications as if herein repeated or hereto attached.

N. If the contractor should note items in the drawings or the specifications, construction of which would be a code violation, promptly call them to the attention of the owner's representative in writing.

O. Where the requirements of other sections of the specifications are more stringent than applicable codes, rules, regulations, and ordinances, the specifications shall apply.

P. All material shall be listed by UL or other National Independent testing standard shall apply.

Q. If this document and any of the documents listed above are in conflict, then the more stringent requirement shall apply. All construction documents listed are believed to be the most current. The Vendor has the responsibility to determine and adhere to the most recent release when developing the proposal for installation.

R. This document does not replace any code, either partially or wholly. The Contractor must be aware of local codes that may impact this project.

1.5 APPROVED CONTRACTOR

A. The Contractor shall have total responsibility for the coordination and installation of the work shown and described in the Drawings and Specifications. The Contractor shall be a company specializing in the design, fabrication and installation of integrated telecommunication systems.

B. The installation of all cable, equipment, terminations, & associated services shall be performed by a company that is a Manufacture's Certified Structured Cabling System Installer in good standing with a minimum of three (3) years of experience on similar systems.

C. A copy of certification documents must be submitted with the product submittals for quote to be valid. The telecommunications contractor is responsible for workmanship and installation practices in accordance with the manufacturer's written policies.

D. The cable or connectivity manufacturer will extend a 25-year manufacturer's warranty for all products installed in this project to the end user once the telecommunications contractor fulfills all requirements under these specifications.

E. The contractor must have an office with qualified service and installation personnel within 100 miles of the project site.

F. The Telecommunications cabling contractor must provide a reference list with contact names and phone numbers for three (3) projects of similar scope.

G. The contractor shall employ a full-time RCDD to perform the role of Project Manager. RCDD shall be available for consultation and to attend project meetings. The contractor shall not subcontract a third party RCDD.

H. A BICSI certified installer shall be employed by the contractor and be on site as the installation manager.

I. The owner reserves the right to require the Vendor to remove from the project any such employee the Owner deems to be incompetent, careless or insubordinate.

J. All clean up activity related to work performed, will be the responsibility of the Contractor and must be completed daily before leaving he site.

1.6 COORDINATION WITH OTHER TRADES

A. The Contractor shall coordinate telecommunications work with that of other Sections as required ensuring that the entire telecommunications work will be carried out in an orderly, complete and coordinated fashion.

1.7 SUBMITTALS

A. Submit to the engineer/designer shop drawings, product data (including cut sheets and catalog information), and samples required by the contract documents. Submit shop drawings, product data, and samples with such promptness and in such sequence as to cause no delay in the work or in the activities of other contractors. The engineer/designer will indicate approval of shop drawings, product data, and samples submitted to the engineer by stamping submittals "APPROVED" with a stamp. Submitted shop drawings shall be initialed or signed by the contractor's legitimate firm name.

1. By submitting shop drawings, product data, and samples, the Vendor represents that he/she carefully reviewed and verified materials, quantities, field measurements, and field construction criteria related thereto. It also represents that the Vendor has checked, coordinated, and verified that information contained within shop drawings, product data, and samples conform to the requirements of the work and of the contract documents.
2. The engineer's/designer's approval of shop drawings, product data, and samples submitted by the Vendor shall not relieve the Vendor of responsibility for deviations from requirements of the contract documents, unless the Vendor has specifically informed the engineer/designer in writing of such deviation at time of submittal, and the engineer/designer has given written approval of the specific deviation. The vendor shall continue to be responsible for deviations from requirements of the contract documents not specifically noted by the Vendor in writing, and specifically approved by the engineer in writing.
3. The engineer's/designer's approval of shop drawings, product data, and samples shall not relieve the Vendor of responsibility for errors or omissions in such shop drawings, product data, and samples.
4. Storage and handling requirements and recommendations.
5. Installation method.

B. Shop Drawings: Show compliance with requirements on isometric schematic diagram of network layout, showing cable routings, telecommunication closets, rack and enclosure layouts and locations, service entrance, and grounding, prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).

C. Submit proof from manufacturer that the contractor is in good standing with the manufacturer's warranty program.

D. Submit letter from manufacturer stating that the manufacturer will provide twenty-five (25) year warranty in accordance with the requirements stated in this document.

E. Submit copy of RCDD certification.

F. Upon request by the engineer/designer, furnish a list of references with specific information regarding type of project and involvement in providing of equipment and systems.

G. Submit references as required.

H. At completion of project, Contractor shall submit the following:

1. Horizontal certification test results printed and saved to USB drive.
2. Backbone certification test results printed and saved to USB drive.
3. Project Record Documents: Prepared and approved by BICSI Registered Communications Distribution Designer (RCDD). The record documents shall be bound and consist of the following:

   a. Product cut sheets for all products supplied.
   b. Test reports for horizontal cabling.
   c. Test reports for backbone cabling.
   d. Manufactures warranties.
   e. "D-Size" As built drawings.

I. As built drawings should accurately record location of service entrance conduit, termination backboards, outlets boxes, cable raceways, cable trays, pull boxes, and equipment racks electronically using AutoCAD 2000 or later version and on minimum "D" size reproducible paper prints.

J. The contractor shall prepare an 18" x 24" as-built serving zone drawing for each Telecommunication Room. The drawing shall be laminated, framed and secured to the wall in the Telecom Room.

K. Work shall not proceed without the Engineer's approval of the submitted items. The Contractor shall receive approval from the Engineer on all substitutions of material. No substituted materials shall be installed except by written approval from the engineer.

1.8 QUALITY ASSURANCE

A. Equipment and materials required for installation under these Specifications shall be the current model and new (less than one (1) year from the date of manufacture), unused and without blemish or defect.

B. Equipment and materials of the type for which are independent standard testing requirements, listings, and labels, shall be listed and labeled by the independent testing laboratory.

C. Material and equipment shall be new, and conform to grade, quality, and standards specified. Equipment and materials of the same type shall be a product of the same manufacturer throughout installation.

D. Product Requirements:

1. The product shall be manufactured by an ISO 9001-2000 Certified Facility.
2. Product shall be free from defects in material and workmanship.
3. The manufacturer must have a field representative who holds an RCDD who will perform quality control inspections monthly, during the life of the project.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Products must be stored according to manufacturers' recommendations.

B. Keep stored products clean and dry.

C. If the Telecommunications Contractor wishes to have a trailer on site for storage of materials, arrangements shall be made with the owner.

1.10 DRAWINGS

A. It shall be understood that the electrical details and drawings provided with the specification package are diagrammatic. They are included to show the intent of the specifications and to aid the Telecommunications Contractor in bidding for the job. The Telecommunications Contractor shall make allowance in bid proposal to cover whatever work is required to comply with the intent of the plans and specifications.

B. The Telecommunications Contractor shall verify all dimensions at the site and be responsible for their accuracy.

C. Prior to submitting the bid, the telecommunications Contractor shall call the attention of the Engineer to any materials or apparatus the Telecommunication Contractor believes to be inadequate and to any necessary items of work omitted.

1.11 WARRANTY

A. See Section "Closeout Submittals" for additional warranty requirements.

B. The Contractor shall provide a manufactures warranty to guarantee end-to-end high performance cabling systems that meet application requirements. The guarantee shall include all Horizontal drops and Backbone fiber optic cable and connectivity components and have one point of contact for all cabling system issues. The system shall be warranted for a period of 25 years.

C. Materials and workmanship hereinafter specified shall be fully guaranteed by the vendor for a (1) one year period after Date of Substantial Completion against any defects. Defects which may occur as the result of faulty materials or workmanship within one year after installation and acceptance by The Customer shall be corrected by the Vendor at no additional cost to the Customer. The Vendor shall promptly, at no cost to The Customer, correct re-perform (including modifications or additions as necessary) any nonconforming or defective work within one year after completion of the project of which the work is part.

1.12 SEPARATION FROM EMI SOURCES

A. Comply with BICSI TDMM and ANSI/TIA/EIA-569-B recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

B. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

1. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
2. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
3. Electrical Equipment Rating More than 5 kVA: A minimum of 12 inches.

C. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows.

1. Electrical Equipment Rating Less than 2 kVA: A minimum of 2 ½ inches.
2. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
3. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

D. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

1. Electrical Equipment Rating Less than 2 kVA: No requirement.
2. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
3. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

E. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.

F. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 12 inches.

PART 2 - PRODUCTS

2.1 EQUIVALENT PRODUCTS

A. Due to the nature and type of communications all products, including but not limited to racks, patch panels, jacks, faceplates, patch cords, J-hooks shall be manufactured by Hubbell, Siemon, or Panduit.

B. Provide products of manufacturers as named in individual articles.

C. Where no manufacturer is specified, provide products of manufacturers in compliance with requirements.

D. Where equipment is identified by manufacturer and catalog number, it shall be a base of requirements for quality and performance. Where manufacturers for equipment are identified by name, the Contractor may submit for approval, similar equipment of other manufactures as substitution. The Engineer's decision as to whether the submitted equipment is acceptable shall be final and binding.

E. The request for substitutions must be received (10) ten days prior to bid opening by Engineer in writing, listing all physical and technical differences between product

specified and product request for substitution. Product samples of each item must accompany written request.

F. Accepted substitutions will be approved by means of addendum.

2.2 CATEGORY 6 HORIZONTAL DISTRIBUTION CABLE

A. All Horizontal station cables shall terminate on modular patch panels in their respective Telecommunication Room or Equipment Room as specified on the drawings.

B. All cable, workstation jack modules and patch panel jack modules shall be the same color as designated on prints. If colors are not designated Coordinate color with Engineer. See details.

C. Unshielded Twisted-Pair Cabling:

1. Cable construction shall be 23 AWG with four twisted pairs of insulated solid bare annealed copper conductors with separator.
2. Outer jacket shall meet NEC requirements and have a Nominal Cable diameter not to exceed .200 for CMP (in)
3. Cable shall have a minimum bend radius of 1.0 (in).
4. Contain "Crossweb" Filler
5. Must have positive PSACR beyond 250 MHz.
6. Application assurance warranty.
7. All transmission performance parameters shall be independently verified by UL or ETL third party testing organization.
8. Contractor will use a plenum rated cable jacket unless being installed in slab and below grade.
9. Approved Manufacturer - Category 6 Horizontal Cable:

Manufacturer	CMR	CMP
Hubbell	HC6RRx	HC6RPx
Siemon	9C6R4-E4-(XX)-RBA	9C6P4-E4-(XX)-RBA
Panduit	PUR6504xx-UY	PUP6504xx-UY

D. ANY CABLE LOCATED IN SLAB BELOW GRADE SHALL BE RATED FOR WET LOCATIONS.

1. Approved Manufacturer - Indoor/Outdoor Rated Cable:

Manufacturer	CMP
Hubbell	C6IOSPBK
Siemon	9U6W4-A5-12-R1A
Panduit	PUO6AS04BL-G

2.3 CATEGORY 6A HORIZONTAL DISTRIBUTION CABLE

A. All Horizontal WAP Cable shall terminate on modular patch panels in their respective Telecommunication Room or Equipment Room as specified on the drawings.

B. All cable and patch panel jack modules shall be the same color as designated on prints. If colors are not designated Coordinate color with Engineer. See details.

C. Unshielded Twisted-Pair Cabling:

1. Cable construction shall be 23 AWG with four twisted pairs of insulated solid bare annealed copper conductors with separator.
2. Outer jacket shall meet NEC requirements and have a reduced diameter not to exceed .265 for CMP (in)
3. Cable shall have a minimum bend radius of 1.0 (in).
4. Contain "Crossweb" filler.
5. +7dB of Headroom Above Standards to suppress Alien Crosstalk
6. High Power PoE (4PPoE) Read
7. All transmission performance parameters shall be independently verified by UL or ETL third party testing organization.
8. Approved Manufacturer - Category 6A Horizontal Cable:

Manufacturer	CMR	CMP
Hubbell	C6ASRDSY	C6ASPDSY
Siemon	9C6R4-A5-05AR1A	9C6P4-A5-05AR1A
Panduit	PUR6AV04YL-G	PUP6AV04YL-G

2.4 WORK AREA OUTLETS

A. WAO shall consist of a single gang 2 Port or 4 Port thermoplastic face plate.

B. Work area outlets shall each be terminated at their designated work area location in the connector types described below.

C. The same orientation and positioning of jacks and connectors shall be utilized throughout the installation. Prior to installation, the Telecommunications Contractor shall submit the proposed configuration for each outlet assembly, with labeling, for review by the owner.

D. The wiring scheme for this project shall be T568B unless otherwise directed by the owner.

E. Category 6 Modular Jack:

1. Third Party Verified Category 6 Component
2. Cobra-Lock Termination Technology
3. Wires Secured Under Constant Compression
4. Easily Re-Terminate
5. 25 IDC Re-termination Cycles
6. Qualified to 150% of 802.3bt PoE Current Level
7. Where color is not indicated coordinate with Engineer prior to installation.
8. Approved Manufacturer - Category 6 Modular Jack (WAO):

Manufacturer	Modular Jack
Hubbell	HJU6xx
Siemon	U6-K0xx
Panduit	CJ688TGxx

F. Jacks at WAO and patch panels shall be color-coded with appropriate colored jacks or icons as follows:

1. Two port face plates:

   a. The left jack shall be BLUE, and the right jack RED. Contractor shall be responsible for making sure the color at the patch panel coordinates with jack at WAO.

2. Four port face plates:

   a. The upper left jack shall be BLUE, the upper right.
   jack shall be RED, the bottom-left jack shall be GREEN, and the bottom right jack shall be GRAY.

2.5 WIRELESS ACCESS POINT OUTLET

A. WAP outlets shall consist of a minimum of two (2) Category 6A cables be terminated above ceiling using a Cat6A Yellow jack in a 2-port Surface Box or using a Cat6A MPTL assembly. Either option shall leave a 10-foot service loop on the horizontal cable run.

B. Each WAP location shall be identified with a 1"x 2" black phenolic tag with white lettering affixed to the underside of the ceiling grid. It shall be the contractor's responsibility to verify measurements of the ceiling grid prior to ordering the phenolic tags, so as not to create an overhang by the label.

C. Each cable shall be identified with a printed wire wrap label.

D. The wiring pattern for this project shall be T568B unless otherwise directed by the owner.

E. The wiring pattern of jacks and connectors shall be utilized throughout the installation. Prior to installation, the Telecommunications Contractor shall submit the proposed configuration for each outlet assembly, with labeling, for review by the owner.

F. Category 6A Modular Jack:

1. Third Party Verified Category 6 Component
2. Cobra-Lock Termination Technology
3. Wires Secured Under Constant Compression
4. Easily Re-Terminate
5. 25 IDC Re-termination Cycles
6. Qualified to 150% of 802.3bt PoE Current Level
7. Where jack color is not indicated coordinate with Engineer prior to installation.

a. Approved Manufacturer - Category 6A Modular Jack Assembly (WAP):

Manufacturer	Jack	Surface Box
Hubbell	HJU6AY	HSB2W(P)
Siemon	U6A-K05	MX-SMZ2-02
Panduit	CJ688TGYL	CBX2IW-AY

b. Approved Manufacturer - Category 6A Modular Plug (WAP):

Manufacturer	Modular Plug
Hubbell	SCP6A
Siemon	ZP1-6AS-01S
Panduit	FP6X88MTG

2.6 COPPER PATCH CABLES

A. Patch Cables shall be factory terminated with modular plugs featuring a tangle-free latch design and clear strain-relief boots to support easy moves, adds and changes. Each patch cord shall be 100% performance tested at the factory to the TIA/EIA Category 6 standard. *Each patch cord shall be made by the same factory as the Cat6 jacks and patch panels used in the project*.

B. Contractor shall provide one 5ft patch cable for each cable terminated at patch panel. Contractor shall provide one patch cable for each terminated WAO, with half the WAO patch cables being 10ft and remaining half being 15ft. Provide an additional 5% surplus equally divided between 5ft, 10ft & 15ft. Confirm lengths and color with owner prior to ordering and transmittal.

C. Approved Manufacturer - Patch Cable:

Manufacturer	5ft Cat6	10ft Cat6	15ft Cat6
Hubbell	HCL6x05	HCL6x10	HCL6x15
Siemon	MC6-05-xx-28	MC6-10-xx-28	MC6-15-xx-28
Panduit	UTP28SP5xx	UTP28SP10xx	UTP28SP15xx

Manufacturer	5ft Cat6A	10ft Cat6A	15ft Cat6
Hubbell	HCL6x01	HCL6x07	HCL6Ax01
Siemon	SP6A-05-xx	SP6A-10-xx	SP6A-15-xx
Panduit	UTP28X5xx	UTP28X10xx	UTP28X15xx

2.7 MODULAR PATCH PANELS

A. All horizontal voice, data and wireless, CCTV & AV cables shall be installed in a modular rack mount patch panel. Each patch panel shall have strain relief bars for each row of 24 ports (a 48-port panel gets 2 relief bars).

B. Approved Manufacturer - Patch Panel:

Manufacturer	24 Port	48 Port	Strain Relief
Hubbell	HPJ24	HPJ48	CMBR
Siemon	KPNL-F1-24-01S	KPNL-F2-48-01S	KPNL-RWM
Panduit	CPPL24WBLY	CPPL24WBLY	SRB19BLY

2.8 HIGH IMPACT THERMOPLASTIC FACEPLATES WITH LABEL FIELDS

A. Verify color of faceplate with architect and engineer prior to ordering.

B. Approved Manufacturer -Faceplate:

Manufacturer	1-Port	2-Port	4-Port
Hubbell	IFP11W	IFP12W	IFP14W
Siemon	KFP-S-01-02	KFP-S-02-02	KFP-S-04-02
Panduit	CFPL1W	CFPL2W	CFPL4W

2.9 BACKBONE FIBER OPTIC CABLE

A.. Furnish and install a minimum of one (1) 12 strand fiber optic cable from the MDF to each IDF, unless otherwise indicated on backbone Riser diagram.

B. All indoor fiber optic cable shall be tight buffered construction with Interlocked Armored Plenum rated.

C. All outdoor or underground fiber optic cables shall be an indoor/outdoor jacket with tight buffered construction.

D. Approved Manufacturer - Indoor Interlocking Armored Fiber Optic Cable:

Manufacturer	Singlemode (OS2)	Multimode (OM4)
Hubbell	HFCD15012PS	HFCD15012P4
Siemon	9BC5P012G-E205	9BC5P012G-T512
Panduit	FSPP912Y	FOPPZ12Y

E. Approved Manufacturer - Indoor/Outdoor Fiber Optic Cable:

Manufacturer	Singlemode (OS2)	Multimode (OM4)
Hubbell	HFCD14012PSBK	HFCD14006P4BK
Siemon	9GD8012G-E201	9GD5012G-T501
Panduit	FSCP912Y	FOCPZ12Y

2.10 FIBER OPTIC RACK MOUNT ENCLOSURE

A. Enclosure shall be mounted in standard 19" rack or cabinet. Shall have front and rear access on all modules via molded-hinged doors. Must have radius control and cable

management for fiber patch cords. Shall have multiple cable entry locations. Include fiber optic cable routing kit (grommets, cable ties, saddle clips, strain relief bracket and ID/caution labels for various cable management solutions.

B. Approved Manufacturer - Rack Mount Fiber Optic Enclosure:

Manufacturer	1U	2U	4U
Hubbell	FCR1U3SPT	FCR2U6SPT	FCR4U15SPT
Siemon	LVE-1U-MD-P01A	LVE-2U-MD-P01A	LVE-4U-MD-P01A
Panduit	FCE1U	FCE2U	FCE4U

2.11 FIBER OPTIC ADAPTER PANELS

A. All adapter panels shall be LC form factor and use zirconia ceramic split sleeves. Use blank adapters in each empty port in each fiber optic enclosure.

B. Fill unused slots of fiber enclosure with blank panels

Approved Manufacturer - LC Adapter Panel:

Manufacturer	LC 12-Port OS2	LC 12-Port OM4	Blank Panel
Hubbell	FSPNLCDS6AQ	FSPNLCDS6AQ	FSPNB
Siemon	LVA12-LCQ-BC-A	LVA12-LCQ-BC-A	LVA-BLANK-01A
Panduit	FAP6WBUDLCZ	FAP6WAQDLCZ	FAPB

2.12 FIBER OPTIC CONNECTORS

A. Fiber connectors shall have a LC UPC interface. Connectors may be a mechanical or splice-on type connector.

B. Approved Manufacturer - Fiber Optic Connectors:

Manufacturer	LC; OS2 Mechanical	LC; OM4 Mechanical	LC; OS2 Splice-On	LC; OM4 Splice-On
Hubbell	FCLC900KSM12	FCLC900K50GM12	FCLCF900SMBP	FCLCF900M50GBP
Siemon	FC1-LB-LCU-9BL	FC1-LB-LC5-9AQ	FC-F-LCU-29BL	FC-F-LC5-29AQ
Panduit	FLCSSCBUY	FLCSMCXAQY	FLCS2/9SOCU9BU	FLCS2/9SOCPXAQ

2.13 FIBER OPTIC PATCH CABLES

A. Contractor shall provide six (6) duplex fiber patch cords for each 12 strands of fiber installed. Patch cables shall be capable of connecting from fiber patch panel to owner provided equipment.

B. Fiber patch cables shall be manufactured in the USA.

C. Approved Manufacturer - Fiber Patch Cables Products:

Manufacturer	OS2; LC/LC; 1M; YL; Plenum	OM4; LC/LC; 1M; AQ; Plenum
Hubbell	DFHPCLCLCS1SM	DFHPCLCLCF1MM
Siemon	FPSLDLD001M	FP4LDLD001M
Panduit	F92RPU1U1ONM001	FZ2RPU1U1ONM001

2.14 Network/EQUIPMENT CABINETS

A. Secure cabinet per manufactures instructions and install 18" Ladder Rack from top of each rack to wall.

B. Each ladder rack shall utilize a "waterfall" or cable drop out at each 2-post rack to maintain the bend radius to each vertical cable manager.

C. Ground each cabinet per ANSI/TIA/EIA-607 Requirements.

D. Maintain 36" clearance from the front and rear of cabinet and on one side.

E. Where no dedicated MDF/IDF closet is available or space will not allow for the use of a floor mounted cabinet use a Wall Mount Swing Gate Style Cabinet

F. Where space is extremely narrow use Hubbell REBOX Part Number: RE4XB or equivalent.

G. Reference riser diagram to determine Cabinet type.

1. Approved Manufacturer - Cabinets:

a. Floor Cabinet

Manufacturer	45RU Floor Cabinet
Hubbell	H3S4748
Siemon	V62B-2AB121-45
Panduit	XG84822BS0005

b. Wall Mount Cabinets

Manufacturer	24"H x 26"D Wall Cabinet	36"H x 26"D Wall Cabinet
Hubbell	HSQ2436	HSQ3626
Siemon	WC2-P101-12	WC2-P101-18
Panduit	PZWMC12W	PZWMC1830W

2.15 EQUIPMENT RACKS

A. Secure each 2-post relay rack to floor per manufactures instructions and install 18" Ladder Rack from top of each rack to wall.

B. Each ladder rack shall utilize a "waterfall" or cable drop out at each 2-post rack to maintain the bend radius to each vertical cable manager.

C. Ground each rack per ANSI/TIA/EIA-607 Requirements.

D. Maintain 36" clearance from the front and rear of rack and on one side.

E. If more than one rack is installed, install all racks in a straight line, side by side with vertical wire management between each rack (see section 2.26.B).

F. Where no dedicated MDF/IDF closet is available or space will not allow for the use of a floor mounted rack use a Wall Mounted Cabinet.

G. Reference riser diagram to determine rack type.

1. Approved Manufacturer – Floor Racks:

Manufacturer	2-Post; 45RU Rack	4-Post; 45RU Rack
Hubbell	HPW84RR19	SF841929T
Siemon	RS1-07-S	RSQ1-07-S
Panduit	R2P	R4P

2.16 CABLE MANAGEMENT

A. Vertical Cable management shall be provided on each side and between each set of racks.

B. Install 6" vertical cable management at the end of each rack row and 10" vertical cable management between each rack.

C. Reference drawings for further detail:

D. Approved Manufacturer – Vertical Cable Manager:

Manufacturer	45RU; 6 in; Vert Cable Mgr	45RU; 10 in; Vert Cable Mgr
Hubbell	VM620	VM1020
Siemon	VCM-6D	VCM-10D
Panduit	PR2VD06	PR2VD10

E. Approved Manufacturer – Horizontal Cable Manager:

Manufacturer	Horz. Cable Mgr
Hubbell	HM277C
Siemon	RS-RWM-2DS
Panduit	CMPH2

2.17 LADDER TRAY FOR TELECOMMUNICATION ROOMS

A. All ladder tray shall be 18" in width and have 1 1/2" x 3/8" stringers, unless instructed otherwise per drawings,

B. Ladder tray shall be made of tubular steel; and the finish shall be black powder coat.

C. Furnish and install 18" ladder tray from each floor mount rack/server cabinet to wall. Furnish and install 18" ladder tray around wall as required to support cables. (A minimum of (2) walls shall be completely covered by ladder tray).

D. Furnish and install cable retaining post on each side of tray every 4ft as required to support cables.

E. A "waterfall" or cable drop out shall be utilized for each transition from ladder tray to vertical cable manager. A proper bend radius shall be maintained at all times.

F. All raw ladder tray ends shall be covered with a protective cap to match the color of the ladder tray itself.

G. Provide necessary accessories from original ladder rack manufacturer for a complete solution.

H. Approved Manufacturer – Ladder Tray:

Manufacturer	12 in Ladder Tray	18 in Ladder Tray
Hubbell	HLS0612B	HLS1018B
Legrand	TRT10-12B	TRT10-18B

2.18 RACK MOUNT PDU

A. Contractor shall provide and install (1) 30A/208V metered/switched vertical PDU in each cabinet or 4 post rack specified on project, and (1) 30 amp basic rack mount horizontal PDU in each floor mount 2 Post rack.

B. Approved Manufacturer – Power Distribution:

Manufacturer	Horizontal PDU	Vertical PDU
Hubbell	PHJB02	PV72IC30EBD-10
Panduit	P12B47M	P24E28M

2.19 COPPER BACKBONE CABLING

A. Furnish, install and terminate a minimum Cat3 100pr 24awg solid copper cable from the MDF to each IDF unless indicated otherwise on the Riser Diagram.

B. All indoor conductors are to be terminated on 100pr wall mount 110 terminal block kits. Each 100pr 110 block shall be terminated with C5 blocks.

C. Where cable routes above ceiling provide a plenum rated cable. Where cable routes underground provide an outdoor PE-89 type cable with building entrance protector at each end.

D. Approved Manufacturers – 100 Pair Cable:

Manufacturer	Indoor 100Pr Plenum	Outdoor 100Pr PE-89
Essex	18-799-36	09-104-92
Prysmian	2131758	7525819

E. Approved Manufacturers - 110 Block Kits:

Manufacturer	100pr 110 Terminal Block Kit with C5 blocks
Hubbell	18-799-36
Siemon	S110AA2-100FT
Panduit	P110KB1005Y

F. The building entrance protector shall be a 100 pair 110 in/110out with cover and splice chamber. Unit shall be 16awg powder coated and allow up to 22awg line termination. Unit shall be stackable for future expansion and equipped with internal fuse link and accommodate industry standard 5-pin protection modules. The unit shall be UL497 approved. Contractor shall fully populate each 5-Pin protector port with the specified protector module.

1. Approved Manufacturers – Building Entrance Protectors:

Manufacturer	100pr Building Entrance Protector	5-pin protection modules
CircaMax	1880ECA1-100	3B1E
Tii Technologies Inc.	24100-110-M110C	75-3C1EW-N

2.20 CATV HORIZONTAL CABLES

A. Coax Cable shall be Series 6 quad shield plenum rated.

1. Approved Manufacturers – Series 6 Cable:

Manufacturer	Series 6 Quad Shield; Plenum
Essex	78-14C-91
Prysmian	2131758

B. Coax Terminations & Connectors :

1. All coax shall be terminated with compression style connectors. All corresponding strippers and crimp tools shall be used for complete and proper termination.
2. Approved Manufacturers – Series 6 Connectors:

Manufacturer	Series 6 Compression Connectors
Hubbell	FRG625

Siemon	RG6C
Panduit	FSNS6U

2.21 GROUNDING AND BONDING

A. Grounding shall conform to ANSI-J-STD607(A)- Commercial building Grounding and bonding Requirements for Telecommunications, National Electrical Code, ANSI/NECA/BICSI-568 and manufacture's grounding requirements as minimum.

B. Bond and ground equipment racks, housings, messenger cables, and raceways.

C. Connect cabinets, racks, and frames to single-point ground which is connected to building ground system via (minimum #6) green insulated copper grounding conductor.

D. Contractor shall verify actual measurement of the Telecommunication Bonding Backbone (TBB) and size the bonding backbone accordingly.

E. Approved Products:

Manufacturer	Primary Bonding Busbar (PBB)	Secondary Bonding Busbar (SBB)	Compression Lug; 2-Hole	Ladder Tray Bonding Jumper Kit
Hubbell	HBBB14416H	HBBB14212	HGBLxxxx	HGRKTKA9KA5
Burndy	BBB14416H	BBB14212N	BGBLxxxx	BGRKTKA9KA5

F. Contractor to provide all additional necessary components, including but not limited to C-Taps, H-Taps, RB, RBC, TEBC

2.22 J-HOOKS

A. The cable support used must maintain complete horizontal and vertical 1" bend radius control.

B. Do not exceed EIA/TIA standards or manufactures recommendations of 40% fill ratio in each cable support.

C. All J-Hooks are to be placed no more than 4-5 feet apart.

D. Approved Products:

1. Hubbell
2. Caddy
3. B-Line

PART 3 - EXECUTION

3.1 PRE-INSTALLATION SITE SURVEY

A. Prior to start of system, meet at the project site with owner's representative and representatives of trades performing related work to coordinate efforts. Review areas of potential interference and resolve conflicts before proceeding with the work. Facilitation with the General Contractor will be necessary to plan the crucial schedule completions of the equipment room and telecommunication closet.

B. Examine areas and conditions under which the system is to be installed. Do not proceed with work until satisfactory conditions have been achieved.

3.2 INSTALLATION GUIDELINES

A. The work included under this specification, consist of furnishing all labor, equipment, material, and supplies and performing all operations necessary to complete the installation of this structured cabling system in compliance with the specifications and drawings. The Telecommunications contractor will provide and install all of the required material to form a complete system whether specifically addressed in the technical specification or not.

B. All work performed on this project will be installed in accordance with the current edition of the National Electrical code, the current edition of The National Electrical Safety Code, the current issue of the National Electrical Code, The current edition of ANSI/NECA/BICSI-568- Standard for Installing Commercial Building Telecommunications Cabling, the current edition of the BICSI Telecommunications Distribution Methods Manual, the current edition of the BICSI Cabling Installation Manual, the latest issue of ANSI/TIA/EIA Standards as published Global Engineering Documents as ANSI/TIA/EIA Telecommunications Building Wiring Standards, and all local codes and ordinances. Should conflicts exist with the foregoing, the authority having jurisdiction for enforcement will have responsibility for making interpretation.

C. If this document and any other documents listed above are in conflict, then the more stringent requirements shall apply. All documents listed are believed to be the most current release of the documents. The Vendor has the responsibility to determine and adhere to the most current release.

D. This document does not replace any code, either partially or wholly. The Vendor must be aware of local codes that may impact this project. All, local, State and federal codes are to be followed.

E. All materials shall be UL Listed or listed by other National Independent testing agency and shall be marked as such.

F. Section Includes: Equipment, materials, labor, and services to provide a complete structured cabling system including, but not limited to:

1. Furnish and install a complete telecommunication wiring infrastructure.
2. Furnish, install, terminate and test all copper and Optical fiber cables.

3. Furnish and install Raceway, boxes, and cable tray.
4. Furnish and install all wall plates, jacks, patch panels, and patch cords as described.
5. Furnish and install all required cabinets and/or racks as required and as indicated.
6. Furnish any other material required to form a complete system.
7. Perform Link testing (100% of horizontal and/or backbone links) and certification of all components. All test must meet or exceed link testing requirements as specified in this document.
8. Furnish test results of all cabling to the owner on disk and paper format, listed by each closet, then by workstation ID.
9. Provide owner test results and documentation. (Testing documentation and as-built drawings).
10. Removal of abandoned cable, if required.

3.3 WORK NOT INCLUDED

A. Unless otherwise indicated, the Vendor is not responsible for providing data concentrators, hubs, switches, servers, computers, and other active devices such as PBX's.

3.4 INSTALLATION

A. Install materials and equipment in accordance with applicable standards, codes, requirements, and recommendations of national, state, and local authorities having jurisdiction, and current National Electrical Code and with manufacturer's instructions.

B. Install in accordance with manufacturer's instructions.

C. All cable shall conform to the requirements for communications circuits defined by the National Electrical code (Article 800). Cable listed to NEC Article 800-51(a) will be used for "Plenum" installations. Cable listed to NEC Article 800-51(b) shall be installed in vertical runs penetrating more than one floor.

D. Adhere to manufacturer's specifications for pulling tension, minimum bend radii, and sidewall pressure when installing cables.

1. Where manufacturer does not provide bending radii information, minimum-bending radius shall be 15 times cable diameter. Arrange and mount equipment and materials in a manner acceptable to the engineer and the owner.

E. Penetrations through floor and fire-rated walls shall utilize intermediate metallic conduit (IMC) or galvanized rigid conduit (GRC) sleeves and shall be fire stopped after installation and testing, utilizing a fire stopping assembly for that application. Contractor may also utilize EZ Path fire rated pathway or equivalent.

F. Install station cabling to the nearest telecommunications room (TR), unless otherwise noted.

G. Installation shall conform to the following basic guidelines.
Use of approved wire, cable, and wiring devices.

Neat and uncluttered wire termination.

H. Where cable tray is not used, attach cables to permanent structure with suitable attachments at intervals of 48 to 60 inches. Support cables above removable ceilings.

I. Follow manufactures recommendations on spacing and number and type of cables installed in j-hooks or cable tray to avoid cable stress.

J. Separation and physical barriers between communication cabling and power cables must be always maintained.

K. Install adequate support structure for 10-foot service slack at each TR.

L. Support riser cables every (3) floors and at top of run with cable grips.

M. Limit number of four-pair data riser cables per grip to fifty (50).

N. Install cables in one continuous piece. Splices or taps will not be allowed.

O. Provide overvoltage protection on both ends of cabling exposed to lightning or accidental contact with power conductors.

3.5 LABELING

A. Label each outlet with permanent self-adhesive label.

B. Label each cable within 1" of termination on each end.

C. Use labels on the face of patch panels. Provide facility assignment records in a protective cover at each telecommunications closet location that is specific to the facilities therein.

D. Use color-coded labels for each termination field that conforms to ansi/TIA/EIA-606(A) standard color codes for termination blocks.

E. Labels shall be machine-printed. Handwritten labels shall not be acceptable.

F. Mark up floor plans showing outlet locations, type, and cable marking of cables. Turn these drawings over to the owner two (2) weeks prior to move in date.

G. Three (3) sets of as-built drawings shall be delivered to the owner within four (4) weeks of acceptance of project by the owner. A set of as-built drawings shall be provided to the owner in electronic form utilizing CAD software that is acceptable to the owner. The electronic media shall be delivered to the owner within six (6) weeks of acceptance of project by owner.

3.6 TESTING

A. Testing shall conform to ANSI/TIA/EIA-568-B.1 standard. Testing shall be accomplished using a level IIe or higher field testers.

B. All testing shall meet or exceed Manufactures recommendation for 25-year warranty program,

C. Test each pair and shield of each cable for open shorts, grounds, and pair reversal. Correct grounded and reversed pairs.

D. If copper backbone cable contains more than one (1) percent bad pairs, remove and replace entire cable.

E. If horizontal cable contains bad conductors or shield, contractor shall remove and replace cable at no additional cost to owner.

F. Test optical cable with a light source and power meter utilizing procedures as stated in ANSI/TIA/EIA-526-14a: OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant and ANSI/TIA/EIA-526-7 Measurements of Optical Power Loss of Installed Singlemode Fiber Cable Plant. Measure results shall be plus/minus 1 dB of submitted loss budget calculations. Correct improper splices and replace damaged cables at no charge to the owner.

1. Cables shall be tested at 850 and 1300 nm for multimode optical fiber cables. Cables shall be tested at 1310 and 1550 for singlemode optical fiber.
2. Testing procedures shall utilize "Method B"- one jumper reference.
3. Bi-directional testing of optical fiber is required.
4. Submit printout for each cable tested. The use of handwritten test results will not be acceptable.

3.7 FIELD QUALITY CONTROL

A. Employ job superintendent or project manager during the course of the installation to provide coordination of work of this specification and of other trades and provide technical information when requested by other trades. This person shall maintain current RCDD (Registered Communication Designer) registration and shall be responsible for quality control during installation, equipment set-up, and testing.

B. Installation personnel shall meet manufacturer's training and education requirements for implementation of extended warranty program.

END OF SECTION

SECTION 274100 – ARCHITECTURALLY INTEGRATED AUDIOVISUAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Related sections include the following:

1. Division 26 – Electrical

1.02 BIDDER QUALIFICATIONS

A. The installation of the Audio-Video systems requires the experience and skills of a specialty contractor.

1. Only bidders who have been qualified by the architect shall be permitted to bid.

B. Only bid proposals from qualified bidders will be accepted.

C. The following outlines the criteria used to determine the qualifications of the bidder, at the discretion of the owner and architect.

1. Each bidder shall be recognized in the industry as an Audio-Video systems contractor and actively engaged in the engineering, installation, and maintenance of professional Audio-Video systems for performing arts & educational facilities.
2. Each bidder shall be capable of providing the operational, technical, and financial resources required to complete a project of this size and scope.
3. Each bidder shall have at least five years of experience in the engineering, installation, testing and maintenance of Audio-Video.
4. Each bidder must maintain facilities, equipment inventory, and trained technicians for fabricating, testing, rigging, installing, and servicing the equipment specified herein within 50 miles.
5. Each bidder must hold current certifications from all manufacturers requiring certification to procure, install, program, and otherwise support their equipment.

D. The qualification submittal package shall include a minimum of the following items to be submitted to the architect for approval before bidding:

1. A company overview including the markets served and the number of years in business as an Audio-Video systems contractor serving the performing arts and professional AV market.
2. A legal description of the company including corporate name, date of incorporation, corporate officers, mailing address, and shipping address.
3. List of three similar projects completed in the last five (5) years including contract amount, and references. Include as references the client, architect, Audio-Video architect, and general contractor where applicable.

a. At least one of these prior projects must have been completed through a Design-Bid-Build process.

4. Description of the size and capabilities of the shop and warehousing facility.
5. A list of all full-time employees and their current title and responsibilities. Provide a résumé for each of the key individuals that would be assigned to this project including sales, engineering, project manager, and site foreman.
6. A complete set of approved shop drawings from one of the reference projects submitted in response to item 3 above.
7. An example of client training presentations or training documentation from one of the reference projects submitted in response to item 3 above.
8. A complete set of approved as-built drawings from one of the reference projects submitted in response to item 3 above.
9. A list of professional affiliations and memberships.
10. A list of equipment dealerships.

1.03 SCOPE OF SPECIFICATION

A. This specification describes the stock ticker system associated with the Southern University and A&M College Baton Rouge New College of Business. The intent of the specification is for the Audio-Video systems contractor to provide a professionally installed system that is complete, tested, and ready to use.

B. This project manual and any addenda constitute the contract documents.

1.04 CONTRACTOR RESPONSIBILITY

A. The specification is detailed only to the extent to show design intent. Areas within the specification will require further engineering, equipment, and coordination with other trades to complete a fully functioning Stock Ticker system. The Audio-Video contractor understands and accepts that the work described in the specification shall be complete in every detail as necessary to supply a professional working system.

B. Equipment and parts not mentioned in the Major Equipment List or identified on the drawings but required to complete a professionally installed and working system shall be provided without request for additional monies or services.

1. Where additional engineering or design is required to establish a complete bill of materials for the system installation, the AV contractor shall determine the required materials and furnish them.

1.05 SYSTEM DESCRIPTION

A. Stock Ticker

1. The Stock Ticker in the SU School of Business Lobby is a customizable, high-resolution Direct View LED scrolling display that provides real-time financial data, market updates, Designed universities they feature easy content updates, such as, displaying stock quotes (NYSE, Nasdaq),, cryptocurrencies, or, news.

1.06 SCOPE OF WORK

A. Furnish all equipment, materials, cable, labor, and engineering services to provide

complete and professionally installed systems in working order and in accordance with good engineering practice.

B. Coordinate with other trades.

1. Coordinate with the Electrical Contractor to ensure correct audio and video raceway routing, audio and video back box locations, and clean technical power circuit locations as specified in Division 26 – Electrical.
2. Coordinate with General Contractor to ensure all structural rigging points and backing required to install and deploy Audio-Video equipment is provided and positioned correctly.

    a. The Audio-Video Systems Contractor shall coordinate requirements with General Contractor.

3. Coordinate with IT designer and/or the owner's IT staff or representative to ensure the necessary accommodations are made related to the facility networks and internet (e.g. VLAN requirements, network topology, security, et al.)
4. Coordinate with other trades as required to ensure timely progress and successful integration of the Audio-Video systems.

C. Install, pull, and terminate all wire and cable in the raceway system provided by the electrical contractor.

D. Furnish any additional items, not specifically mentioned herein, to meet good engineering practice, without claim for additional payment. Such items may include, but are not limited to, hardware, transformers, terminal strips, connectors, resistors, capacitors, blank cover plates, and other Audio- Video devices for proper installation, interface, isolation, and/or gain structure. Furnish additional items not specifically mentioned herein as required to provide a fully functioning Stock Ticker system.

E. Furnish shop drawings and receive design team and owner approval prior to procurement, fabrication, and installation.

F. Perform initial adjustments, verification tests, and final adjustments.

G. Assist the architect in the Acceptance Testing of the systems.

H. Provide training of owner's staff on all AV systems.

I. Provide system documentation including copies of all relevant as-built documentation and equipment manuals.

J. Provide maintenance and warranty services for the specified period from the date of acceptance.

K. Note that the work scope under this section does not include the materials or installation for the AC power system except for the fabrication required within the equipment racks and where specifically called out in the contract documents.

L. Note that the scope of work described in this specification does not include materials or installation for the Audio-Video systems raceway. This includes conduit, couplings,

hangers, supports, pull boxes, pull box lids, pull string, back boxes, lids/covers/blank plates for all AV boxes, and ladder tray.

1.07 SUBMITTALS

A. Bid submittals

1. Contractors shall examine, review, and acknowledge receipt of all drawings, specifications, and addenda prior to submitting a bid. No allowances will be made for failure to read and understand the bid documents. In the case where a conflict exists between the written specification and the drawings, the Audio-Video system contractor must seek written clarification from the architect and design team prior to submitting a bid. Should the contractor fail to obtain written clarification, the interpretation of the architect will prevail.
2. Request for clarification of the specification shall be made in writing not later than ten (10) days before the bid date.
3. Bid proposals shall include all work and equipment specified as well as any incidental items or Audio-Video equipment required in the fabrication, installation, and operation required to complete a functioning Audio-Video system.

    a. A detailed work plan for the anticipated installation of the AV systems, including key submittal and installation milestones, including but not limited to the following:

        1). Contract Award
        2). Identification of long-lead items
        3). Shop Drawing submission
        4). Shop Drawing approval
        5). Equipment procurement
        6). AV system rough in, fabrication, and termination
        7). Acceptance testing
        8). Training and Demonstration (refer to section 1.8-H)
        9). Substantial Completion

B. Shop drawing submittals

1. Within sixty (60) days or a negotiated time period after the contract award, submit electronic copies of the shop drawings to the architect for review and comment. Do not begin procurement, fabrication, or installation without the approval of the architect and architect.

    a. Early procurement of long-lead items or other critical schedule impacts may be allowed with the explicit approval of the architect. It is the AV contractor's responsibility to provide adequate time for procurement of equipment for timely installation prior to the contractually agreed upon substantial completion date.

2. Review of the shop drawings and their acceptance does not constitute final approval of the system or its function. The contractor remains subject to the requirements of the contract documents.
3. Failure of the contractor to submit shop drawings in sufficient time for evaluation

will not entitle the contractor to an extension of contract time or additional compensation.

4. The pre-construction shop drawing submittal shall be submitted as one package and include the following items:

    a. Cover Sheet – Shop Drawing Submittal Checklist (provided by architect after contract award)
    b. Table of contents
    c. Itemized list of all equipment, cable, and materials used to assemble the system. This list should include the manufacturer, model number, description of item, and quantity.

        1). Include product data and cross-reference details for any substituted cable. Refer to section 2.1-D for additional information.

    d. Floor plans, ceiling plans, and other drawings as required identifying all AV devices, their dimensioned locations, and a schedule or spreadsheet based on the AV termination schedule provided by the Architect.
    e. Detailed one-line signal diagrams of all systems showing point-to-point wiring connections (detailing the wire type, wire identification numbers, and termination method) for all equipment.

        1). Each and every wire and connection must be shown with no bussing of cables or grouping of typical components or systems.

    f. AV systems raceway report: The AV contractor shall review, in detail, the plan for implementation of the AV system raceway by the Electrical Contractor, or the existing conditions on site, and provide a detailed report identifying compliance with and potential deviations from the design intent and infrastructure requirements.
    g. Detailed schematic diagrams for all modified or custom circuitry.
    h. Detailed schematic diagrams for typical connections between audio lines, patch bays and rack mounted equipment.
    i. Detailed mechanical drawings of all custom fabricated plates and panels, including each individual instance of typical panels as well as connector labels and numbering.
    j. Detailed mechanical drawings for all modified or custom fabricated devices.
    k. Full scale drawings of patch bay layouts and labeling.
    l. Detailed equipment rack plans, sections, and elevations showing cable management, grounding, acoustic isolation, required clearances, mounting heights, structural requirements, and other details as required for clarity and coordination.
    m. Detailed equipment rack Audio-Video cable and power routing, dressing, and support details.
    n. Control and equipment room device layout drawings.
    o. Detailed mounting drawings for all loudspeakers, emitters, antennas, microphones, screens, displays, projectors, cameras, video walls, AV equipment racks, etc. showing rigging details and interface to the adjacent structure and architecture.

        1). Customized or specialized rigging assemblies for any AV equipment

require a structural engineer stamp at no additional cost to the owner.

5. Additional submittals are required no later than three months prior to acceptance testing. The items listed below shall be submitted as one package:

    a. IT coordination plan, including but not limited to:

        1). Description of interface and coordination between AV systems and facility networks (e.g. list of facility network resources required for AV system functionality, their intended applications, and the contractor's plan for implementation)
        2). Wireless networking coordination plan, including locations of AV-specific wireless access hardware and verification of compliance with facility IT requirements
        3). List of IP Addresses, Subnets, and VLANs for AV system networks as well as a description of network behavior (e.g. multicast vs. unicast) for each device.

    b. Training agenda, schedule, and supporting materials (presentations, etc.).

6. All drawings must be produced using a professional CAD program. Reproductions of the bid documents are not acceptable.

C. Substitution submittals

1. Substitutions will be considered during the bid process. Bidding contractors shall base their bid on the listed specified equipment.
2. All substitutions shall require the written approval of the architect.
3. The proposed substitutions must be equivalent to the specified products in quality, performance, construction, function, warranty, and conformance to the design intent.

    a. For discontinued equipment, it is the Contractor's responsibility to propose an equivalent for approval. Follow manufacturer's recommendations when available.

4. It is the responsibility of the contractor to prove to the satisfaction of the architect and owner that the proposed substitution is equal to the specified product. The following shall be the minimal information required for consideration of the substitution:

    a. List of advantages to the owner.
    b. Cost savings to the owner.
    c. Printed specification sheets.
    d. Statement of previous field performance, reliability, and experience.
    e. A/B evaluation of the specified device and the proposed substitution.
    f. The contractor shall list the unit price of each item proposed for substitution and each specified item that is deleted.

D. Samples

1. Submit samples of custom work, finishes or other materials as required by the architect or architect to verify quality and appearance.
2. Submit samples of proposed substitute equipment to the architect in order to prove equivalency to the items specified.
3. Shipping costs associated with the samples shall be the responsibility of the contractor.

E. Verification test report

1. Submit a report detailing the results of the verification testing. Refer to paragraph 3.8 Verification Tests for details regarding the requirements of the verification testing.
2. This report must be completed and submitted to the architect five (5) days prior to acceptance testing.
3. Submission of the verification test report certifies that the installation conforms to the bid specifications, is complete, and is ready for the acceptance testing by the architect.
4. The architect will visit the site once to perform the acceptance testing. Should the system not be ready upon the architect's arrival for acceptance testing and final optimization, the contractor will bear full responsibility for all expenses and professional fees associated with a return trip by the architect. Current rates are minimum $250 per hour plus expenses. Architect will provide Audio-Video Contractor with estimated cost for return trip if required.

F. As-built drawings

1. Within thirty (30) days of the completion of acceptance testing, prepare and submit electronic copies of the as-built documentation in PDF and CAD format. The As-built drawings shall be submitted as one package for review and approval.
2. The as-built documentation shall consist of the shop drawing submittal updated, corrected, and reflecting all field modifications and changes.
3. One-line signal flows shall be updated with all cable runs and patch points identified by alphanumeric character.
4. A laminated copy (minimum 11x17 page size) of the one-line signal flows shall be provided in the back of each bay of permanent racks.
5. A laminated copy (minimum 11x17 page size) of a Clean Technical Power circuit schedule listing all circuits and associated panel board shall be provided as part of the as-built package.

G. Owner's manuals

1. Within thirty (30) days of the completion of the acceptance testing, prepare and submit three (3) copies of the operation and maintenance manuals to the owner. These copies are in addition to the one copy provided to the architect during the acceptance testing. Manuals are to be submitted in electronic form with 2 sets supplied on USB media, and one set supplied as a paper copy bound in a binder OR an electronic tablet. Tablet is to include a ruggedized protective case and all applications necessary to view the provided content.
2. The manual is to include:

a. Table of contents.
b. Warranty statement.
c. Emergency contact information.
d. Rigging information (documentation on any dynamic rigging systems operation and maintenance).
e. Basic power on/off procedures.
f. All available manufacturer's operational and service manuals for each piece of equipment identified in the equipment list.
g. A copy of the verification test report.
h. A copy of the final digital signal processor settings as provided by the architect.
i. Network information (a copy of Audio-Video network settings listing all static IPs, and login information per device, along with router and WAP default setup files.)
j. A copy of any default system starting files for mixers, Digital Signal Processors, amplifiers, and other programmable or configurable audio equipment.
k. A copy of any default system starting files for video matrix routers, switchers, robotic cameras, servers, playback or recording equipment, and other programmable or configurable video equipment.
l. A copy of all calibrated setup files for projectors, displays, and cameras.

m. Training Material (a copy of all presentation and training documentation).

H. Training

1. The contractor shall provide the following Audio-Video system training. All training sessions are to be video captured and provided to client with project manuals. Video recordings shall be edited into individual files/segments that relate to each topic or subsystem discussed, with appropriately specific file naming.
2. Training must be presented by competent personnel, who are familiar with the detailed operation of the systems in discussion. Training provided by the manufacturer is an acceptable alternative.

a. Provide a minimum of 1 day of training on all equipment and system operation, including the topics noted below.
b. Training should be scheduled by the AV contractor to occur after successful completion of Acceptance Testing

1). Coordinate with the owner, Architect, and Construction Team to schedule training and confirm attendees.

c. The owner will select personnel to attend training sessions.

1). The Contractor shall submit an agenda or outline to the owner and architect prior to each training session for review and comment.

d. Provide at least 1 technician to support the facility's technical staff during the grand opening (as determined by owner).
e. Technicians present during events must be capable of operating all Audio-Video equipment provided and make necessary changes to system

programming or configuration.

1.08 JOB CONDITIONS

A. The contractor shall:

1. Review the conduit system design with the Electrical Contractor prior to installation and notify the architect, the architect and the Electrical Contractor of any deficiencies or inadequacies.
2. Always keep the job adequately staffed. The contractor shall keep the same individual in charge of the project from start until finish, except in the case of circumstances beyond the contractor's control.
3. Cooperate with all parties to achieve coordinated progress throughout the construction schedule and successful integration of the stock ticker.
4. Watch for conflicts with other trades on the project and execute, without claim for additional compensation, moderate moves or changes as are necessary to accommodate other equipment or to preserve acoustic performance, symmetry, function, and aesthetics.
5. Immediately report to the architect and architect any design or installation irregularities that may obstruct or interfere with the intended stock ticker or infrastructure.
6. Do all cutting, patching, and painting for proper and finished installation of the stock ticker systems in coordination with the other trades.
7. Repair any damage to work completed by others caused by the installation of the stock ticker systems.
8. Leave the job site and all equipment and materials clean and free from marks and blemishes.

B. Quality assurance

1. All supplied equipment must meet the manufacturer's specifications.
2. All equipment, parts and materials supplied shall be new and free from manufacturing defects.
3. All equipment, parts and materials must conform to applicable provisions of Underwriters Laboratories and the American Standards Association.
4. The contractor shall obtain and incur all costs for all required permits, licenses and inspections and conform to any requirements stipulated therein.
5. The contractor shall comply with federal, state, and local labor regulations including any applicable union agreement.
6. The Audio-Video systems installation shall conform to latest federal, state, and local electrical and safety codes. Where conflicts exist, the most stringent code or regulation shall apply.

1.09 GUARANTEE AND SERVICE

A. The contractor shall for a period of three years, after final acceptance of the system, repair or replace all defective equipment or workmanship at no cost to the owner. This service and support shall be provided irrespective of any limitations of the manufacturer's warranty or equipment procurement timelines.

B. All equipment supplied under this specification shall be warrantied for parts for the full period of the manufacturer's standard warranty, or for the duration of the

contractor's warranty period, whichever is longer.

1. All manufacturer's warranties that exceed the length of the contractor's warranty period must be valid and transferable to the owner for the full duration of the manufacturer's warranty period.

C. The contractor shall repair or replace the defective item within forty-eight (48) hours following notification by the owner.

D. Should any device demonstrate repeated failure (i.e. more than two service visits are required to address defects) during the warranty period the contractor shall supply and install a new component or software configuration at no additional cost to the owner.

E. Unless specifically identified in this section, owner-directed changes to the system configuration during the warranty period are not covered by the AV contractor's warranty.

F. The contractor shall provide a minimum of two (2) service visits to the site for inspection and adjustment of equipment during the warranty period. During the last month of the warranty period the contractor shall contact the owner to inquire as to the condition of the system and schedule a final (second) warranty visit. During the visit, the contractor shall evaluate the systems' working condition and repair any problems or defects that may exist.

1.10 INSURANCE

A. The contractor shall fully insure all materials and equipment against loss or damage until acceptance of the system by owner.

B. The contractor shall refer to the general conditions section of the specification for other project insurance requirements including but not limited to liability, workers compensation, coverage limits, and bonding requirements.

PART 2 - PRODUCTS

2.01 GENERAL EQUIPMENT

A. Where the specification calls out a manufacturer and model number it is for the purpose of establishing a standard of quality, performance, and function.

B. All equipment shall operate at the required line voltage.

C. The contractor shall provide quantities as indicated in the equipment list, detail drawings, location drawings, termination schedule, and otherwise as required for a complete, professionally installed system.

D. Video wire and cable:

1. All cable must meet or exceed all local, state, or federal ordinances, codes, or regulations. Where a conflict exists between these regulations

the most stringent shall apply.

2. All wire numbers listed in the specification and drawing set are listed for the purpose of establishing a standard of quality, performance, and function.
3. Should the contractor desire to use cable other than the manufacturer and model specified in the drawing set:

    a. The AV contractor shall submit to the architect a manufacturer-supplied cross- reference list specifying the substituted cable part number as equivalent to the specified model number that it replaces.
    b. Verify and revise the conduit system sizing as needed to accommodate the potential differences in cable size between manufacturers.
    c. Incur any additional costs associated with increasing the conduit sizes due to the substitution.

4. Pre-approved cable manufacturers are:

    a. West Penn Wire
    b. Belden CDT Inc.
    c. Approved equal

5. HDMI cable assemblies must comply with HDMI 2.0 standard at a minimum, and pass UHD/4K signals at 60hz refresh rate, with 4:4:4 color sampling and be certified for 18 Gbps high-speed end-to-end transmission.

    a. Approved cable assembly manufacturers are:

        1). BTX
        2). Comprehensive
        3). Extron

    b. All HDMI runs should be continuous with no barrels or splicing. Barrels are allowed at plate connection points only.

6. Typical category cable assemblies must meet or exceed the standard specified for use in all jacks, patch panels, and other associated devices in the signal path. Approved cable assembly manufacturers are:

    a. Belden
    b. Hubbell
    c. HellermannTyton
    d. Comprehensive

7. LC Fiber cable assemblies for single mode or multimode fiber must comply with or exceed OS/OM rating for patch panels, connectors, and all other devices in the signal path. Approved cable assembly manufacturers are:

    a. Comprehensive
    b. Bittree
    c. Belden
    d. Hubbell
    e. HellermannTyton

E. Electrical wire and cable

1. All cable must meet or exceed all local, state, or federal ordinances, codes, or regulations. Where a conflict exists between these regulations the most stringent shall apply.
2. Cable shall be THHN or as required by code.

F. Wiring devices

1. All wiring devices must meet or exceed all local, state, or federal ordinances, codes, or regulations. Where a conflict exists between these regulations the most stringent shall apply.

G. Electrical plates and panels

1. Rack panels shall be minimum 1/8" thick anodized aluminum or powder-coated 16-gauge steel, black in color with white labels unless noted otherwise. All rack panels must be flanged to increase rigidity.

    a. Labeling shall be engraved, etched, or inherently permanent. Adhesive labeling or screen-printed text is not allowed.
    b. Panels with different materials or finish requirements are defined on Audio-Video rack panel elevation detail drawings.

2. Termination plates shall be minimum 1/8" thick anodized aluminum, black in color with white labels unless noted otherwise

    a. Labeling shall be engraved, etched, or inherently permanent. Adhesive labeling or screen-printed text is not allowed.
    b. Plates with different materials or finish requirements are defined on Audio-Video termination schedule or Audio-Video panel detail drawings.
    c. All plate finishes must be approved by the architect prior to procurement and installation.

3. All plates and panels with fiber connections must have separate back box mounted to plate or panel, or another approved protection scheme, to avoid damage to fiber connection points.
4. All Audio-Video connectors will be back loaded unless noted otherwise. Audio-Video connectors that cannot be back loaded must be flagged and noted on shop drawing panel layouts.

H. Network connectors

1. All panel-mount connectors shall be punch down (no barrel connectors allowed unless otherwise noted).
    a. Approved manufacturers:

        1). Panduit
        2). Neutrik
        3). Legrand
        4). Hubbell

5). Signamax
6). Belden

2. All cable-mount connectors shall be cable guided inserts with crimp (no pass-through cut & crimp allowed).

a. Approved manufacturers:

1). Panduit
2). Neutrik
3). Legrand
4). Hubbell
5). Signamax
6). Belden

l. Fiber connectors

1. All cable mount connectors shall be terminated per manufacturer specifications.

a. Approved manufacturers:

1). Panduit
2). Belden
3). Neutrik
4). Lemo

2. All panel mount connectors shall be terminated per manufacturer specifications.

a. Approved manufacturers

1). Panduit
2). Neutrik
3). Belden
4). Lemo

2.02 MAJOR EQUIPMENT

A. Major equipment consists of all components and products required to communicate the design intent and establish a standard of quality, performance, or function.
B. Minor equipment consists of items that are not identified in the Major Equipment List but are required to complete the installation and provide a professional, working system.
C. The contractor shall provide the equipment specified in appendix A, or approved substitute (see paragraph 1.8.C). Additionally, the contractor shall provide all incidental products and materials required for a complete installation even if not explicitly described in the Contract Documents.
D. The following manufacturer quotes should be referenced when obtaining pricing. Individual line items are listed in the Major Equipment List in Appendix A.

2.03 dvLED Stock Ticker:

A. Manufacturers
1. Pixel Flex LED - Flex Mod Pro 3.7mm – Indoor smooth curve LED display with Novastar Processing – Product Bid Specifications.
2. Daktronics DVX-3020 series, Model DVN-3070-1200-BR-MA
3. Substitutions will be considered before bidding.
   a. All substitutions shall require the written approval of the architect before bidding.
   b. The proposed substitutions must be equivalent to the specified products in quality, performance, construction, function, warranty, and conformance to the design intent.

B. LED Video Display
1. General Information
   a. Pixel Design: RGB 3 in 1 Surface Mount Device (SMD)
   b. Line and Column Spacing: 0.9mm, 1.2mm, 1.5mm, 1.8mm, 2.5mm, or 3.7mm (recommended spec)
   c. Nationstar – SMD 2121 with copper wire bonds
2. Shall be curve radius edge, no faceted edges will be approved.
3. Minimum Resolution: 7200 x 360mm
4. Minimum Active Viewing Area: 140 degrees vertical and 140 degrees horizontal
5. Brightness: 1200 nits (3.7mm pixel pitch)
6. Optional (TAA Compliant)

C. Display Capabilities
1. LED Refresh Rate: 3840Hz
2. Certifications: CE/FCC/ETL
3. Manufacturer shall conduct in-house component and design testing to verify performance and product lifetime.
   a. In house testing shall include: 3 Step QC process that includes the following tests: Unit weight, Smell, Scratches, Hi-Pot test, earth bond test, fatigue test, picture quality test, Failed Pixel test, Adhesive logo test, Impact test, processing software test.
4. Mechanical and digital seam adjustment capability shall be available as a standard feature in all product offerings

D. LED Image Quality
1. LEDs must be burned in at the factory, full white point and color factory calibration required. Onsite burn in not accepted.
2. Field camera calibration is not considered a viable approach to initial calibration
3. Batch testing on each red, green, and blue LED must be factory tested for intensity, consistency, and color
4. LED lifetime: 100,000 hours of operation as defined by time at which display intensity has decreased to 50% of the original intensity.

E. Display Design
1. Front Serviceable
2. Cabinet Depth: Cabinet depth must be thin depth and not to exceed 38mm when the cabinet is flat.
3. LED cabinet weight must not exceed 5.5 lbs/square ft.
4. Project Optional: The manufacturer shall provide signal to controller redundancy, module redundancy, or full redundancy to ensure continuous operation and reliability.

F. Installation/Serviceability
1. Contractor shall include at no additional cost to the client Assisted Install and Commissioning by the dvLED video wall manufacturer.
2. Manufacturer shall provide a comprehensive spare parts package including:
   a. Minimum of 10% spare modules
   b. 3% or minimum quantity of 2 (whatever is greater) for other key internal components (power supplies, hub board, receiver card, internal spare cables)
   c. Must include 1% spare parts for installation
3. Manufacturer must guarantee critical component and part access for up to 10 years. This includes factory calibrated matching modules.
4. Display must be capable of x, y, and z axis adjustments at frame level, panel level and module level for seam control.
5. The successful bidder must be a certified installation and service provider of display manufacturer at time of installation.
6. Manufacturer must have US-based repair and service center staffed by manufacturer employees and not be a 3rd party.
7. 5 year parts warranty

G. Viewing Characteristics
1. Display Intensity: 1,200 nits
2. Contrast Ratio: 5000:1
3. Brightness Control: 256 levels (manual, scheduled)
4. Suggested Viewing Angle: Horizontal-140 degree/ Vertical - 140 degree

2.04 LED Controller:

A. Novastar H2 Rack
1. Form Factor: 2U Rackmount (482.6 mm × 88.1 mm × 455 mm).
2. Capacity: Up to 26 million pixels (standard).
3. Modular Slots: 4 Input Card Slots, 2 Output Card Slots.
4. Input Capability: Max 16 channels (via HDMI 1.3/2.0, DP1.1/1.2, 3G/12G-SDI, IP).
5. Output Capability: Max 20x RJ45 or Fiber ports (using LED 4K sending cards).
6. Processing: 32 layers (max) and 8 independent screen configurations.
7. Control: Web-based B/S (Browser/Server) architecture (no software required).
8. Power: 100-240V AC, ~210W consumption.
9. Physical and Environmental:
   a. Weight: 15.6 kg (34.4 lbs).
   b. Dimensions: Standard 19-inch rack compatible.
   c. Architecture: Stable, pure hardware FPGA, hot-swappable cards.

PART 3 - EXECUTION

3.01 GENERAL

A. The contractor shall install all systems specified herein utilizing the highest standards of craftsmanship and in accordance with good engineering practice.

B. The contractor shall install all equipment in accordance with this specification and the manufacturer's recommendations.

C. All equipment and devices shall be installed neatly, plumb, square and with respect to the aesthetic of the project.

D. The standard reference for installation and implementation of the audio and video systems design specified herein shall be: AVIXA ANSI Standards, Audiovisual best practices Infocomm International, PLASA technical standards, and Audio Systems Design and Installation by Philip Giddings, Focal Press, Boston, MA.

3.02 CONDUIT

A. The contractor shall review the termination schedule, Audio-Video System Raceway (ASR) guidelines, and other supporting information issued as part of the contract documents and field coordinate with the electrical contractor to ensure proper sizing, routing, separation, and operation of the Audio-Video systems.

B. All the Audio-Video system cabling must be housed in a continuously grounded, ferrous metallic ASR, including all conduit installed or encased in concrete. PVC or aluminum conduit is only acceptable below ground.

C. The contractor shall coordinate with the general contractor (or construction manager) and visit the construction site frequently to inspect the installation of the ASR during construction. Visits shall be scheduled prior to pouring of concrete or other construction that would cover or encapsulate the ASR. The architect and architect shall be notified immediately regarding construction methods inconsistent with the requirements identified in the contract documents.

3.03 ELECTRICAL POWER

A. The contractor shall review and coordinate the installation of the clean technical power system with the electrical contractor to ensure proper system implementation.

B. The contractor shall verify that all circuits designated on the contract documents have been installed, correctly wired, and labeled. Any discrepancies shall be reported to the architect in writing for corrective action.

C. The contractor shall be responsible for power distribution within all portable and permanent Audio- Video equipment racks.

1. Plug strips are not acceptable.
2. Permanent audio and video equipment racks shall be hardwired and terminated directly to the panel board.
3. Permanent audio and video equipment racks shall contain vertical power raceways, unless otherwise noted.

a. Approved Manufacturers

1. Middle Atlantic MPR series
2. Juice Goose PD Series

3. Approved Equal

4. The electrical contractor shall be responsible for delivering and terminating the specified CTP circuits to the equipment racks.
5. Portable racks shall have a minimum ten (10) foot SO-type extension cable for connection to the CTP receptacles.
6. Each permanent rack shall have a minimum of one (1) unused receptacle per circuit.
7. Each portable rack shall have a minimum of two (2) unused receptacles per circuit.

3.04 GROUNDING

A. The contractor shall review and coordinate the installation of the Isolated Technical grounding system with the electrical contractor to ensure proper system implementation.

B. The contractor shall verify that the Isolated Technical grounding shown on the electrical plans have been installed, correctly wired, and labeled. Any discrepancies shall be reported to the architect in writing for corrective action.

1. The AV contractor shall periodically spot-check clean technical power devices to verify proper isolation of technical ground. Any apparent faults shall be reported to the architect and electrical contractor in writing for corrective action.

C. A single point star grounding system shall be used in the implementation of the Audio-Video systems. Reference for this type of system can be found in: *Audio Systems Design and Installation* by Philip Giddings, Focal Press, Boston, MA, and *Fundamentals of Grounding, Shielding, and Interconnection*, Kenneth R. Fause, Journal of the Audio Engineering Society, vol. 43, #6, June 1995.

3.05 RIGGING

A. The Audio-Video systems contractor shall be responsible for the installation and mounting of all equipment specified herein.

B. The Audio-Video systems contractor shall coordinate with all applicable trades for proper installation and performance of the specified equipment.

C. The Audio-Video systems contractor shall provide detailed mounting drawings for all devices that will attach to surfaces or structures, LED walls and wall-mounted equipment racks.

D. The minimum safety factor for all mounting and rigging shall be the USA industry established 5:1 OR the local code, whichever is higher. Always defer to project structural engineer, as higher standards may apply in certain scenarios.

1. The Audio-Video systems contractor shall be responsible for the safe and proper installation of all devices specified herein and shall adhere to all applicable federal, state, and local codes, regulations, and standards.

E. The installation of mounting brackets or supports shall not weaken or overload the

building structure. Coordinate as necessary with the project's structural engineer and if necessary, secure the services of a structural engineer licensed in the state of the project for any unique or questionable structural matters.

F. Audio-Video equipment mounting hardware and systems shall not share or utilize fixtures, devices, or supports intended for other trades or systems unless specifically noted.

G. The Audio-Video systems contractor shall coordinate with General Contractor any backing or reinforcement needed to meet required safety factor and other applicable local, state, or federal codes.

H. The Audio-Video systems contractor shall not cut, drill, weld or otherwise alter any structural member without the written authorization of the architect and project structural engineer.

3.06 WIRING

A. All Audio-Video wiring or cabling shall be installed with respect to proper routing, types, quantities, lengths, identification, and separation.

B. Splicing of cables is not permitted between points of termination unless directed by the architect.

C. All wires and cables shall be permanently and uniquely labeled and accurately documented on the as-built drawings. "P-Touch" or similar printed labels are not permitted.

1. Labels are required for spare cables that are not terminated to equipment or plates/panels.
2. Approved cable ID labels:

a. Brady Jet-30 type
b. Phoenix Contact adhesive wrap labels

D. Pull all wire and cable in accordance with the manufacturer's requirements regarding lubricant, pulling tensions, bend radius and temperature. Protect the cable and wiring from abrasion, kinks, and excessive tension during installation.

E. All exposed cable ends, e.g. where it meets a terminal block, shall be wrapped with shrink tubing and each shield or drain wire sheathed in clear tubing.

F. All cabling and wiring shall be grouped, neatly bundled, and labeled according to signal level in all enclosures and racks utilizing hook & loop (e.g. Velcro®) tie wraps of the appropriate size. Zip ties are not allowed.

G. Service loops should be provided at all panel and equipment terminations allowing ease of dismounting for installation, service, and inspection.

H. All devices shall be installed and wired with respect to proper polarity. Absolute polarity shall be maintained throughout the entire audio chain.

1. Polarity for XLR type connectors shall be: pin 2 hot, pin 3 cold, and pin 1 shield.

2. Polarity for ¼"-TRS type connectors shall be tip hot, ring cold, and sleeve shield.

3. Connector polarity shall be maintained throughout the system except for terminations at equipment manufactured to other standards. Should this case exist the connector shall be flagged with a label noting the variance.

3.07 EQUIPMENT RACKS

A. Middle Atlantic BGR-4527-AV or Approved Equal.

1. Additional accessories:

a. (1) Associated Caster Base

b. (1) Middle Atlantic RLNK-P915R

c. (1) Middle Atlantic UPS-S2200R

d. (1) Middle Atlantic UPS-OLIPCARD

B. All equipment racks shall be considered custom assemblies and shall be fabricated and tested at the contractor's facility prior to installation at the site.

C. Equipment racks shall not be brought to the site until the rooms they are to be set in are painted, cleaned, dust free and ready for occupancy.

D. All equipment racks shall be installed level and square allowing both front and rear access per code. Submit drawings detailing the placement of the racks coordinated with all other furniture, fixtures, and equipment prior to installation.

E. All equipment racks shall be electrically isolated from the floor.

F. All equipment racks shall be electrically isolated from the conduit system as detailed in the electrical plans and specifications.

G. All equipment shown in the rack elevation drawings is placed for proper operator convenience. Submit any changes for architect approval with the shop drawing submittal.

H. All wiring and cable shall be formed into harnesses, neatly grouped, Velcro® wrapped and supported by vertical and horizontal lacing bars. All cables connecting to equipment, patch bays, and panels must be supported by horizontal lacing bars.

1. Wiring accessories for cable management in racks shall be provided by the AV contractor as required.

I. All wire, cable, terminals, and equipment shall be clearly labeled as to their function, circuit, or system.

J. All equipment shall be placed in the rack with regards to logical signal flow, EMI, proper ventilation, and operator convenience. Submit any changes to the bid

specification rack elevations for approval as part of the shop drawing submittal.

K. All empty spaces on the front of the rack shall be filled with blank panels

L. Provide a light inside the rear of each equipment rack bay providing an adequate working light level.

1. Approved products:

a. Middle Atlantic LT-CABUTL-DUAL
b. Middle Atlantic FWD-LT-UTL-XX-X Series
c. Lowell Manufacturing RLB-KIT Series
d. Approved equal

3.08 VERIFICATION TESTS

A. The Audio-Video systems contractor shall provide the initial adjustment and testing of the Audio- Video systems to ensure that the systems are properly installed, operational, and ready for acceptance testing.

B. The Audio-Video systems contractor shall perform the following tests, adjustments, and verifications and include the results as part of the verification test report prior to acceptance testing. The verification test report is due to the architect per section 1.8.E.2. prior to acceptance testing.

1. Each Audio-Video clean technical power outlet shall be tested to verify proper polarity, safety grounding, and voltage.

2. Each category cable shall be tested and documented confirming compliance with the minimum performance parameters set forth by ANSI/BICSI N1-2019 standards including:

a. Wire map (continuity) including shield when applicable.
b. Length.
c. Propagation delay & delay skew.
d. Attenuation (insertion loss).
e. Return loss
f. Near-end crosstalk (next) loss
g. Equal level far-end crosstalk (ELFEXT)
h. Power sum crosstalk

2. Each HDMI cable shall be tested and documented confirming:

a. Wire map (continuity)
b. 5V signal presence
c. Resolution passage of 3840 x 2160 at 60Hz in 4:4:4 color space.

3. Each optical fiber strand shall be tested and documented confirming minimum performance parameters set forth by ANSI/TIA-568.3-D standards including:

a. For interbuilding backbones, intrabuilding backbones, and horizontal and

centralized cabling

1. End-to-end attenuation testing for all connectorized fibers at both 850 nm. And 1300 nm. For multimode fiber or 1310 nm. And 1550 nm. For single mode (if any fibers are to be left unterminated, use an OTDR to test end-to-end attenuation).
   2. OTDR signature trace documentation

3.08.B.3.a.2.1 For intrabuilding backbones, documentation is only required if the attenuation testing indicates questionable results.

3.08.B.3.a.2.2 For horizontal and centralized cabling, documentation is not necessary unless the end-to-end readings are high.

b. If a loudspeaker excites other objects affixed to architecture in the space to audible vibration, alert the General Contractor, acoustician, and AV architect.

4. All devices during the verification test shall be adjusted according to the manufacturer's recommendations and optimized for unity gain where applicable.

5. All digital video cable runs shall be verified to pass signals conforming to the SMPTE 259m (SDI 270Mbit), SMPTE 292m (HD-SDI 1.485Gbit), and SMPTE 424m (3G-SDI
   2.970Gbit) standards.
6. All imaging devices shall be confirmed to have no inoperative pixels.
7. All display devices shall be confirmed to have no inoperative pixels.
8. Verify that each system is operating within the design intent, "passing signal," requires no further termination, installation, troubleshooting or repair, and is ready for acceptance testing and final tuning.
9. All audio and video equipment shall be installed, setup, programmed, and verified for correct signal connectivity and routing.

10. All equipment shall have the latest stable version of firmware installed.

3.09 ACCEPTANCE TESTING

A. Prior to the scheduled acceptance testing visit, the following conditions should be met:

1. Receipt and acceptance of the verification test report by the Architect
2. All specified systems functional and configured according to factory recommended settings
3. All labels for equipment, patch bays, installed cabling, and software configurations complete
4. All equipment installed, aimed/aligned/focused, and with manufacturer's recommended processing applied

B. The architect will perform the acceptance testing during a period scheduled by the architect/general contractor/owner. The minimum expected time is one (1) working day of dedicated quiet.

C. The contractor shall coordinate this time with the architect, general contractor, owner, and all other applicable parties to ensure:

1. A quiet testing environment.
2. Complete access to all areas, equipment, devices, and loudspeakers (including lifts/ladders where required).
3. Adequate work lighting.
4. Availability of electrical power.
5. Portable work surface.
6. If available, coordinate guest access to wireless internet for use during acceptance testing

D. The contractor shall furnish a minimum of two (2) technicians for the duration of the acceptance testing.

E. At the time of acceptance testing the contractor shall have available all approved shop drawings noting any field changes, modifications, and corrections and a copy of the operation maintenance manual for use during the testing and final tuning of the systems.

F. The contractor shall provide the following test equipment for the duration of the acceptance testing.

1. General tools

   a. High impedance multi-meter
   b. Laptop preloaded and connected with all software needed to communicate with equipment onsite.

2. Video tools

   a. Multi-format video signal generator (HDMI, SDI, VGA, et al.)
   b. SDI based multi-format, multi-standard portable waveform monitor
   c. HDMI/VGA EDID reader
   d. Portable ENG monitor with SDI, component, composite, HDMI, DVI, and VGA capabilities.
   e. HDMI/SDI audio embedder and de-embedder for both analog and digital audio signals

3. Network tools

   a. Fluke One Touch Network Assistant (or equivalent) with all adapters for fiber connections and category cable connections.
   b. Optical loss test set
   c. Optical time domain reflectometer (OTDR)

G. The contractor shall be prepared to verify all tests performed as part of the verification test report and assist in the balancing, adjustment, and tuning of all systems.

H. The contractor shall be prepared to make additional modifications to the systems within the scope of the bid specification and as deemed necessary by the architect to meet the design and performance intent of the systems.

I. During the acceptance testing, a punch list will be developed and shall serve as the architect's written acceptance of the contractor's substantial completion.

J. Final acceptance shall be contingent on the satisfactory completion of the items documented in the punch list and delivery and acceptance of the as-built documentation and owner's manuals.

END OF SECTION 274100

SECTION 275120 – AREA OF RESCUE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Furnish, install, and wire all equipment associated with the installation of an Audio-Visual Rescue Assistance Signal System to comply with ADA requirements. This work shall include a main annunciator panel, remote call stations, power supply, outlet boxes, cables and wiring as shown on the drawings and as specified herein.

1.2 SUBMITTALS

A. General: Data sheets on all equipment being provided as well recommended cable types. Internal control cabinet drawings showing internal block diagram connections shall be provided. Wiring diagrams showing typical field wiring connections as well as single line floor plan indicating equipment locations as well as cable routings and quantities.

B. Product Data: Submit product data, including manufacturer's (Spec- Data) product sheet, for specified products.

C. Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage and accessories. Include cabling diagrams, wiring diagrams, station installation details, and equipment cabinet details.

D. Quality Assurance Submittals: Submit the following:

1. Test Reports: Certified test reports showing compliance with specified performance characteristics.
2. Manufacturer's Instructions: Manufacturer's installation instructions.
3. Manufacturer's Field Reports: Manufacturer's field reports specified herein.

E. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance. Include troubleshooting guide, wiring terminal identification and equipment parts list.
2. Warranty: Warranty documents specified herein.

F. Project Closeout

1. A one-year maintenance contract offering continued factory authorized

service of this system shall be provided as part of this contract. Built drawings that include changes to wiring, wiring designations, junction box labeling and other pertinent information shall be supplied upon completion of the project.

2. The contractor shall furnish manufacturer's manuals of the completed system including individual specifications sheets, schematics, inter-panel and intra-panel wiring diagrams.

    a. All information necessary for the proper maintenance and operation of the system must be included.
    b. Provide four copies.

3. As built drawings that include changes to wiring, wiring designations, junction box labeling, and other pertinent information shall be supplied upon completion of the project.
4. Provide a minimum of two (2) hours of in-service training with the system.

    a. These sessions shall be broken into segments that will facilitate the training of the system users in operating station equipment.
    b. Operating manuals and user's guides shall be provided at the time of training.

1.3 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

1. Warranty Period: One year commencing on the Date of Substantial Completion.
2. All materials and installation shall be guaranteed to be free of defects in material and workmanship for one year after final acceptance of installation and tests.

1.4 INSTALLATION STANDARDS

A. The system shall be installed in accordance with the 1993 NEC and ADA requirements.

B. The completed system shall be in compliance with state and local electrical codes.

C. All wiring shall test free from grounds and shorts.

1.5 SYSTEM OPERATIONS

A. Furnish, install and place into operation a Rescue Assistance System for this building

as indicated on the drawings and as specified herein.

B. A common annunciator shall be provided at the main building entrance where shown on the drawings to indicate light and tone signals from multiple remote call stations.

1. When the call station switch is activated, a red LED button illuminates and a one shot tone sounds.
2. When the alarm signal is acknowledged, the remote call station is signaled with a flashing light and tone.
3. Voice communication with the remote call can then be initiated from the annunciator.
4. Optional access to a public telephone system shall be provided when specified.

PART 2 - PRODUCTS (RESCUE ASSISTANCE SYSTEM – AUDIO/VISUAL)

2.1 RESCUE ASSISTANCE-VISUAL EQUIPMENT

A. Manufacturer: The following are acceptable manufacturers and series:

1. Cornell 4200

B. Substitutions:

1. References to manufacturer's model numbers and other information is intended to establish minimum standards of performance, function, and quality.
2. Substitute equipment proposed as equal to equipment specified shall meet or exceed requirements of this section. For equipment other than listed above provide proof that such substitute equipment equals or exceeds features, functions, performance, and quality of specified equipment. This proof shall be provided by submission of a copy of specification with each copy of the submittals that has had each paragraph marked as either compliant or non-compliant along with a letter from engineering manager or product manager at factory that certifies information presented as either compliant or non-compliant including a detailed explanation of each paragraph identified as non-compliant. In order to ensure that the Owner is provided with a system that incorporates required survivability features, this letter shall also specifically certify that the system is capable of complying with the test requirements of this section.

2.2 RESCUE ASSISTANCE-AUDIO/VISUAL SYSTEM AND COMPONENTS

A. Equipment

1. This system shall consist of multiple remote call stations, which will share a common annunciator panel and optional access to a public telephone system for external alarm notification.

B. Annunciator

1. The annunciator panel shall be a CORNELL Model A42XX, with capacity for number of zones required, recessed mounted at the Main Fire Department Entrance to the building.
2. An alternate action switch with internal LED indicator shall be included for each zone.

    a. A yellow LED light on the zone switch shall illuminate and the alarm shall emit a repeating sound if the supervised wiring is faulted.

3. An audible alarm shall be mounted on the annunciator panel, which will emit a minimum sound level of 90 db at 30 cm when a remote station calls.

    a. Depressing the zone switch will answer a zone and open the intercom line to the zone.

4. The front panel shall have silk-screened zone designations and operating directions as well as zone designation strips.
5. The power supply shall be a 120 volt emergency battery backup, CORNELL model B-5243A or P-512243A.
6. The optional, TAK-4200 telephone access kit will place a call to a designated location via a dedicated public telephone line to notify them of the alarm.

C. Remote Call Stations

1. The remote call station shall be CORNELL Model 4201B/V or 4201B/VM, vandal resistant with one momentary switch with LED and loudspeaker.
2. The station shall have hands free voice communication with the annunciator.
3. The station shall have silk-screened operating instructions.
4. The station shall be flush wall mounted on a 2-gang stainless steel plate with a 48" maximum mounting height for forward reach, and a 54" maximum for side reach.

2.3 SOURCE QUALITY

A. Source Quality: Obtain rescue assistance equipment and system from a single manufacturer.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.

3.2 EXAMINAITON

A. Site Verification of Conditions: Verify substrate conditions, which have been previously

installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

3.3 INSTALLATION

A. Cabling Requirements

1. Wiring from the annunciator to the call station shall be CORNELL CB-4200 custom cable.
2. Wiring from the annunciator to the power supply shall be 18- gauge, 2 conductor.
3. Verify cable types with the Rescue Assistance System Manufacturer.
4. The optional telephone access kit requires a 120V AC outlet and dedicated external telephone line.

B. Rescue Assistance Signal System - Audio/Visual Installation

1. Complete system shall be installed in strict accordance with manufacturer's recommendations.
2. Wiring shall be installed in raceways throughout the building.

    a. Conduit, if required, shall be 1/2" minimum.

3.4 FIELD QUALITY REQUIREMENTS

A. Site Tests (Post Installation Testing): Checkout final connections to the system shall be made by a factory technician authorized by the manufacturer of the products installed.

1. Factory authorized technicians shall demonstrate operation of the complete system and each major component to the staff.
2. System field wiring diagrams shall be provided to this subcontractor by the system prior to installation.

B. Inspection: Perform a complete functional test of the system upon completion of the installation and instruct the staff in the operation and maintenance of the system.

3.5 CLEANING

A. Cleaning: Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 275120

SECTION 282000 – VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes

1. Basic Requirements for surveillance system rough-ins and cabling

1.2 REFERENCES:

1.3 DELIVERY, STORAGE AND HANDLING:

A, Deliver materials in manufacturer's original, unopened, undamaged packaging; and unharmed original identification labels.

B. Protect stored materials from environmental and temperature conditions following manufacturer's instructions.

C. Handle and operate products and systems according to manufacturer's instructions for installation, environmental, mechanical or electrical requirements and within thermal stress limits.

D. Ensure conformance with operating limitations according to applicable data sheet.

PART 2 – PRODUCTS

2.1 SYSTEM COMPONENTS:

A. Cameras & headend equipment will be provided by Southern University.

B. CAT 6A cabling, raceways, terminations shall be provide by electrical contractor.

PART 3 – EXECUTION

3.1 EXAMINATION:

A. Examine areas to receive devices and identify adverse conditions affecting installation or subsequent operation.

B. Do not begin installation until unacceptable conditions are corrected. Non-compliance with security instructions may result in loss of data. Ensure environmental, mechanical and electrical requirements are met.

3.2 INSTALLATION:

A. Provide CAT 6A cable to each camera shown. Route cable to nearest IDF or MDF. Provide RJ45 female connector at camera end.

B. Rough-in requirements:

1. Cameras in Accessible Ceilings: Leave camera end of data drop coiled in ceiling space above camera location with 10' of slack and terminated with Panduit CBX1WH-A surface mount box. Provide minimum 5' long Cat 6A jumper from data drop end for connection to the camera. The jumper shall be terminated at the camera end with an RJ45 male connector. For all data cable termination points in accessible ceilings, provide a label on the ceiling with 1/8" size lettering listing the camera number.
2. Cameras on Non-accessible Ceilings (Hard Ceilings) and Walls: At the camera location provide a recessed rough-in J box with single gang opening. Provide a ¾" conduit from the J box to nearest accessible ceiling in the direction of the nearest data rack. Leave the camera end of the data drop coiled in the accessible ceiling space at the end of conduit with minimum 10 ft of slack and terminate with Panduit CBX1WH-A surface mount box. Provide and install a Cat 6A data cable jumper from the connector on the end of the data drop in the accessible ceiling through the conduit to the camera J box leaving as much slack as will fit in the box. The jumper shall be terminated at the camera end with an RJ45 male connector. Connect the jumper to the data drop connector in the accessible ceiling space. The installation of the connector on the camera end of the jumper will be by the camera installer. Provide a blank coverplate over the box for the camera in case a camera is not installed with the initial construction.
3. Exterior Cameras: Provide a 1/2" sleeved conduit from the camera to the nearest accessible ceiling space. Terminate the conduit end at the camera with a sleeved and sealed exterior wall penetration as close to the camera as possible in the least visible location. Provide a grommeted opening on both ends of the conduit to protect cable from snagging. Provide and install outdoor-rated section of Cat 6A data cable jumper from the connector on the end of the data drop in the accessible ceiling through the conduit to the camera leaving 10' of unterminated slack at the accessible ceiling end. The jumper shall be terminated at the camera end with an RJ45 male connector. Connect the jumper to the data drop connector in the accessible ceiling space. Protect the exterior exposed end of the cable from the weather. Installation of the connector on the exterior end of the jumper will be by the camera installer.
4. Cameras in Elevator Cabs: The data drop for an elevator cab camera shall be provided in the elevator shaft with 10 ft of slack coiled at the top of the shaft. On top of the elevator car, the electrical contractor shall provide a quad receptacle connected to the elevator 120V power.

5. Cameras on Exterior Poles: Provide & install a 16"x14"x8" NEMA 4X non- metallic, padlockable, box with galvanized backplate at base of pole to house camera and radio equipment. Bottom of box shall be approximately 24" above grade and shall not obstruct handhole. For round poles, mount the box to the pole using a U-bolt arrangement wrapped around the pole connecting to two minimum horizontal unistrut supports on the back of the box. Paint the box and all associated mounting hardware to match the pole color. Provide an unswitched 120V power circuit to a fourplex receptacle in a separate device box within the overall box. Provide two stacked 1/2" bushed nipples through the back of the box into the pole (bottom for power, top for data). Power conductors are to go directly into the receptacle device box and are not to be exposed inside the overall box. Provide a new ground rod at the pole with a solid #6 connection form it to the receptacle equipment grounding conductor. Install 2 black exterior-rated Cat6A data cables from the box thru the pole to a ½" grommeted opening made near the top of the pole. Data cables will be terminated by others. Seal all openings for a watertight installation. Camera and radio equipment are to be provided by Southern University.

END OF SECTION 282000

SECTION 283100 - FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 INCLUDED IN THIS SPECIFICATION

A. Provide a complete fire alarm system per this project's plans and specifications. The system shall include a state-of-the-art, software-based control panel using addressable and analog type initiating devices and be capable of voice evacuation capabilities.

1.2 REFERENCES

A. Electrical Industries Association (EIA):

1. RS-232-D – Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
2. RS-485 – Electrical Characteristics of Generators and Receivers for Use in Balanced Multipoint Systems

B. National Fire Protection Association (NFPA):

1. NFPA 12 – Standard on Carbon Dioxide Extinguishing Systems.
2. NFPA 13 – Installation of Sprinkler Systems.
3. NFPA 15 – Standard for Water Spray Fixed Systems for Fire Protection.
4. NFPA 16 – Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems.
5. NFPA 16A – Standard for the Installation of Closed Head Foam-Water Sprinkler Systems.
6. NFPA 70 – National Electrical Code (NEC).
7. NFPA 72 – National Fire Alarm Code 2010 Edition
8. NFPA 90A – Standard for the Installation of Air Conditioning and Ventilating Systems.
9. NFPA 101 – Life Safety Code 2012 Edition
10. NFPA 750 – Standard on Water Mist Fire Protection Systems.
11. NFPA 5000 – Building Construction and Safety Code.
12. IBC Chapters 9 & 10 2012 Edition
13. ADAAG Americans with Disabilities Act Application Guidelines

C. Fire Alarm Control Panel Equipment: System shall comply with applicable provisions of the following UL standards and classifications:

1. UL 864 9th Edition
2. UOJZ, Control Units, System.
3. SYZV Control Units, Releasing Device.
4. UOXX, Control Unit Accessories, System.

D. The Fire Alarm Control Panel's U.L. Listed signaling types shall be:

1. Digital alarm communicator
2. Other Technology

1.3 SUBMITTALS

A. Equipment Submittal Brochures:

1. Provide minimum 10 copies of submittal brochures and shop drawings.
2. Submittal brochures shall be bound my means of 3 ring binders, binding combs or similar. Stapled brochures will be rejected.
3. Provide one submittal brochure in color, highlighted and reserved for use by the Louisiana State Fire Marshal Plan Review Office. This copy shall become the record copy for the project.
4. Include a cover page that indicates the following minimal information:

    a. Project name and address.
    b. Engineered systems distributor's name and contact information.
    c. Installing contractor's name and contact information.
    d. The date of the equipment submittals and date of any subsequent required re-submittals. Indicate on revised submittals the original submittal date and re-submittal date.
    e. Architectural project review number assigned by the Louisiana State Fire Marshal's Office.

5. Provide a Scope of Work Narrative describing the system's basic operating premise in written word.
6. Provide a detailed Sequence of Operation Matrix Grid tailored for this project indicating the cause and effect of all fire alarm system control panels, input and output functions.
7. Include a system bill of material prepared specifically for this project. Include the make, model, description, quantity and manufacturer for every component to be installed in the project.
8. Provide manufacturer's data sheet for each component to be installed in the project. For data sheets that include multiple part numbers, options and accessories, the components included or pertinent to this project shall be highlighted in yellow.
9. Include the U.L. (Underwriters Laboratories) Certification for each component to be installed in the system. The U.L. Certification shall be placed directly behind its corresponding data sheet.
10. Manufacturers device compatibility documentation shall be included proving testing and operational compatibility between control panels and peripheral devices.
11. Separate battery calculations shall be provided for each control panel and prepared on manufacturer's official worksheets.

B. Shop Drawings

1. Shop drawings shall be prepared with the contractor's own title block which shall include:

a. Project name and address.
b. Contractor's name, address and phone number.
c. Date.
d. Drawing pages shall be numbered.
e. Bound with spines and stapled.
f. Floor plan scale.
g. Louisiana State Fire Marshal architectural assigned project number.
h. Revision number with re-submittal dates.

2. Drawings shall contain one floor per page. If a floor must be split use match lines and references that refer sheet number to match lines.
3. Floor plan shop drawings shall be prepared in AutoCAD.
4. Prepare floor plans to a 1/8" = 1'-0" scale unless directed otherwise by the architect.
5. Show all equipment, control panels, and device locations.
6. Include a distinct address for every device including panels, initiating, notification, auxiliary, and peripheral devices. All visual notification appliances shall have their candela indicated.
7. Floor plans shall include the following:

   a. Door swings.
   b. Room names and numbers.
   c. Reflected ceiling plan overlay.
   d. Ceiling heights.
   e. Fire and smoke barriers.
   f. Office furnishings when available.

8. Include a symbol schedule of devices for this project.
9. Include the necessary details and general notes for mounting heights, device placement restrictions, etc.
10. End-of-line symbols shall be shown on the floor plans.
11. Riser locations shall be indicated on the floor plan by a bold circle.
12. A detailed riser shall be provided as part of the shop drawings. The riser shall include:

    a. Control panels, power supplies, annunciators, demark cabinets, each identified with its own address and description matching the symbol schedule.
    b. Operating power requirements with breaker panel and breaker number identification.
    c. All system circuits including initiating, notification, SLC, power, control, monitor, network, audio, riser, fiber optic, phone, category cable and auxiliary circuits. Circuits shall be individually addressed indicating wire type, size, quantity and color.
    d. Provide a point to point diagram of every system device on its riser circuit using the exact device symbol as the floor plan. Provide the corresponding device address and candela rating next to each device.
    e. Provide the cumulative current draw at the end of each notification appliance circuit.
    f. Indicate location and placement of surge suppressors.

g. Provide detail circuit diagrams for connections with systems from other trades.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name, number and manufacturer.

B. Store materials in clean, dry area indoors in accordance with manufacturer's instructions.

C. Protect materials from damage during handling and installation.

1.5 WARRANTY

A. Contractor shall warranty material and installation against defects in manufacturing and workmanship for a period of one year beginning on the date of final acceptance of the project. Warranty related service calls shall be provided at no charge during the contractor's normal working hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following are acceptable manufacturers and series for control panels. No substitutions are allowed.

1. EST4 Series
2. Gamewell E3 Series

B. References to manufacturer's model numbers and other information is intended to establish minimum standards of performance, function, and quality. No other manufacturers, other than those listed will be considered for use on this project.

C. Substitute equipment proposed as equal to equipment specified shall meet or exceed requirements of this section. For equipment other than Gamewell-FCI S3 Series provide proof that such substitute equipment equals or exceeds features, functions, performance, and quality of specified equipment. This proof shall be provided by submission of a copy of specification with each copy of the submittals that has had each paragraph marked as either compliant or non-compliant along with a letter from engineering manager or product manager at factory that certifies information presented as either compliant or non-compliant including a detailed explanation of each paragraph identified as non-compliant. In order to ensure that the Owner is provided with a system that incorporates required survivability features, this letter shall also specifically certify that the system is capable of complying with the test requirements of this section.

2.2 FIRE ALARM SYSTEM

A. Control Panel shall be EST4 or Gamewell E3 Series with integral audio controls inside the cabinet.

2.3 CONTROL PANEL

A. System Cabinet

1. Shall be all metal with a textured finish suitable for surface or semi-flush mounting. Cabinets containing anything non-metal are not acceptable.
2. Front door of steel construction with lockout or dead-front inner door of steel construction to conceal internal circuitry and wiring.
3. Cabinet shall be capable of housing 12 amp hour batteries.
4. Cabinet shall be pre-fabricated to accept all available internal circuitry. Installations with loosely hanging internal panel components will not be accepted.

B. Main Power Supply

1. Shall incorporate the latest power-saving switching technology using no step-down transformers.
2. Shall provide minimum 7 amps of continuous rated output to supply all necessary power under normal and emergency conditions.
3. Shall include an internal battery charger capable of charging up to 55 amp hour batteries while under full load.

C. Batteries

1. Provide U.L. Listed batteries of sufficient capacity to provide power for the entire system automatically upon loss of AC power for a period of 24 hours with 15 minutes of alarm signaling at the end of the 24 hour period.
2. Battery connectors shall be the exact size and type required for the standby battery posts or tabs.
3. Connect batteries to the main panel with minimum 14 AWG stranded hook up wire. Red for positive and black for negative. Use fully insulated crimp style connectors.

D. Battery Cabinets

1. Provide U.L. listed metal battery cabinet and enclosures with key lockable door for installations requiring batteries too large to be housed in control panels.
2. Battery cabinet shall be textured painted to match the control panel it is housing the batteries for.

E. Display

1. Main control panel shall include a color touch screen display for user interface.
2. Display shall be capable of a minimum 200 characters.
3. The touch screen communications shall be textual RS-485 based with the capability of being mounted locally or remotely.

4. The display shall provide both audible and visual annunciation of all system events.
5. Separate LED's shall be dedicated for:

    a. AC (normal power): Green
    b. Fire: Red
    c. Hazard: Blue
    d. Supervisory: Yellow
    e. Trouble: Yellow
    f. Silenced: Yellow

6. Pre-programmed keys shall be on board for:

    a. Menu
    b. Fire Drill
    c. System Reset

7. Display shall contain a minimum 5 keys that can be custom programmed for system functions
8. The display shall be suitable to be remotely installed as a remote annunciator up to 3,000 feet away from the main CPU cabinet. The remote display shall be available with a manufacturer's custom metal cabinet suitable for surface or semi flush installation complete with a lockable see through door and textured finish matching the main control cabinet.

F. Main System CPU

1. System CPU shall incorporate a 32-bit RISC multiprocessor design on a single circuit board. An isolated watchdog circuit shall monitor the microprocessor and shall activate system trouble on the display upon any failure. The system program shall not be lost upon any loss of power. The CPU software shall support control-by-event (CBE) programming using Boolean logic including AND, OR, NOT, XOR and TIMING functions to provide complete custom programming flexibility. An auto programming option shall be available where only devices that are present on the SLC shall activate.
2. System shall be programmed via the manufacturer's proprietary field configuration program (FCP), allowing the project configuration custom programming to be uploaded and downloaded via a portable laptop computer at the project.
3. An RJ-45 Ethernet port shall be provided to accept downloaded programs from a portable computer, or provide 80-column readout of all alarms, troubles, location descriptions, time, and date. Communication shall operate at 10/100 speeds.
4. An on-board supervised RS-232C Serial Output shall be included to operate remote printers and video terminals.
5. The system CPU shall include an on-board supervised RS-485 Serial Output for connection and communication to system modules. The RS-485 port shall allow for communication with remote annunciator modules up to 3,000' from the cabinet.
6. Smoke detector alarm verification shall be a standard software option while allowing other devices such as manual stations and sprinkler flow to create

immediate alarms. This feature shall be selectable for smoke sensors that are installed in environments prone to nuisance or unwanted alarms.

7. Standard software shall provide for the analog drift compensation of smoke detectors allowing each smoke detector to automatically adjust its sensitivity to accommodate changes caused by the effects of component aging or its surrounding environment including dust. Each sensor shall maintain its actual sensitivity under adverse conditions to respond to alarm conditions while ignoring factors which generally contribute to nuisance alarms. System trouble circuitry shall activate, display smoke detectors that require cleaning and maintenance.
8. System software shall automatically test each analog smoke sensor a minimum of 3 times daily. Test shall be a recognized functional test of each photocell (analog photoelectric sensors) and ionization chamber (analog ionization sensors) as required annually by NFPA 72. Failure of sensor test shall activate system trouble circuitry, display "Test Failed" indication, and identify individual device that failed.
9. The system control panel shall be capable of setting any detector or sensor into Positive Alarm Sequence mode. Positive Alarm Sequence will operate in the following manner. Any alarms received from a device will activate an alarm at the control panel but will not execute any output functions (e.g. turning on the strobes or fire horns). The operator has 30 seconds to "acknowledge" the event or the system will activate a general alarm and sound all the fire horn and strobes. If the operator does acknowledge the vent within thirty (30) seconds, the panel will start a timer for 180 seconds (3 minutes) in which time the operator must find the device in alarm and reset the device. If the operator has not performed a reset within 180 seconds or a second device reports an alarm, the system will immediately sound the general alarm.
10. The CPU display shall have the option of being configured as an additional remote annunciator. This annunciator shall be mounted in its own metal cabinet with lockable door.
11. The CPU shall maintain a 4100 event history log. The log shall be maintained upon loss of any power.
12. 24 volt D.C. power-limited 1 amp outputs shall be provided for both resettable and non-resettable power. The outputs shall be screw terminal on board the CPU board.
13. Manufacturer's standard software shall accommodate a 1 man walk test feature.

G. Signaling Line Circuits

1. Provide 1 SLC loop for this project. Projects including more than 1 floor shall include a second SLC loop. Each SLC shall be capable of being wired Class B Style 4 or Class A Style 6 and shall operate in NFPA Style 7 configuration when equipped with isolator modules.
2. Each SLC shall accommodate a maximum 159 analog sensors and 159 monitor/control devices.

H. Notification Appliance Circuits

1. The CPU shall include a minimum 4 on-board polarized NAC circuits rated at 2 amps DC each. Each NAC shall be capable of being wired Class B, Style Y or Class A, Style Z.

I. Dry Contacts

1. Form C dry contacts with a 2 amp at 30VDC resistive rating shall be included on-board the CPU for alarm, trouble and supervisory events.

J. DACT

1. Fire alarm control panel shall include a Digital Alarm Communicator Transmitter (DACT) for signaling to central station. DACT shall contain "Dialer-Runaway" feature preventing unnecessary transmissions as result of intermittent faults in system and shall be Carrier Access Code (CAC) compliant, accepting up to 20-digit central station telephone numbers. Fire department shall be consulted as to authorized central station companies serving municipality. Fire alarm system shall transmit both alarm and trouble signals, with alarm having priority over trouble signal. Contractor shall be responsible for all installation charges and Owner will be responsible for line lease charges
2. DACT shall be a U.L. listed internal component of the main control panel and shall be capable of transmitting specific detailed point by point system events to the monitoring station.
3. Systems using external standalone digital communicators will not be accepted.

K. Cellular/IP COMMUNICATOR

1. Provide a dual path commercial fire communicator as part of this project.
2. Acceptable manufacturers:
3. Fire-Lite Alarms Model IPGSM-4G by Honeywell. All equipment must be available "over the counter" through security equipment distributor network markets and can be installed by dealerships who are independent of the manufacturer. No substitutions allowed.
4. The central station's supervisory equipment shall be Honeywell's AlarmNet Network Control Center.
5. Contract the services of a monitoring company sub-contractor or distributor to provide, program the communicator and provide monitoring of the system.
6. The communicator shall use the internet or GSM cellular network as a primary transmission format.
7. IPGSM-4G Communicator is connected to any Fire Alarm Control Panel DACT telephone ports, the system shall be capable of transmitting Contact ID formatted alarms, supervisory or troubles to a Honeywell's AlarmNet Network Control Center equipped with a Honeywell AlarmNet receiver via Ethernet over a private or public WAN/LAN, Intranet or Ethernet.
8. The IPGSM-4G Communicator shall include connections to the Fire Alarm Control Panel's phone outputs and shall convert the contact ID protocol into Ethernet Packets.
9. The IPGSM-4G Communicator shall be completely field-programmable locally from a 7720P Programming Tool.
10. The IPGSM-4G Communicator shall be capable of transmitting events in contact ID format.
11. Communication shall include vital system status such as:

    a. Independent Zone (Alarm, trouble, non-alarm, supervisory)
    b. Independent Addressable Device Status
    c. AC (Mains) Power Loss
    d. Low Battery and Earth Fault

e. System Off Normal
f. 24 Hour Test Signal
g. Abnormal Test Signal (per UL requirements)

12. The IPGSM-4G Communicator shall support independent zone reporting via the Contact ID format. This format shall enable the central station to have details concerning the location of the fire for emergency response. The IPGSM-4G Communicator shall be capable of providing simulated phone lines to the Fire Alarm Control Panel. The IPGSM-4G Communicator shall communicate over IP or GSM primary and shall be transparent to the Fire Alarm Control Panel normal operation over phone lines.

2.4 PRINTERS

A. A printer shall not be required for this project.

2.5 SUPPLEMENTARY NOTIFICATION APPLIANCE POWER SUPPLIES

A. The following are acceptable manufacturers and series for supplementary notification appliance circuit power supplies. No substitutions are allowed. It is the intent of this specification that all notification equipment must be available over the counter through security equipment distributor network markets

1. APS6 of APS10 with the appropriate amp.

B. The supplementary NAC power supply shall offer up to 6.0 amps continuous regulated 24-volt power. The power supply shall include the following features:

1. Integral Charger: Charge up to 35.0 amp-hour batteries and support 60-hour standby.
2. 2 Input Triggers. Input trigger shall be Notification Appliance Circuit (from fire alarm control panel) or supervised addressable relay.
3. Surface-mount back box.
4. Ability to delay AC fail delay in accordance with applicable NFPA requirements.
5. Power limited circuitry in accordance with applicable UL standards.
6. Operates as sync follower or a sync generator.
7. Shall have on-board built in sync capability for System Sensor and Wheelock brand appliances.

C. Do not exceed 75% of the power supply's available listed current. Provide the necessary quantity of power supplies to satisfy this requirement with the quantity of devices indicated on the plans.

2.6 VOICE EVACUATION PANEL

A. Provide a standalone voice evacuation panel from one of the approved manufactures:

1. Edwards

2. Honeywell

B. The voice evacuation panel shall be a single assembly complete with metal lockable enclosure, power supply, amplifier, audio controller board and supervised hand-held microphone.

C. Provide a system with 4 on-board circuits capable of supervising U.L. listed speakers.

D. The amplifier shall provide a minimum of 50 watts of output power on either 25 or 70.7 Vrms circuits.

E. The panel shall support a minimum of two pre-recorded messages and have the capability of adding application specific messages through the use of a P.C.

F. The system audio notification emergency message shall initiate automatically from a supervised D.C. polarity reversing fire alarm notification appliance circuit.

G. The power supply shall be capable of charging up 18 amp hours batteries.

H. The audio controller board shall be complete with form C dry trouble and alarm contacts, and LED's for the following:

1. Speaker circuit trouble
2. Alarm
3. Microphone trouble
4. Ground fault
5. Low battery
6. Power fail

I. The system shall be available with a U.L. listed remote microphone accessory manufactured for the system.

2.7 SYSTEM PERIPHERALS

A. Every devices address shall be set by means of a rotary-decimal switch using a standard screwdriver. Devices using or requiring binary switches, handheld device programmers or addressed only through software mapping shall not be acceptable.

B. Smoke detectors

1. Shall be fully listed and compatible with the furnished system.
2. Each detector shall be provided with 2 status LEDs that shall flash under normal conditions and remain steady during alarm conditions.

C. Pull Stations

1. Shall be fully listed and compatible with the furnished system, dual action, and constructed of Lexan with clearly visible operating instructions provided on cover. The word FIRE shall appear on front of stations in raised letters.
2. Stations shall be designed so after actuation they cannot be restored except by key reset.

3. Stations shall be keyed alike with the fire alarm control panel and NAC power supply.
4. Surface boxes shall be available as an option from the manufacturer.
5. Pull stations shall not utilize glass rods.

D. Duct Detectors

1. Duct detectors shall be System Sensor DNR or DNRW Series housings.
2. Housings and all the related accessories listed below shall be provided for the each of the following:

    a. On the ductwork of every supply branch of every HVAC air handling/rooftop unit exceeding 2,000 CFM
    b. On the ductwork of every return branch of HVAC air handling/rooftop unit exceeding 2,000 CFM. Where duct detectors cannot be practically or effectively installed on return ductwork, securely fasten the duct detector on the side of the AHU and install and secure its sampling tube across the front of the return air filter.
    c. On every shown smoke and fire/smoke damper. Where duct detectors cannot be practically installed on dampers consult with the general contractor to coordinate their installation with other trades.

3. The housing shall include the listed addressable photoelectric smoke detector head which shall twist in and lock inside the housing.
4. Provide System Sensor DST Series sampling tube of enough length to extend 75% of the width of the duct it is being installed in. Sampling tubes in ducts exceeding widths of 6 feet shall exceed and install across the entire width of the duct and be supported by drilling a hole in the opposite side of the ductwork.
5. A System Sensor model RTS151KEY module shall be installed for each duct detector. Provide phenolic labels identifying the related HVAC unit it is connected to. The RTS151KEY module shall mount in a standard single gang electrical box. Verify and coordinate location of RTS151KEY modules with architect.
6. Provide one addressable relay module for each HVAC required function including:

    a. AHU Shutdown
    b. Smoke damper operation
    c. Smoke sequence/exhaust/pressurization operations

7. System designs incorporating hardwired, conventional relays for any mechanical functions are not allowed and will be subsequently rejected.

E. Thermal Detectors

1. Shall be listed and compatible with the furnished system.
2. Detector shall be rated at 135 degrees and shall have rate of rise element rated at 15 degrees per minute.

F. Addressable Monitor Modules

1. Where required provide addressable monitor modules to monitor normally open dry contacts from other non-addressable equipment.
2. Module shall be suitable for installation on a standard 4" square electrical box 2-1/8" deep and shall include the manufacturer's matching cover plate.
3. An LED shall be visible on the outside of the module's cover plate and shall flash under normal conditions and remain on steady when it's connected device is in alarm.
4. Modules not suitable for mounting directly onto a 4" square electrical box or those which wire with pigtail type connectors are not acceptable.

G. Supervised Addressable Output Module

1. Provide addressable supervised output module where required for the project to provide a supervised, programmed 24volt DC reverse polarity output.
2. Module shall be suitable for installation on a standard 4" square electrical box 2-1/8" deep and shall include the manufacturer's matching cover plate.
3. An LED shall be visible on the outside of the module's cover plate and shall flash under normal conditions and remain on steady when the module is activated.

H. Addressable Relay Output Module

1. Provide addressable modules suitable for installation on a standard 4" square electrical box 2-1/8" deep and shall include the manufacturer's matching cover plate.
2. The module shall provide two isolated sets of Form-C normally open and normally closed contacts
3. Contact ratings shall be rated at minimum 2.0 amps resistive or 1.0 amp inductive
4. An LED shall be visible on the outside of the module's cover plate and shall flash under normal conditions and remain on steady when the module is activated.

I. Audio Visual Notification Appliances

1. Shall be System Sensor SpectrAlert Advance Series listed for use on both wall and ceiling as indicated on the plans.
2. Provide devices white in color with red FIRE screened on device from manufacturer.
3. Audio visual devices shall be one complete assembly utilizing a speaker for audible notification for this project.
4. The device shall be suitable for mounting on standard electrical boxes using the manufacturer's universal mounting plate. The strobe device shall snap into the mounting plate and secured by one fastener.
5. The manufacturer's mounting plate shall include screw terminals to accept all field wiring.
6. Candelas shall be selectable in settings of 15, 15/75, 30, 75, 95, 110, 115, 135, 150, 177 and 185.
7. The strobe shall be listed to U.L. 1971 standards and meet all current ADAAG Guidelines.
8. The system shall utilize speakers for audible alarm notification. The speakers shall be listed to UL 1480 for Fire Protective Signaling Systems. It shall be a dual-voltage transformer speaker capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz. The speaker shall be

capable of mounting to a standard 4x4x2 1/8 electrical box. The speaker shall have power taps from ¼ watt to 2 watts and voltage output selectable via rotary switches. The speaker shall have a maximum sound output of 86 dB at 10 feet. Provide System Sensor Spectralert SPS Series speakers and speaker strobe devices.

9. Provide manufacturer's surface mount and weatherproof backboxes where required.

2.8 WIRE AND CABLE

A. The following are acceptable manufacturers:

1. Windy City Wire
2. General Cable

B. Cable shall be approved for plenum use without conduit per the NFPA 262 Flame Test

C. Cable shall be approved per NEC 800, 760; UL, CMP, FPLP UL, RoHS Complaint

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive fire alarm system.

1. Notify Architect of conditions that would adversely affect installation or subsequent use.
2. Do not begin installation until unacceptable conditions are corrected.

3.2 INSTALLATION

A. Install fire alarm system in accordance with NFPA 72, NFPA 70, state and local codes, manufacturer's instructions, and as indicated on the Drawings.

B. Conceal conduit, junction boxes, and conduit supports and hangers in finished areas. Conceal or expose conduit, junction boxes, and conduit supports and hangers in unfinished areas.

C. Do not install smoke detectors before system programming and test period. If construction is ongoing during this period, take measures to protect smoke detectors from contamination and physical damage.

D. Flush-mount fire detection and alarm system devices, control panels, and remote annunciators in finished areas. Flush-mount or surface-mount fire detection and alarm system devices, control panels, and remote annunciators in unfinished areas.

E. Ensure manual stations are suitable for surface mounting or semi-flush mounting as indicated on the Drawings. Install not less than 42 inches, not more than 48 inches, above finished floor measured to operating handle.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide service of competent, factory-trained technician authorized by manufacturer to technically supervise and participate during pre-testing and acceptance testing of system.

B. Testing:

1. Conduct complete visual inspection of control panel connections and test wiring for short circuits, ground faults, continuity, and insulation before energizing cables and wires.
2. Close each sprinkler system control valve and verify proper supervisory alarm at Control Panel.
3. Verify activation of flow switches.
4. Open initiating device circuits and verify that trouble signal actuates.
5. Open signaling line circuits and verify that trouble signal actuates.
6. Open and short notification appliance circuits and verify that trouble signal actuates.
7. Ground initiating device circuits and verify response of trouble signals.
8. Ground signaling line circuits and verify response of trouble signals.
9. Ground notification appliance circuits and verify response of trouble signals.
10. Check installation, supervision, and operation of intelligent smoke detectors.
11. Introduce on system each of the alarm conditions that system is required to detect. Verify proper receipt and proper processing of signal at Control Panel and correct activation of control points.
12. Consult manufacturer's manual to determine proper testing procedures when system is equipped with optional features. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality, and similar.

C. Acceptance Testing:

1. Before installation shall be considered completed and acceptable by AHJ, a complete test using as a minimum, the following scenarios shall be performed and witnessed by representative approved by Engineer. Monitoring company and/or fire department shall be notified before final test in accordance with local requirements.
2. Contractor's job foreman, in presence of representative of manufacturer, representative of Owner, and fire department shall operate every installed device to verify proper operation and correct annunciation at control panel.
3. Open signaling line circuits and notification appliance circuits in at least 2 locations to verify presence of supervision.
4. When testing has been completed to satisfaction of both Contractor's job foreman and representatives of manufacturer and Owner, a notarized letter co-signed by each attesting to satisfactory completion of said testing shall be forwarded to Owner and fire department.
5. Leave fire alarm system in proper working order and, without additional expense to Owner, replace defective materials and equipment provided within 1 year (365 days) from date of final acceptance by the owner.

3.4 DEMONSTRATION

A. Provide instruction as required for operating fire alarm system.

END OF SECTION 283100

SECTION 31 00 00 - EARTHWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Protection, modification and/or installation of utilities as sitework progresses paying particular attention to grade changes and any necessary staging of work.

B. Cutting, filling and grading to required lines, dimensions, contours and proposed elevations for proposed improvements.

C. Scarifying, compaction, drying and removal of unsuitable material to ensure proper preparation of areas for fills or proposed improvements.

1.2 RELATED SECTIONS

A. Section 31 11 00 - Site Preparation

B. Section 31 23 16 - Excavation, Backfill and Compaction for Pavement

C. Section 31 23 33 - Excavation, Backfill and Compaction for Utilities

D. Construction Drawings

1.3 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM) latest edition. D 422 Method for Particle Size Analysis of Soils

D 698	Test for Moisture-Density Relations of Soils Using 5.5 lb. (2.5 kg) Rammer and 12-inch (304.8 mm) Drop (Standard Proctor)
D 1556	Test for Density of soil in Place by the Sand Cone Method
D 1557	Test for Moisture-Density Relations of Soils Using 10-lb (4.5 Kg) Rammer and 18-inch (457 mm) Drop (Modified Proctor)
D 1559	Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
D 2167	Test for Density of Soil in Place by the Rubber Balloon Method
D 2216	Laboratory Determination of Moisture content of Soil D 2487 Classification of Soils for Engineering Purposes
D 2922	Tests for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth)
D 3017	Test for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
D 4318	Test for Plastic Limit, Liquid Limit, and Plasticity Index of Soils
C 25	Chemical Analysis of Limestone, Quicklime and Hydrate Lime
C 110	Physical Testing for Quicklime and Hydrated Lime, Wet Sieve Method
C 618	Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
C 977	Quicklime and Hydrated Lime for Soil Stabilization

B. American Association of State Highway and Transportation Officials (AASHTO) latest edition

T 88	Mechanical Analysis of Soils

1.4 QUALITY ASSURANCE

A. Independent Testing Laboratory selected and paid by owner, shall be retained to perform construction testing on site. Frequency of tests will be as follows:

1. In cut areas: Not less than one compaction test for every 5,000 square feet.
2. In fill areas: Same rate of testing for each 8" lift (measured loose).

B. If compaction requirements are not complied with at any time during construction process, remove and recompact deficient areas until proper compaction is obtained at no additional expense to owner.

C. The following tests shall be performed on each type of on-site or imported soil material used as compacted fill as part of construction testing requirements.
   1. Moisture and Density Relationship: ASTM D 698 or ASTM D1557.
   2. Mechanical Analysis: AASHTO T-88
   3. Plasticity Index: ASTM D 4318

D. Field density tests for in-place materials shall be performed according to one of the following standards as part of construction testing requirements.
   1. Sand-Cone Method: ASTM D 1556
   2. Balloon Method: ASTM D 2167
   3. Nuclear Method: ASTM D 2922 (Method B-Direct Transmission)

E. Independent Testing Laboratory shall prepare test reports that indicate test location, elevation data, and test results. Owner, landscape architect, and contractor shall be provided with copies of reports within 96 hours of time test was performed. In event that any test performed fails to meet these Specifications, owner and contractor shall be notified immediately by independent testing laboratory.

F. All costs related to retesting due to failures shall be paid for by the contractor at no additional expense to owner. Owner reserves the right to employ an Independent Testing Laboratory and to direct any testing that is deemed necessary. Contractor shall provide free access to site for testing activities.

1.5 SUBMITTALS

A. Submit a sample of each type of off-site fill materials that is to be used at the site in an air tight, 10 lb container for the testing laboratory.

B. Submit the name of each material supplier and specific type and source of each material. Any change in source throughout the job requires approval of the owner or engineer.

C. For use of fabrics or geogrids, a sample and "cut sheet" shall be submitted for approval by the Owner and Landscape Architect.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP, or AASHTO M 145 soil classification groups A-1, A-2-4, A-2-5, and A-3. See specifications 029300 for topsoil description.

B. Backfill and Fill Materials shall be those satisfactory soils, inactive, with a maximum plasticity index (PI) of 15, free of rock or gravel larger than two (2) inches in any dimension, debris, vegetation or other deleterious materials.

C. Granular Fill shall be a washed, evenly graded mixture of crushed stone, or crushed gravel with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

D. Excavated and re-used material for subsoil fill as specified herein (outside limits of pavement only).

E. Imported select material - sandy clay having a PI of 4 to 15, a maximum LL of 35, and less than 60% passing #200 sieve.

F. Acceptable stabilization fabrics and Geogrids:
   1. Mirafi 500X or 600X
   2. Phillips 66 Supac 6WS

3. Dupont Typar 3401 and 3601

PART 3 - EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, contours and datum.

B. Locate and identify existing utilities that are to remain and protect them from damage.

C. Notify utility companies to remove and/or relocate any utilities that are in conflict with the proposed improvements.

D. Protect plant life, lawns, fences, existing structures, sidewalks, paving and curbs from excavating equipment and vehicular traffic.

E. Protect benchmarks, property corners and all other survey monuments from damage or displacement. If a marker needs to be removed it shall be referenced by a licensed land surveyor and replaced, as necessary, by the same.

F. Remove from site material encountered in grading operations that, in opinion of owner, is unsuitable or undesirable for backfilling, subgrade or foundation purposes. Dispose of in a manner satisfactory to owner. Backfill areas with layers of suitable material and compact as specified.

G. Prior to placing fill in low areas, such as previously existing ditches, perform following procedures:
   1. Drain water out by gravity with ditch having flow line lower than lowest elevation in low area. If drainage cannot be performed by gravity ditch, use adequate pump to obtain same results.
   2. After drainage of low area is complete, remove mulch, mud, debris, and other unsuitable material by using acceptable equipment and methods that will keep natural soils underlying low areas dry and undisturbed.
   3. If material is found to be unsuitable, all unsuitable material shall be removed from site.

3.2 EXCAVATION

A. Excavate for trenches to the depth indicated or otherwise required and to establish indicated flow lines or invert elevations. Maintain uniform width required for particular item to be installed, including width to provide ample working room.

B. Cut existing ground under pavement areas to comply with cross-sections, elevations, and grades indicated on the Drawings.

C. If unsatisfactory soil materials are encountered at design elevations, continue excavation as directed by the Structural Engineer.

3.3 PROOF ROLLING / SHAPING

A. After stripping topsoil, clearing and grubbing, proof roll the entire area to detect any soft spots. Remove soft spots, backfill with satisfactory material and compact as specified.
   1. Proof rolling shall be accomplished by making a pass with a fully-loaded tandem-axle dump truck, or approved equivalent. Areas of failure shall be excavated and re-compacted as stated above. Care shall be taken to not overload soils; pumping of soft material shall be avoided.

B. Grade and shape the entire area of construction to conform with the grades, lines, and cross-section required for the completed paving. Remove any unsuitable soils encountered and replace with specified materials.

C. Spoil materials resulting from clearing, grubbing and stripping shall be removed from the site

and legally disposed of. Appropriate excavated earth may be used in yard areas as topsoil.

3.4 FILLING AND SUBGRADE PREPARATION

A. Fill areas to contours and elevations shown with unfrozen materials.

B. Place fill in continuous lifts specified herein.

C. After proof rolling is complete, scarify area so that fill material will bond with the existing soil.

D. Compact each layer of backfill and fill materials to 95 percent maximum density as measured by the Standard Proctor Test, ASTM D698.

3.5 MAINTENANCE OF SUBGRADE

A. Finished subgrades and subbase shall be verified to ensure proper elevation and conditions for construction above subgrade.

B. Protect subgrade and subbase from excessive wheel loading during construction, including concrete trucks and dump trucks.

C. Remove areas of finished subgrade or subbase found to have insufficient compaction density to depth necessary and replace in a manner that will comply with compaction requirements by use of select material. Surface of subgrade or subbase after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.

3.6 FINISH GRADING

A. Grade all areas where finish grade elevations or contours are indicated on Drawings, other than paved areas and buildings, including excavated areas, filled and transition areas, and landscaped areas. Graded areas shall be uniform and smooth, free from rock, debris, or irregular surface changes. Finished subgrade surface shall not be more than 0.10 feet above or below established finished subgrade elevation, and all ground surfaces shall vary uniformly between indicated elevations. Finish ditches shall be graded to allow for proper drainage without ponding and in a manner that will minimize erosion potential.

B. Correct all settlement and eroded areas within one year after date of completion at no additional expense to owner. Bring grades to proper elevation. Replant or replace any grass, shrubs, bushes, or other vegetation that appears dead, dying or disturbed by construction activities. Refer to Section 31 35 00 for slope protection and erosion control.

END OF SECTION 310000

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Protecting existing vegetation to remain.
   2. Removing existing vegetation.
   3. Clearing and grubbing.
   4. Stripping and stockpiling topsoil.
   5. Removing above- and below-grade site improvements.
   6. Disconnecting, capping or sealing, and removing site utilities abandoning site utilities in place.
   7. Temporary erosion- and sedimentation-control measures.

B. Related Sections:
   1. Section 015000 "Temporary Facilities and Controls" for temporary utility services, construction and support facilities, security and protection facilities, and temporary erosion- and sedimentation-control measures.
   2. Section 017300 "Execution" for field engineering and surveying.
   3. Section 024119 "Selective Structure Demolition" for partial demolition of buildings or structures.

1.3 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

B. 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.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally 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 subsoil and weeds, roots, toxic materials, or other nonsoil materials.

D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.

F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
   1. Use sufficiently detailed photographs or videotape.
   2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.6 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site .

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 Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service Louisiana One Call for area where Project is located before site clearing.

C. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

D. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

E. Do not direct vehicle or equipment exhaust towards protection zones.

F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

G. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
   1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

B. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with MPI #79, Alkyd Anticorrosive Metal Primer or SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating.
   1. Use coating with a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain. Flag each tree trunk at 54 inches above the ground.

C. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction. Contractor shall submit an Erosion-and Sedimentation-Control Plan for Landscape Architects approval.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. General: Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Landscape Architect.

3.4 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
   1. Arrange with utility companies to shut off indicated utilities.
   2. Natural Gas Pipeline – ensure that natural gas pipeline is protected and undisturbed.

B. Locate, identify, and disconnect utilities indicated to be abandoned in place.

C. Interrupting 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 Landscape Architect not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Landscape Architect's written permission.

D. Removal of underground utilities is included in earthwork sections and with applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security and utilities sections and Section 024116 "Structure Demolition" and Section 024119 "Selective Structure Demolition."

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
   1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
   2. Grind down stumps and remove roots, obstructions, and debris to a depth of 24-inches below exposed subgrade.
   3. Use only hand methods for grubbing within protection zones.
   4. Chip removed tree branches and dispose of off-site.

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 a loose depth of 8 inches , and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and non-soil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

B. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches .
2. Do not stockpile topsoil within protection zones.
3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. 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.

END OF SECTION 311000

SECTION 31 20 01 - EARTH MOVING FOR LANDSCAPE

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. Preparing subgrades for concrete walks, pavements, turf and grasses, and plants.
   2. Subbase course for concrete walks, pavements, turf and grasses, and plants.
   3. Subsurface drainage backfill for walls.

B. Related Sections:
   1. Section 013200 "Construction Progress Documentation" Section 013233 "Photographic Documentation" for recording preexcavation and earth moving progress.
   2. Section 015000 "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
   3. Section 033000 "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
   4. Section 311000 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
   5. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
   6. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.
   7. Section 334600 "Subdrainage" for drainage of foundations slabs-on-grade walls and landscaped areas.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material 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: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Landscape Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
   2. Bulk Excavation: Excavation more than 10 feet and more than 30 feet in length.
   3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Landscape Architect. Unauthorized excavation, as well as remedial work directed by Landscape Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. 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.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:
   1. Geotextiles.

B. Samples for Verification: For the following products, in sizes indicated below:
   1. Geotextile: 12 by 12 inches .

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
   1. Classification according to ASTM D 2487.
   2. Laboratory compaction curve according to ASTM D 698.

C. Seismic survey report from seismic survey agency.

D. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.6 QUALITY ASSURANCE

A. Preexcavation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving 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 Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
   1. Do not proceed with work on adjoining property until directed by Landscape Architect.

C. Utility Locator Service: Notify utility locator service Louisiana One Call for area where Project is located before beginning earth moving operations.

D. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Section 311000 "Site Clearing," are in place..

E. Do not commence earth moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

F. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.

2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487 , or a combination of these groups; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: AHTD Class 7 (or) Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Structural Select Fill: Clean, low plasticity sandy lean clay (CL) material with a liquid limit of less than 40 and a plasticity index between 10 and 20. Select fill should be placed in thin lifts, not exceeding 8-inch loose measure, moisture conditioned between – 2% and +3% of optimum moisture content and compacted to a minimum of 95% of a maximum dry density as determined by ASTM D 698.

H. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

I. Drainage Gravel: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; 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.

J. Pea Gravel: Narrowly graded mixture of washed uncrushed gravel conforming to ASTM C 33 for 3/8” aggregate.

K. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.

L. Sand: ASTM C 33; fine aggregate.

M. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 GEOTEXTILES

A. Subsurface Drainage Geotextile: Non-woven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
   1. Grab Tensile Strength: 157 lbf ; ASTM D 4632.
   2. Sewn Seam Strength: 142 lbf ; ASTM D 4632.
   3. Tear Strength: 56 lbf ; ASTM D 4533.
   4. Puncture Strength: 56 lbf ; ASTM D 4833.
   5. Apparent Opening Size: No. 70 sieve, maximum; ASTM D 4751.
   6. Permittivity: 0.5 per second, minimum; ASTM D 4491.
   7. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355..

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
   1. Survivability: Class 2; AASHTO M 288.
   2. Grab Tensile Strength: 247 lbf ; ASTM D 4632.
   3. Sewn Seam Strength: 222 lbf ; ASTM D 4632.
   4. Tear Strength: 90 lbf ; ASTM D 4533.
   5. Puncture Strength: 90 lbf ; ASTM D 4833.
   6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
   7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
   8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

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 earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Prevent surface water and ground water 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.

3.3 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
   1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
   2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
      a. 24 inches outside of concrete forms other than at footings.
      b. 18 inches outside of concrete forms at footings.
      c. 12 inches outside of minimum required dimensions of concrete cast against grade.

d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
e. 8 inches beneath bottom of concrete slabs-on-grade.
f. 8 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

3.4 EXCAVATION FOR STRUCTURES

A. See Section 312300, “Excavation for Buildings”.

B. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

C. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch . Do not disturb bottom of excavations intended as bearing surfaces.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

B. Excavations at Edges of Tree- and Plant-Protection Zones:
1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 SUBGRADE INSPECTION

A. Notify Landscape Architect when excavations have reached required subgrade.

B. If Landscape Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph .
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Landscape Architect, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Landscape Architect, without additional compensation.

3.7 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Landscape Architect.
1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Landscape Architect.

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory 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.

3.9 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:
   1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
   2. Surveying locations of underground utilities for Record Documents.
   3. Testing and inspecting underground utilities.
   4. Removing concrete formwork.
   5. Removing trash and debris.
   6. Removing temporary shoring and bracing, and sheeting.
   7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.10 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:
   1. Under grass and planted areas, use satisfactory soil material.
   2. Under walks, pavements, and walls use structural select fill material.
   3. Under steps and ramps, use engineered fill.
   4. Under building slabs, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.11 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

Table 1
Compaction Equipment and Maximum Lift Thickness

Compaction Equipment	Maximum Lift Thickness
Mechanical Hand Tamper	4-in
Pneumatic Tired Roller	6-in
Tamping Foot Roller	8-in
Sheepsfoot Roller	8-in

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
   1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.

2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.13 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Turf or Unpaved Areas: Plus or minus 1 inch.
   2. Walks: Plus or minus 1/2 inch.
   3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.14 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: Specified in Section 334600 "Subdrainage."

B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches of filter material, placed in compacted layers 6 inches thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches .
   1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor..

C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches of final subgrade, in compacted layers 6 inches thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches .
   1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698 with a minimum of two passes of a plate-type vibratory compactor.
   2. Place and compact impervious fill over drainage backfill in 6-inch- thick compacted layers to final subgrade.

3.15 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
   1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
   2. Shape subbase course and base course to required crown elevations and cross-slope grades.
   3. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
   4. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
   5. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

C. Pavement Shoulders: Place shoulders along edges of subbase course 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 to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.16 FIELD QUALITY CONTROL

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

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Landscape Architect.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, 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 test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
   2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet or less of wall length, but no fewer than two tests.
   3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length, but no fewer than two 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 materials to depth required; recompact and retest until specified compaction is obtained.

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 Landscape Architect; reshape and recompact.

C. 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 greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 20 00

SECTION 316316 – AUGERCAST GROUT PILING

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Install piling and related items as shown on the drawings and as specified herein.

B. Piling subcontractor shall be an established, qualified, and experienced firm regularly engaged in placing auger cast grout piles. He shall use necessary standard equipment, experienced operators and workmen, and other necessary items to expediently complete this work. His equipment, personnel, and method of placing the piles shall be subject to the approval of the Architect or his authorized representative.

1.2 DESCRIPTION OF WORK

A. Provide labor, material, equipment, and supervision necessary to furnish and install auger cast grout piling.

B. Although not specifically set forth herein, all miscellaneous items, appurtenances and devices incidental to or required for a sound, secure and complete installation, shall be provided as a part of this work.

C. The piles shall be located in the field in accordance with the drawings. The Contractor shall furnish records of three (3) past successful installation of piles under similar soil conditions. Prior to commencing work, the Contractor shall submit for review details of the piles to be furnished, including shop drawings of the pile, proposed method of drilling, and data sheet on the type and capacity of the drilling equipment.

D. The Contractor shall include in his bid, the price required to account for 50% grout overage during the installation of the auger cast pile foundations. The Contractor shall also include a single unit price on the bid form to account for grout overage above or below 50%. If the grout overage is less than 50%, the Owner will be credited the amount of grout overage less than 50% times the unit price. If the grout overage is more than 50%, the Owner will issue a change order for the amount of grout overage above 50% times the unit price. The grout overage only applies to the grout that goes into the foundation excavations as recorded by the testing laboratory. The cost of all other grout purchased by the Contractor shall be included in the base bid.

1.3 QUALITY ASSURANCE

A. Testing Lab:

a. The testing laboratory, under the supervision of the Geotechnical Engineer of Record, is to log the placement of each pile and furnish the Architect and Structural Engineer with weekly detailed drilling logs. The testing and inspection is

to be performed in accordance with ASTM E-329. Also see Section 01 40 00 – TESTING LAB SERVICES.

1. Review the qualifications and equipment of the Piling Subcontractor;

2. Review the grout design to confirm that the mix meets project requirements;

3. Provide one (1) competent and experienced laboratory field man per each rig to be present during pile placement and to keep records relative to drilling and conditions encountered.

B. Installation Tolerances:

a. Deviation shall not be more than ¼ inch per foot from the vertical or batter line, with a total deviation of the head of pile not more than two inches from plan location. Finished elevation to be no more than 1-1/2 inches above or below the design elevation.

C. Flow-Cone Test:

a. Use quantity of water to produce a grout equivalent to a consistency of flow of not less than 15 seconds when tested with a flow cone in accordance with Corps of Engineers CRD C-79.

D. Testing of Mortar:

a. One set of six (6) 2 inch cubes made each day while pile casting with two cubes of each set tested after three (3) days, two (2) cubes of each set tested after seven (7) days and two (2) cubes of each set tested after 28 days. Cubes shall be made and tested in accordance with ASTM C-109.

E. Volume of Pile:

a. The amount of grout placed in each piling shall be recorded and that amount shall not be less than 115% of the theoretical volume of the augered hole.

F. Depth and Alignment of Auger:

a. Provide an accurate means of determining the depth and alignment of the auger.

G. Pressure Gages:

a. Provide grout pressure gauges which accurately indicate displacement pressure at the pump;

b. It is intended that a 50 psi pressure be maintained at the tip of the auger at all times. The foreman shall control the withdrawal rate of the auger to maintain the above specified minimum pressure level at the tip of the auger;

c. The Piling Foreman shall have not less than three (3) years experience in placing augered piling in soft soils, and he shall maintain continuous observation of grout pressure in the discharge system;

d. Provide gauge savers to protect gauges from grout. Clean gauges daily to prevent grout blockage. Replace inaccurate gauges with new gauges.

H. Testing of Piles:

a. In addition to pile load test Sec. 3.04, piles may be subjected to single-hole sonic logging (SSL) where installation records indicate that structural defects or anomalies may exist. If structural defects or anomalies are found, it will be the Contractor's responsibility to pay for the testing. If no defects or anomalies are found, it will be the Owner's responsibility to pay for the testing.

1.4 SUBMITTALS

A. Prior to beginning work, submit information on the following to the Architect:

a. Types and ratings of drilling equipment;

b. Outline of placement methods;

c. Grout mix design;

d. Augering equipment;

e. Pile details.

B. During Work:

a. Testing and Inspection Laboratory:

Prepare log of the following:

1. Identify pile by location, number and date of installation;

2. Record size and length;

3. Record elevations of the top of ground, top of shaft concrete, and bottom of pile;

4. Pile pay length, theoretical and actual grout volumes, the grout factor and pumping pressures;

5. Length and size of pile reinforcing, including projection above top of pile;

6. Drilling characteristics.

b. Submit load test data and results.

1.5 RELATED WORK SPECIFIED ELSEWHERE

A. Reinforcing for piling: Section 03 20 00.

PART 2 – PRODUCTS

2.1 AUGERCAST CONCRETE PILES

A. High Strength Grout Materials: Mix as Portland Cement, fluidifier and/or retarder, sand and water so proportioned and mixed as to provide a grout capable of maintaining the solids in suspension without appreciable water gain, yet which may be placed without difficulty, and which will laterally penetrate and fill any voids in the foundation material. Mineral filler may be added to the above mix in lieu of a small percentage of the Portland Cement at the Piling Contractor's option. The materials shall be so proportioned as to provide a hardened grout having an ultimate compressive strength of 4,000 psi at 28 days. The grout design shall include the following typical ingredients and shall be submitted to the Geotechnical Engineer of Record for review prior to construction:

a. Portland Cement: Portland Cement shall conform to ASTM C 150, Type I or Type III;

b. Pozzolan (when approved): Pozzolan shall be a fly ash or other approved pozzolanic material conforming to ASTM C 618;

c. Grout fluidifier: Grout fluidifier shall conform to Corps of Engineers CRD C-566, except that expansion shall not exceed 4%. The fluidifier shall be a compound possessing characteristics which will increase the flowability of the mixture, assist in the dispersal of cement grains, and neutralize the setting shrinkage of the high-strength cement mortar;

d. Water: Water shall be fresh, clean, potable, and free from sewage, oil, acid, alkali, salts, or organic matter;

e. Fine aggregate: Fine aggregate shall meet the requirements of ASTM C33. The sand shall consist of hard, dense, durable, uncoated rock particles and be free from injurious amounts of silt, loam, lumps, soft or flaky particles, shale, alkali, organic matter, mica, and other deleterious substances. If washed, a washing method shall be used that will not remove desirable fines, and the sand shall subsequently be permitted to drain until the residual-free moisture is reasonably uniform and stable. The sand shall be well graded from fine to coarse with fineness modulas between 1.30 and 3.40. The fineness modulus if defined as the total divided by 100 or the cumulative percentages retained on U.S. Standard Sieve numbers 16, 30, 50, and 100;

f. Mineral Filler (if required): Finely powdered siliceous material which combines lime liberated during Portland cement hydration.

B. Augering Equipment:

a. Grout pump: Use a positive displacement piston pump of an approved design, capable of developing displacing pressure at the pump up to 350 psi. Calibrate the pump discharge capacity in strokes per cubic foot or revolutions per cubic by a method approved by the Architect. Remove oil or other rust inhibitors from mixing drums and pressure grout pumps prior to mixing and pumping. Equip pump with digital counter for counting pump strokes to determine volume of grout pumped.

b. Crane: Use crane equipped with torque convertor or hydraulic drive system to permit a slow continuous auger lifting (grouting operation).

c. Auger: Use 3" minimum I.D. hollow shaft auger to facilitate grout flow. The hole through which the high strength grout is pumped during the placement of the pile shall be located at the bottom of the auger head below the bar containing the cutting teeth. The auger flighting shall be continuous from the auger head to the top of auger with no gaps or other breaks. The pitch of the auger flighting shall be a minimum of 9 inches.

d. Auger Drive: Use auger drive head having minimum static weight of 4,000 pounds and drive 150 horsepower. The piling leads shall be prevented from rotating by a stabilizing arm.

PART 3 – EXECUTION

3.1 PILING INSTALLATION

A. General: Provide piling of the length and configuration necessary to:

a. Achieve the required penetration determined by the Architect;

b. Extend into the pile cap or structure footing the indicated length;

c. Attain the indicated bearing capability.

B. Install piling to the required elevation. The piling subcontractor's method and procedure of drilling, injecting of the grout, withdrawal of the auger, as well as the other pile-placing procedures shall be initially monitored by a representative of the Geotechnical Engineer of Record.

C. Excavation of the pile shall be completed after augering and grouting. Completely fill the augered hole with grout and sleeve to cutoff elevation.

D. Feed materials to the mixer accurately measured by weight, except water, which may be measured by volume. The order of placing the material shall be as follows:

   a. Water;

   b. Fluidifier and other solids in order of increasing particle size. Time of mixing shall not be less than one minute. Ready-mix grout may be used.

E. The continuous hollow shaft flight auger shall be rotated into the ground to the required depth of penetration as shown on the plans and specified herein. The auger shall remain full of earth to prevent lateral cave-in of the clay and sand soils.

F. When the auger has penetrated to the required depth, concrete shall be pumped through the shaft under a pressure at discharge of about 50 psi. The auger shall continue to be rotated slowly (3 – 5 RPM) in a forward (digging) direction and then shall be slowly withdrawn, allowing the concrete under pressure to fill the shaft and to penetrate laterally into any porous soils as the auger is withdrawn. The auger shall not be allowed to "get ahead" of the concrete and allow soils to cave into the shaft. This can be detected by a drop in pressure at the pump. This procedure shall continue without break from bottom to top of piling.

G. It shall be required that a high grout discharge pressure be maintained at all times during pile construction to eliminate the possibility of intrusion of soils and/or water into the grout column under these conditions.

H. If the auger jumps upward more than 6 inches but less than 12 inches (12") during withdrawal, reinsert auger at least three feet past the questionable area and re-grout the pile.

I. If the auger jumps upward more than 12 inches (12") during withdrawal, or the pile is not installed in general accordance with accepted procedures, reinsert auger to the base of the pile and re-grout the pile.

J. Auger grout injected pile reinforcement is to be as shown on the plans.

K. Grout volume: The volume of grout per linear foot of pile shall not be less than the theoretical volume of the augered hole. The subcontractor shall provide calibrated equipment to make sure measurements.

L. Protection of piles: Provide a sequence of pile installation such that adjacent piles are not disturbed. Evidence of disturbance may appear as a drop in the grout surface. Do not place pile within three feet (3') of adjacent piles until the grout in the piles has undergone initial set.

M. The uppermost eighteen inches (18") of all piling shall be contained by a rigid sleeve. This sleeve shall be removed after the concrete has set.

3.2 LOCATION OF PILES

A. Piles shall be located as shown on drawings or as otherwise directed by the Architect. Pile centers shall be located to an accuracy of +-2". In the event that non-augerable material is encountered which prevents placing of a pile to the depth required, the short pile shall be completed and, if necessary, an additional adjacent pile placed as directed by the Architect.

3.3 CUT-OFFS

A. Cut piles off after excavation or pile caps at elevations shown on drawings.

3.4 LOAD TESTS AND TEST PILES

A. Test piling(s) shall be constructed at the locations designated by the Geotechnical Engineer of Record. These pilings shall be constructed using the same materials, equipment, and labor that will be used for the remainder of the piling. Pile(s) shall be constructed to the required depth below cut-off. The test piling shall be completed also as described previously. The test piling shall not be utilized as permanent foundation piles.

B. The Contractor must employ a civil/structural engineer, licensed to practice in the state where this job is located, to design the test shaft apparatus. The Contractor will be required to submit this sealed design to the Architect for approval, including detailed plans of the loading apparatus he intends to use.

C. Pile Test Loads:

a. The Contractor shall include in his bid, the cost to provide and install one test pile, reaction piles and beam. The testing laboratory shall provide everything else necessary to conduct the test including calibrated jack, gages, etc;

b. The load test shall be performed by the Testing Laboratory under the supervision of the Geotechnical Engineer of Record. Pile test load shall be applied in accordance with the specifications ASTM D-1143 (latest issue). The Contractor shall cooperate fully with the testing laboratory.

D. Install test pile(s) in accordance with the Section 3.01 Piling Installation.

E. Install test pile at the location directed by the Geotechnical Engineer of Record.

a. Install test pile vertically;

b. No piles or sheeting shall be driven in the immediate areas during the time a load test is being performed;

c. The Contractor shall construct a suitable platform or platforms, and furnish and install necessary lighting so that pile load test observations can be made and recorded by the testing laboratory. Access to the test pile and platform shall be provided by the Contractor;

d. The Contractor shall completely protect the test pile and the equipment and facilities for observing pile settlements from rain, wind, direct sunlight and damage;

e. Test pile(s) and reaction piles are to set for 14 days prior to the load test.

F. Either withdraw damaged test piles and remove from site or cut them off one foot below any structure to be installed above.

G. Load test requirement: Compression load tests shall be made in accordance with ASTM D-1143. After rebound readings have been taken, the pile shall be loaded to failure. The load testing of the piles shall be used to determine that correct lengths and installation criteria are being used.

H. The Architect reserves the right to require the Contractor to make additional load tests not specified or otherwise indicated in the event that the behavior of the test pile or any other pile shows any peculiarity, erratic action, or otherwise causes suspicion as to the reliability of the safe load capacity.

I. Following the completion of load tests, the Geotechnical Engineer or Record will evaluate the results to verify the pile load capacities presented in the geotechnical report for the project and will make a determination of the required production pile penetrations.

END OF SECTION 316316

SECTION 32 11 23 - AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 SCOPE OF WORK

A. FURNISH ALL LABOR, MATERIALS, EQUIPMENT, AND INCIDENTALS REQUIRED TO CONSTRUCT the base course foundation for concrete paving as shown on the Drawings and specified herein.

B. The base course shall consist of a No. 610 limestone or similarly graded recycled crushed concrete compacted to 100% of its max dry density as determined by ASTM D-698, Standard Proctor Test with stability present and in accordance with the Project Geotechnical Report.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 CONSTRUCTION

A. Base course material shall be transported and spread by methods that do not damage the subgrade. Any damaged subgrade shall be repaired before base course is placed thereon. Base material shall be shaped and compacted to at least 95% of maximum density at Optimum Moisture Content according to ASTM D-698A.

3.2 PAYMENT:

A. The cost of this item shall be included in the lump sum price for the entire project.

END OF SECTION

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SECTION 321313 - CONCRETE PAVING FOR PARKING LOT

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment and incidentals required to construct the 6-inch, 7-inch, and 8-inch (Heavy Duty) concrete pavement as shown on the Drawings and specified herein.

B. The concrete pavement shall consist of Portland Cement Concrete placed in accordance with these Specifications, Plans, and any field adjustments made by the Project Architect.

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland Cement Concrete (4000psi)

1. Portland cement concrete shall consist of aggregates, Portland cement and water combined to meet requirements presented in the following paragraphs.

a. Cement Allowable types of cement are as follows:

	Cement Types
Cast-in-Place Concrete (Non-Prestressed)	Type I, I(B) or II
Prestresses or Precast Concrete	Type I, I(B), I(C), II or III

b. Admixtures: When approved, water-reducing and air-entraining admixtures may be used; however, no fly ash will be permitted. Air-entraining shall be required for slip form paving

c. Water: Free water shall include all water entering the mix with aggregate, except water absorbed by aggregate.

d. Aggregate: Coarse aggregate shall be the grade specified in Table 10-11 of the current East Baton Rouge Standard Specification for Public Works Construction, Section 1005.

e. Slump: Mixtures shall have slumps within the ranges shown Table 10-11 of the current East Baton Rouge Standard Specification for Public Works Construction, Section 1005 when tested by AASHTO T 119. The engineer may authorize an increase in maximum slump for concrete in walls and diaphragms less than 8" thick.

f. Compressive Strength: Concrete mixtures shall provide compressive strengths not less than as specified in Table 10-11 of the current East Baton Rouge Standard Specification for Public Works Construction, Section 1005

B. PREFORMED JOINT FILLERS

1. Preformed Resilient Bituminous Type: Fillers shall consist of preformed strips made of cane or other cellular fibers bound together and saturated with asphalt or strips formed from granulated cork bound together by an asphalt binder and encased between 2 layers of saturated or glass-fiber felt conforming to AASHTO M 213.

2. Wood Fillers: Bottom boards shall be clear heart redwood. Top boards shall be any type of wood which is free of defects that will impair its usefulness.

3. Preformed Bituminous Type: Bituminous preformed expansion joint filler shall consist of bituminous (asphalt or tar) mastic, formed and encased between 2 layers of bituminous impregnated felt. Preformed filler shall conform to ASTM D 994.

4. Preformed Closed Cell Polyethylene Joint Filler: Filler shall be formed by expansion of polyethylene base resin, extruded as a multicellular, closed cell, homogeneous section of foamed polyethylene. This material shall be used with an adhesive-lubricant conforming to ASTM D 717 4, Type I.

Filler and adhesive -lubricants shall be products listed in the LA DOTD QPL-18.

Filler shall confirm to the following requirements:

Property	Test Method	Requirement
Density, pcf	ASTM D 3574	1.1-3.0
Water Absorption, % by vol, max.	ASTM C 272[1]	1.0
Compression, psi	ASTM D 1056	
@20% deflection, min.		3.0
@80% deflection, max.		125.0
Extrusion @ 80% deflection, inches, max.	ASTM D 545	0.12

[1] The requirement that materials which trap water in flutes be dipped in absolute alcohol shall be omitted. Instead, filler shall be dried by blotting with absorbent paper.

C. Poured and Extruded Joint Sealant:

1. Hot Poured Rubberized Asphaltic Type: This material shall conform to ASTM D 3405. Sealant and backer materials shall be products listed in the QPL. Backer material shall be capable of withstanding temperatures up to 410°F.

2. Polyurethane Sealants: This joint system shall be a 1- or 2-component pourable or extrudable sealant with primers and backer material. It shall cure to a solid rubber-like material able to withstand both tension and compression.

Sealant with primers and backer material shall be products listed in the QPL. Container shall be labeled with name and type of material, batch number, manufacture date, and expiration date.

The material shall conform to the following requirements.

Property	Test Method	Requirement
Flow, inches, max.	AASHTO T 187[1]	0.2
Tack-Free Time, h, max.	ASTM C 679	72
Bond, in. sep., max.	ASTM D 5893	0.25

Resilience, %, min.	ASTM D 5329	75
Ball Penetration	ASTM D 5329	5-20
Resilience (after heat aging) %, min.	ASTM D 5329	75
Weatherometer, 600 h, min.	ASTM D 5893	Pass
Ozone Resistance (Exposure to 100pphm ozone for 100 h@ 104°F, sample under 20% strain or bent loop)	ASTM D 1149	No Cracks
Weight loss, % max.	ASTM C 792	10
Infrared Charts Activator	DOTO TR 610	Pass
Base	DOTO TR 610	Pass
[1] Flow test will be conducted according to AASHTO T 187 except that samples shall be placed in an oven maintained at 150±2°F for 24 hours.		

3. Silicone Sealant: This joint system shall be an extrudable sealant and backer material with primer, if required. Silicone polymer shall cure to a solid rubber-like material able to withstand both tension and compression.

Sealant, backer materials and primers, if required, shall be products listed in the QPL.

Container shall be labeled with name and type of material, batch number, manufacture date, and expiration date

Sealant shall conform to Fed. Spec. TT-S-001543 for Class A Sealants as modified by the following requirements

Property	**Test Method**	**Requirement**
Flow, inches, max.	AASHTO T 187[1]	0.3
Tack-Free Time at 77°F and 45-55% R.H., minutes	Fed. Spec.TT-S-00227	20-75
Resilience, %, min.	ASTM D 3583[2]	60
Resilience (after heat aging) %, min.	ASTM D 3583[2]	60
Durometer, Shore A	ASTM C 661[2]	10-25
Tensile Stress at 150% elongation, psi, max.	ASTM D 412, Die C[2]	75

Elongation, % min.	ASTM D 412, Die C[2]	1000
Bond, inches separation, max.	DOTD TR 635	0.25

[1] Flow test will be conducted according to AASHTO T 187, except that samples shall be placed in an oven maintained at 150±2°F for 24 hours or as recommended by the manufacturer.

[2] Cured 7 days at 75-90°F and 45-55% relative humidity or as recommended by the manufacturer. Check (carefully) above Table.

D. Preformed Elastomeric Compressed Joint Seals:

1. Seals: Seal shall be a product listed in the QPL. Uncompressed seal depth shall be equal to or greater than the uncompressed seal width. Actual seal width shall not be less than nominal seal width.

   a. Pavements: The material shall conform to ASTM D 2628 with the following exceptions:

      1) Ozone resistance may be determined by bend loop test method

      2) Seal shall exert a minimum pressure of 3 psi (4 psi for expansion joints) at 80% of nominal width and a maximum of 25 psi at 50% of nominal width

2. Bridges: Seal shall conform to ASTM D 3542 and shall exert a minimum pressure of 4 psi at 80% of nominal width.

3. Adhesive-Lubricant: Adhesive-lubricant shall conform to ASTM D 4070 and shall be a product listed in the QPL.

E. Combination Joint Former/Sealer: This joint former/sealer is for use in simultaneously forming and sealing a weakened plane in concrete pavements.

Material shall consist of an elastomeric strip epoxied into a toothed groove formed at top of each of 2 rigid plastic side frames or mechanically bonded at top of the 2 rigid plastic side frames and covered with a removable plastic top cap. Side frames shall be of such configuration that when sealer is inserted into plastic concrete and vibrated, a permanent bond forms between side frames and concrete

1. Elastomer: Elastomer strip portion of material shall be manufactured from vulcanized elastomeric compound using polymerized chloroprene as base polymer, and shall conform to the following requirements

Property	**Test Method**	**Requirement**
Tensile Strength; psi; min.	ASTM D 412	1800
Elongation at Break, % min.	ASTM D 412	200

Hardness, Shore A	ASTM D 2240	65±10
Properties after Aging, 70 h @212°F		
Tensile Strength,% loss, max.	ASTM D 573	20
Elongation, % loss, max.		25
Hardness, pts. increase, max.		10
Ozone Resistance, 20% strain or bentloop, 300 pphm in air, 70 h@ 104°F	ASTM D 1149	no cracks
Oil Swell, ASTM Oil #3, 70 h@ 212°F, Wt. change,%, max.	ASTM D 471	45

2. Bond of Elastomer to Plastic: Force required to shear elastomer from plastic shall be at least 5 pounds per linear inch of sealer when tested by DOTO TR 636

    a. Bond of Plastic to Cement Mortar: Force required to separate cement mortar from plastic shall be at least 5 pounds per linear inch of sealer when tested by DOTD TR 636

F. Preformed Polyurethane Joint Filler: This material shall be a preformed polyurethane foam joint filler made with a semi-open, flexible polyurethane foam which is molded to such cross-sectional shape that it can be easily installed in joint and which will be sufficiently self-locking to prevent material from floating out of joint. Molded polyurethane foam shall be free of defects and internal voids greater than ½" and shall show no deterioration when immersed in a 50% by volume solution of mineral spirits and linseed oil for 24 hours. When filler is used to form joint, self-locking feature will not be required and filler will extend full depth

Properties of polyurethane foam when determined on skin-free specimens shall conform to the following requirements:

Property	**Test Method**	**Requirement**
Tensile Strength; psi; min.	ASTM D 412	1800
Elongation at Break, % min.	ASTM D 412	200
Hardness, Shore A	ASTM D 2240	65±10
Properties after Aging, 70 h @212°F		
Tensile Strength,% loss, max.	ASTM D 573	20
Elongation, % loss, max.		25
Property	**Test Method**	**Requirement**
Hardness, pts. increase, max.		10

Ozone Resistance, 20% strain or bentloop, 300 pphm in air, 70 h@ 104°F	ASTM D 1149	no cracks
Oil Swell, ASTM Oil #3, 70 h@ 212°F, Wt. change,%, max.	ASTM D 471	45

[1] 65% deflection after 1-minute relaxation from deflection return.

Lubricant-adhesive recommended by joint filler manufacturer shall be applied according to manufacturer's directions

G. Waterstops

1. Copper waterstops shall conform to ASTM B 370, soft temper.

2. Polyvinyl chloride (PVC) waterstops shall conform to U.S. Army Corps of Engineers Specification CRD-C 572.

3. Rubber waterstops shall conform to U.S. Army Corps of Engineers Specification CRD-C 513.

H. Reinforcing Steel: Reinforcing steel for structures shall be Grade 60. No. 2 bars need not be deformed. Deformed bars shall conform to Headings (1), (2) or (3) below. Wire conforming to Heading (d) below may be used in lieu of No. 2 bars when furnished in size W 5.

1. Billet-Steel Bars shall conform to ASTM A 615.

2. Rail-Steel Bars shall conform to ASTM A 996.

3. Axle-Steel Bars shall conform to ASTM A 996.

4. Cold-Drawn Steel wire shall conform to ASTM A 82 with the following amendment: For material testing over 110,000 psi tensile strength in high strength applications such as spirals and ties, the 25% minimum reduction in area shall be reduced 5% for each 10,000 psi increment of tensile strength exceeding 110,000 psi.

5. Welded Steel Wire Fabric shall conform to ASTM A 185

6. Epoxy Coated Reinforcing Steel shall conform to AASHTO M 284 and shall be a product listed on the QPL.

7. Spiral Reinforcing: Spiral reinforcing shall conform to Section H (1), (2), (3), or (4).

8. Tie bars shall conform to Section H (1), (2), (3), or (4). Tie bars to be bent and restraighten during construction shall be Grade 40.

I. Curing Materials

1. Liquid Membrane-Forming Compounds: This material shall conform to AASHTO M 148 and be a product listed in the QPL. Types shall be Type 2 white-pigmented or Type 1-D, clear or translucent with a fugitive dye, as specified.

2. Burlap Cloth shall conform to AASHTO M 182, Class 3.

3. Waterproof Paper shall conform to AASHTO M 171.

4. White Polyethylene Sheeting shall conform to AASHTO M 171.

5. Combined Burlap and White Polyethylene Sheeting shall conform to AASHTO M 171.

J. Concrete admixtures shall be products listed in the QPL.

1. Water-Reducing Admixtures: These admixtures shall conform ASTM C 494, Type A.

2. Water-Reducing, Set-Retarding Admixtures: These admixtures shall conform to ASTM C 494, Type D.

3. Set-Accelerating Admixtures: These admixtures shall conform to ASTM C 494, Type C.

4. Applied Finish Coating: This material shall be a product listed in the QPL and shall provide a uniform, fine-textured finish.

Material shall consist of a water-based coating containing pigments, texturizers, resins and water. Coating shall contain fungicides to prevent growth of mildew, mold, etc. No field additions to coating will be permitted.

K. Concrete Curing Materials:

1. Liquid Membrane-Forming Compounds: This material shall conform to AASHTO M 148 and be a product listed in the QPL-65. Types shall be Type 2 white-pigmented or Type 1-D, clear or translucent with a fugitive dye, as specified.

2. Burlap Cloth shall conform to AASHTO M 182, Class 3.

3. Waterproof Paper shall conform to AASHTO M 171.

4. White Polyethylene Sheeting shall conform to AASHTO M 171.

5. Combined Burlap and White Polyethylene Sheeting shall conform to AASHTO M 171.

6. Set-Accelerating Admixtures: These admixtures shall conform ASTM C 494, Type C.

L. Applied Finish Coating: This material shall be a product listed in the QPL and shall provide a uniform, fine-textured finish.

Material shall consist of a water-based coating containing pigments, texturizers, resins, and water. Coating Shall contain fungicides to prevent growth of mildew, mold, etc. No field additions to coating will be permitted.

M. Dowel Bars: Dowel bars shall be plain steel bars conforming to Section H (1), (2), (3), or (4). Dowels shall have a uniformly round cross section and shall be saw cut, smooth and free of burrs and projections. Dowel bars shall be uncoated with an adhesive and given an outer coat of polypropylene or polyethylene in accordance with AASHTO M 254, Type A. The coated dowel bar shall conform to AASHTO M 254.

PART 3 EXECUTION

3.1 GENERAL

A. ROADBED PREPARATION: After the roadbed has been graded and compacted, the grade shall be trimmed to the correct elevation, extending the work at least 1 foot beyond each edge of the proposed pavement and to a greater width as necessary when the slip form paving is used.

B. FORMS: Forms shall be metal, and headers shall be timber. They shall be set firm and true to line and grade for a distance of at least 1 day's run of concrete in advance of placing the pavement. They shall be oiled immediately prior to placing concrete and shall remain in place for at least 12 hours after concrete has been placed but must be removed before the work is accepted.

C. Joints:

Longitudinal Joint (Type LJ): The longitudinal joint shall be constructed such that the transverse joint is continuous across the slab. Deformed steel tie bars shall be placed perpendicular to longitudinal joints by approved mechanical equipment or rigidly secured by chairs or other approved supports. Tie bars shall not be coated with asphalt or other material or enclosed in tubes or sleeves. With split-slab construction, only Grade 40 tie bars may be bent at right angles against the form of the first lane constructed and straightened into final position before concrete of the adjacent lane is placed.

Tie bars which break or show evidence of fracture upon straightening shall be replaced by using an adhesive anchor system listed in the QPL or an epoxy resin system.

The joint shall be formed by either of the following methods:

1. Sawing: Sawing shall begin as soon as concrete has reached sufficient strength to support sawing equipment and tearing of concrete does not occur. Sawing shall be completed within 10 hours of placing concrete.

The joint sealant shall conform to Section 2.

After each joint is sawed, the saw cut, and adjacent concrete surfaces shall be cleaned of materials removed during sawing.

No equipment, other than the sawing machine, will be permitted on the pavement during sawing. Sufficient back-up equipment shall be provided at the jobsite to continue sawing operations in case of a breakdown of primary sawing equipment.

During paving operations, joint locations shall be clearly marked.

2. Preformed Filler: Joint filler material conforming to Section 2 shall be inserted in a groove formed by a "T" iron wheel or other device that will ensure a groove that is true in both vertical and horizontal alignment. Grooves shall be cut in such manner that the concrete surface will not be depressed or otherwise disturbed. After insertion, the top edge of the strip shall be flush with the pavement surface and the surface floated.

3. Longitudinal Construction Joint (Type LJ): Longitudinal construction joints shall be constructed when adjacent lanes are constructed separately. Hand vibrators shall be used to consolidate concrete adjacent to joints. Joints shall include tie bars. Tie bars shall be protected from being coated with curing compound.

4. Transverse Expansion Joint (Type EJ): Filler shall be wood conforming to Section 2 (2), and sealer shall be a pourable or extrudable sealer conforming to Section 2 (3).

The wood filler shall be saturated with water before installation.

Dowel bars shall provide bracing adequate to hold wood filler in a vertical position.

5. Transverse Dummy Joint (Type DJ):

    a. Sawing: Sawing shall begin as soon as concrete has reached sufficient strength to support sawing equipment and tearing of concrete does not occur. Sawing shall be completed within 10 hours of placing concrete. When joint cannot be sawed to

pavement edge due to form, an insert shall be placed in the 6" adjacent to form.

Saw cut and adjacent concrete surfaces shall be cleaned of materials removed during sawing.

No equipment, other than the saw machine, will be permitted on the pavement during sawing. Sufficient back-up equipment shall be provided at the jobsite to continue sawing operations in case of a breakdown of primary sawing equipment.

Joints shall be sealed with pourable or extrudable sealer conforming to Section 2 (2) or 2 (3).

b. Combination Former/Sealer: A groove shall be made in the fresh concrete at the joint location with a "T" iron or other suitable device. A combination joint former/sealer conforming to Section 2 (3) shall be immediately installed and the concrete vibrated on each side. Top cap of the former/sealer shall remain in place until after final clean-up.

6. Transverse Construction Joint (Type CJ): A transverse construction joint shall be constructed when concreting is interrupted for over 1 hour, provided it is not within 10 feet of another transverse joint. If joint would be within 10 feet of another transverse joint, concrete shall be removed back to preceding joint.

Transverse construction joints shall include dowel bars and shall be formed and sealed as specified in Subsection 5.

7. Dowel Bars: Dowels may be placed by a mechanical device equipped with means to control depth and alignment of bars. Dowel bars shall be positioned parallel to pavement centerline and surface and held in position by the mechanical device until concrete has been consolidated around bars.

Dowel bar assemblies shall have an expansion tube on each bar in expansion joints. Sleeve shall fit bar tightly and closed end shall be watertight.

D. Placing Concrete: Subgrade or base shall be sprinkled to dampen the surface, but method of sprinkling shall not form mud or pools of water. Concrete shall be deposited in such manner as to require as little rehandling as possible. Placing shall be continuous between transverse joints without the use of intermediate bulkheads.

E. Necessary hand spreading shall be done with shovels or other approved tools, excluding rakes and vibrators. Workers shall not walk in freshly mixed concrete with boots coated with dirt or foreign substances.

When concrete is to be placed adjacent to newly constructed pavement and equipment will be operated on the new pavement, the new pavement shall have attained an age of at least 10 days or a compressive strength of 3,000 psi.

When only finishing equipment is carried on newly constructed pavement, paving of adjoining pavement will be permitted after 1 day.

Concrete shall be placed as near to joints as possible without disturbing them.

1. Consolidation: Concrete shall be vibrated for the full width and depth of slab. Vibrators shall be operated no longer than 15 seconds in one location. Care shall be taken to assure consolidation of concrete against joint material and around dowel bars and tie bars.

2. Screeding: Concrete sha!! be screeded with an approved portable screed moved forward on forms with a combined longitudinal and transverse shearing motion! moving in the direction in which work is progressing and so manipulated that neither end is raised from side forms. This shall be repeated until the surface is of uniform texture1 true to grade and cross section and free from porous areas. The screed shall be controlled to maintain a uniform roll of concrete ahead of the screed.

3. Floating: Floating to provide the final surface will be required using a machine float. Following machine floating! long-handled floats may be used to smooth and fill open-textured areas. Long-handled floats shall not be used to float the entire pavement surface in lieu of machine floating unless the pavement crown will not permit use of the machine float.

4. Straight edging: Excess water and laitance shall be removed from the pavement surface by a steel straightedge. The entire plastic concrete surface shall be tested for trueness with a straightedge held in contact with the surface in successive positions parallel to pavement centerline. Depressions shall be immediately filled with freshly mixed concrete1 struck off and refinished. High areas shall be cut down and refinished.

5. Final Texturing: After surface irregularities have been removed and a satisfactorily smooth surface obtained! concrete shall be textured with a metal tine device. Final texturing as specified herein will not be required for pavement that will be overlaid with asphalt concrete.

6. Grooves shall be produced transverse to the roadway centerline on 1/2" centers and shall be 1/8" wide and 1/8" to 3/16" deep.

7. Edging: After drag finishing and before concrete has reached initial set! pavement edges and joint edges requiring rounding shall be tooled. Tool marks adjacent to joints shall be removed by brooming.

8. Hand Finishing: Concrete shall be hand finished only in the following cases:

   a. In case of breakdown of mechanical finishing equipment, concrete already placed may be hand finished.

   b. Pavement widths less than 15 feet.

   c. Areas of irregular dimensions.

   d. Pavement to be overlaid with asphalt concrete

F. SLIP-FORMING PAVING: Slip-form paving equipment shall be provided with traveling side forms of sufficient dimensions! shape and strength to support the concrete laterally for a sufficient length of time during placement to produce pavement of the required cross section, and it shall satisfactorily spread, consolidate, screed and float the fresh concrete.

The full width of concrete paving shall be internally vibrated. Vibratory placement of dowel bars and tie bars shall occur within trailing forms. Vibration shall be stopped when slip-form paver stops. Pavement edges shall not deviate more than 1/2" from specified alignment. Edges shall not slump more than¼". [Need to tighten/better define prior two sentences, i.e. vertical and horizontal references].

When concrete is placed adjacent to existing pavement, that part of equipment supported on existing pavement shall have rubber tires or shall have protective pads on crawler tracks, offset to run a sufficient distance from pavement edge to avoid breaking the edge.

Concrete shall be given the final surface finish in accordance with Subsection E (5).

G. CURING AND PROTECTION: OUT OF ORDER

1. Curing: Concrete shall not be left exposed for more than 1/2 hour during the curing period. Curing shall be maintained for 72 hours. The pavement surface shall be uniformly sprayed with curing compound immediately after completion of surface finishing and as soon as surface water evaporates. Curing compound shall not be applied during rainfall.

Curing compound shall be applied under pressure by mechanical sprayers at the rate recommended by the manufacturer but no less than 1 gallon/100 SF. Spraying equipment shall be of the fully atomizing type equipped with a tank agitator. During application, compound shall be stirred continuously by mechanical methods. Hand spraying of irregular shapes and surfaces exposed by form removal will be permitted provided compound has been agitated prior to placing in sprayer. Compound shall not be applied to inside faces of joints to be sealed. In split slab construction, compound shall be so applied as to prevent spraying exposed tie bars.

When side forms are removed before the end of the curing period, exposed sides of slabs shall be immediately protected by applying curing compound.

2. Rain Protection: During paving operations, the contractor shall have at the jobsite sufficient polyethylene sheeting (18" minimum overlap) to protect the last hour's concrete from rain damage.

3. Cold Weather Protection: When air temperature is expected to reach the freezing point during the curing period, straw or other approved protective material shall be spread over the pavement to a sufficient depth to prevent concrete from freezing.

H. SEALING JOINTS: Joints shall not be sealed until at least 7 days after concrete is placed. Pavement may be opened to traffic prior to sealing provided insert has not been removed or sawed. After sealing joints, the pavement shall be closed to traffic until the next day.

Joints shall be sandblasted immediately prior to sealing. Joint faces shall be dry and dust free prior to sealant installation. Air temperature at time of placement shall be at least 500 F. Backer material shall be placed as shown in the plans.

The material shall be forced against joint walls by approved methods.

I. ACCEPTANCE REQUIREMENTS

1. General: Sampling and testing for acceptance will be conducted on each lot of pavement for thickness, compressive strength and surface tolerance. Any pavement that is obviously deficient shall be satisfactorily corrected or removed and replaced.

A concrete pavement lot is an identifiable area of approximately 4,000 square yards paid under the same item. The final area of pavement placed will be considered as a lot if it is at least 2,000 square yards; otherwise, it will be included in the previous lot.

Thickness and Compressive Strength: Strength and thickness of pavements will be determined from hardened concrete cores in accordance with DOTO TR 225. Each lot will be divided into 5 equal segments and 1 core will be obtained from each segment.

Core holes shall be patched by the contractor using an approved mixture. Surface of the patch shall be finished to match surrounding pavement.

a. Thickness: Average thickness of the pavement lot shall not be less than the specified thickness. If the thickness of a sample core is deficient by more than 1 ", the core shall be discarded, and the segment recorded. If the thickness of the second core is deficient by more than 1", the pavement segment shall be removed and replaced.

b. Compressive Strength: The compressive strength of cores will be determined after a minimum of 28 days. Average compressive strength for the lot shall be at least 3,800 psi. If the compressive strength of a sample core is less than 3,000 psi, the core shall be discarded, and the segment recorded. If the compressive strength of the second core is less than 3,000 psi, the pavement section shall be removed and replaced.

c. Small Projects: Projects with less than 2,000 square yards of pavement may be cored as required in Headings (1) and (2) above or may be accepted on the basis of compressive strength cylinders and thickness measurements taken by the engineer.

2. Surface Tolerance: The contractor shall furnish a 10-foot rolling straight edge for longitudinal testing and a 10-foot static straightedge for transverse testing, both acceptable to the engineer. The rolling straightedge shall be calibrated and used in accordance with DOTD TR 603 and TR 618.

One path in each lane will be selected by the engineer for longitudinal testing. The contractor shall assist the engineer in pulling the rolling straightedge. Longitudinal and cross-slope variations shall not exceed that specified by mor than ½'. Pavement areas not meeting this tolerance shall be corrected as directed.

J. Measurement: The quantities of Portland cement concrete pavement for payment will be the design quantities specified in the plans, adjusted as required to plan errors or plan changes. Design areas of pavement are based on the horizontal dimensions shown on the plans.

K. PAYMENT: Payment for Portland cement concrete pavement will be made as a part of the lump sum price for the project.

END OF SECTION

SECTION 32 13 13 - CONCRETE PAVING FOR LANDSCAPE

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. Sidewalks and other horizontal concrete paving shown on Landscape Drawings

B. Related Sections:
   1. Section 031000 “Concrete Formwork”
   2. Section 032000 “Concrete Reinforcement”
   3. Section 033101 "Cast-in-Place Concrete" for landscape applications of concrete.
   4. Section 079200 "Joint Sealants for Concrete Paving" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement. None of the following are allowed in any concrete for this project: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 ACTION SUBMITTALS

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

B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.

C. Other Action Submittals:
   1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For the following, from manufacturer:
   1. Cementitious materials.
   2. Steel reinforcement and reinforcement accessories.
   3. Admixtures.
   4. Curing compounds.
   5. Joint fillers.

B. Material Test Reports: For each of the following:

1. Aggregates. Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

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

D. ACI Publications: Comply with ACI 301 unless otherwise indicated.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Landscape Architect and not less than 3 feet x 3 feet.
3. Separate mockups shall be built to demonstrate each different concrete finish specified.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Landscape Architect specifically approves such deviations in writing.

F. Preinstallation Conference: Conduct conference at Project site.
1. Review methods and procedures related to concrete paving, including but not limited to, the following:
   a. Concrete mixture design.
   b. Quality control of concrete materials and concrete paving construction practices.
2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
   a. Contractor's superintendent.
   b. Independent testing agency responsible for concrete design mixtures.
   c. Concrete paving subcontractor.

1.7 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

A. Forms for straight sidewalks: Dimensional lumber (2”x6” or similar), 3/4” Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

B. Forms for curves with a radius of 20 feet or greater: Dimensional lumber (2"x6" or similar), or 3/4" plywood that is kerf cut on the non-concrete side to sufficiently to achieve the desired radius while maintaining stability

C. Forms for curves with a radius of 20 feet or less:
   1. Flexible engineered wood or plastic forms with sufficient bracing to create a smooth, uniform curve.

D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 1064/A 1064M, fabricated from galvanized-steel wire into flat sheets.

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

C. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars. Cut bars true to length with ends square and free of burrs.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
   1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

E. Zinc Repair Material: ASTM A 780.

2.3 CONCRETE MATERIALS

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

B. Normal-Weight Aggregates: ASTM C 33, uniformly graded. Provide aggregates from a single source for exposed surfaces.
   1. Do not use aggregates containing soluble salts or other substances such as iron sulfides, pyrite, marcasite, ochre, or other materials that can cause stains on exposed concrete surfaces.
   2. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances. Dune sand, bank run sand and manufactured
   3. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam, or foreign matter, as follows:
      a. Crushed stone, processed from natural rock or stone in primarily brown and tan colors.
      b. Wash gravel, either natural or crushed. Use of slag and pit or bank run gravel is not permitted.
      c. Coarse Aggregate Size: Size to be ASTM C33, No. 67.

C. Water: Potable and complying with ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, 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, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.5 SURFACE RETARDER AND FINISHING AIDS

A. Water-based, spray-applied, film-forming top surface retarder designed for specific sized aggregates and finish requirements. Color coded to allow for ease of application and verification of etch level being used as well as even and complete coverage.

B. Products and Manufacturers:
1. Top-Cast Surface Retarder by Dayton Superior
2. Top-Surface Surface Retarder by WR Meadows
3. Approved Equals

2.6 Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately

2.7 EXPANSIOIN JOINTS

A. Provide a semi-rigid, closed-cell polypropylene foam, preformed joint filler that meets the following physical property requirements and fully complies with ASTM D8139.
1. Compression Strength30-60 psi per ASTM D 545 or AASHTO T 42
2. Compression Recovery > 80% per ASTM D 545 or AASHTO T 42
3. Extrusion < 0.1 in.per ASTM D 545 or AASHTO T 42
4. Density >3.5 lbs./cu.ft.per ASTM D 545 or AASHTO T 42
5. Water Absorption < 1.0% per ASTM D 545 or AASHTO T 42
6. Heat Resistance °F392˚F± 5˚Fper ASTM D 5249
7. Freeze Thaw ResistanceNo changeper ASTM C 666 (300 cycles)
8. UV Weathering No changeper ASTM D 4329 (1000 hrs., Cycle A)
9. Thickness 3/8” Min.
10. Width 6” Min.

B. Manufacturers
1. Nomaco, WR Meadows, or Approved Equal

2.8 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 , for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 4000 psi .
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
3. Slump Limit: 4 inches , plus or minus 1 inch.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
1. Air Content: 6 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing admixture in concrete as required for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

2.9 CONCRETE MIXING

A. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete batches 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, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.
1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph .
2. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides 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.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting 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 reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges 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 paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
   1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
   2. Provide tie bars at sides of paving strips where indicated.
   3. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys as indicated.
   4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Expansion Joints: Form expansion joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
   1. Typical expansion joint
      a. Locate expansion joints as indicated on plan.
      b. Extend joint fillers full width and depth of joint.
      c. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated where keyway expansion joints are not used.
      d. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
      e. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
      f. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Sawcut Control Joints:
   1. Sawcut control joints to be 1/8” wide. Depth shall be 1/4 the total depth of concrete slab.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/2 inch radius on all exposed edges, no radius on jointed edges. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

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.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   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 paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
   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 design mixtures.

K. Hot-Weather Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
   3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 CONCRETE FINISHING

A. Reference Drawings for concrete surface finishes and locations.

B. General: Do not add water to concrete surfaces during finishing operations.

C. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and 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. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.

E. Sand Wash Finish: After applying a trowel finish, complete one of the following options.
1. Option 1: No Surface Retardant
   a. When warmer weather conditions allow, the sand wash finish may be achieved without the use of a surface retardant
   b. After trowel finish is applied, allow concrete to cure long enough so that foot traffic does not deform the surface elevation.
      1) +/- 45 minutes after troweling
      2) Exact time shall be determined through the mockup process and the exact conditions for each pour.
   c. After surface is ready, lightly brush the surface with a stiff bristled broom to loosen the cream layer, but not enough to expose the concrete aggregate.
   d. After brushing, thoroughly rinse the loosened cream layer off of the surface with an open-ended water hose (no nozzle).
   e. After rinsing, review the finish to verify uniformity and consistency. If there are inconsistencies identified, repeat the brushing and rinsing process as necessary to achieve a uniform surface texture.
2. Option 2: Use of Surface Retardant
   a. During cooler weather or at the discretion of the Contractor, the sand wash finish may be achieved with the use of the specified surface retardant.
   b. After the trowel finish is applied and at the time as directed by the manufacturer, spray the surface retardant onto the concrete at the rate specified by the manufacturer.
   c. After the surface retardant has set long enough to achieve the desired finish, rinse the concrete with a water hose and stiff-bristled broom to remove the cream layer of the concrete. The use of a pressure washer may also be used if a consistent, even finish is achieved.

F. Broom Finish
1. 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.
2. 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.

3.8 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. 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.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing moisture-retaining-cover curing compound or a combination of these as follows:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven 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, 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 Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.9 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:
   1. Elevation: 1/4 inch .
   2. Thickness: Plus 3/8 inch , minus 1/4 inch .
   3. Surface: Gap below 10-foot- long, unleveled straightedge not to exceed 1/4 inch .
   4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of tie bar.
   5. Lateral Alignment and Spacing of Dowels: 1/2 inch .
   6. Vertical Alignment of Dowels: 1/4 inch .
   7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
   8. Joint Spacing: 3 inches .
   9. Joint Width: Plus 1/16 inch , no minus.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:.
   1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
      a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
   5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
   6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
      a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi .

D. Test results shall be reported in writing to Landscape Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture 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 Landscape Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Landscape Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Landscape Architect.

B. Drill test cores, where directed by Landscape Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 13

SECTION 32 14 00 - UNIT PAVING

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. Concrete pavers set in mortar setting beds with polymeric sand filled joints.

B. Related Sections:

1. Section 312000 “Earth Moving” for establishment of subgrade elevations.
2. Section 033101 "Cast In Place Concrete" for concrete base under unit pavers.

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Submit to latex-additive manufacturer, for testing as indicated below, samples of paving materials that will contact or affect mortar and grout that contain latex additives.

1. Use manufacturer's standard test methods to determine whether mortar and grout materials will obtain optimum adhesion with, and will be nonstaining to, installed pavers and other materials constituting paver installation.

1.4 ACTION SUBMITTALS

A. Product Data: For materials other than water and aggregates.

B. Product Data: For the following:

1. Pavers.
2. Mortar setting materials.
3. Joint sand materials.

C. Adhesion and Compatibility Test Reports: From latex-additive manufacturer for mortar and grout containing latex additives.

D. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C 136.

E. Samples for Initial Selection: For the following:

1. Each type of unit paver indicated.
2. Joint materials involving color selection.
3. Edge restraints involving color selection.

F. Samples for Verification:

1. Full-size units of each type of unit paver indicated.
2. Joint materials.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

B. Mockups: Build sample panel to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Panel shall be

8 ft. x 8 ft. minimum, exhibiting the specified base, setting method, thickness, colors, jointing, pattern, finish, and workmanship. The accepted panel shall become the standard for the entire job and shall remain undisturbed until completion of the concrete unit paving.

1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
2. Notify Landscape Architect seven days in advance of dates and times when mockups will be constructed.

C. Substitutions: As approved by the Landscape Architect

D. Preinstallation Conference: Conduct conference at project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Store liquids in tightly closed containers protected from freezing.

E. Store asphalt cement and other bituminous materials in tightly closed containers.

1.7 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Sand:
1. Joint sand to be applied only in dry conditions.

PART 2 - PRODUCTS

2.1 QUALITY

A. Use new materials without flaws or defects.

2.2 SUBSTITUTIONS

A. Specified product is only used to denote the general style, type, character, and quality standard of the product desired. Bidders are not restricted to the specified brand, make, or manufacturer.

B. Use specified product, or pre-approved equal. Alternative products must be approved by Landscape Architect prior to bidding. Changes and associated design costs to accommodate alternative equipment are Contractor's responsibility.

2.3 BASE SLAB

A. Cast-in-place concrete base. Refer to Section 03 3100, Cast-in-Place Concrete

2.4 CONCRETE PAVERS

A. Pavers: Solid paving units, consisting of Portland cement, aggregate, and color admixtures. with a compressive strength not less than 5000 psi , water absorption not more than 5 percent according to ASTM C 140, and no breakage and not more than 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C 67.
1. Portland Cement: ASTM C 150, Type III, high early strength

2. Aggregate: ASTM C 33
3. Color Admixture: By Davis Colors, or equal, as required to achieve color as selected.
4. Aggregate for exposed aggregate surface: As Selected.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or approved equal:

1. Hanover Architectural Products, Inc. 5000 Hanover Road
Hanover, PA 17331
Phone: (717) 637-0500
Toll Free: (800) 426-4242
Fax: (717) 637-7145
www.hanoverpavers.com

2. Tectura Designs by Wasau Tile
PO Box 1520
Wasau, WI
Toll Free: (800) 388-8728
Fax: (715) 355-4627
www.tecturadesigns.com

3. Approved Equal

C. Concrete Paver Unit Types

1. Basis of Design - Prest Brick by Hanover
   a. Thickness: 2-3/8" (Pedestrian areas)
   b. Face Size and shape: 6" x 12"
   c. Edge Profile: Square Edge
   d. Color: Custom Color Matrix
      - Exact Color T.B.D.
      - Basis of Design to be Matrix #B91983
   e. Finish: Ground Tudor (exterior)
   f. Joint Size: 1/16" polymeric sand (based on integral spacer tabs on paver units)

2.5 MORTAR SETTING-BED MATERIALS

A. Mortar that meets or exceeds ANSI A118.4 requirements when mixed with water or a latex admixture, and is designed for installation of large format tile.

1. Portland Cement: ASTM C 150, Type I or Type II.
2. Hydrated Lime: ASTM C 207, Type S.
3. Sand: ASTM C 144.
4. Latex Additive: Manufacturer's standard acrylic resin or styrene-butadiene- rubber water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed, and not containing a retarder.
5. Water: Potable.

2.6 MORTAR AND GROUT MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with optimum performance characteristics. Discard mortars and grout if they have reached their initial set before being used.

B. Mortar-Bed Bond Coat: Mix neat cement and latex additive to a creamy consistency.

C. Latex-Modified, Portland Cement Setting-Bed Mortar: Proportion and mix portland cement, sand, and latex additive for setting bed to comply with written instructions of latex-additive manufacturer and as necessary to produce stiff mixture with a moist surface when bed is ready to receive pavers.

D. Latex-Modified, Portland Cement Bond Coat: Proportion and mix portland cement, aggregate, and liquid latex for bond coat to comply with written instructions of liquid- latex manufacturer.

2.7 SAND MATERIALS

A. Sand for Joints

1. Manufacturer

a. TechniSeal, Inc., Boucherville, Canada J4B 7K2; Tel 800 363 7560; "Alliance DP SuperSand Bond" Polymeric Sand, manufactured by Alliance Designer Products, Inc., Laval, Canada, H7L 6A1; Tel 866 212 1611

b. Approved Equal

2. Type: Polymeric joint sand for pavement Joints

3. Provide sand of color needed to match pavers, for approval by Landscape Architect.

2.8 PAVER SEALER

A. Pavers shall be sealed using a manufacturer recommended concrete paver sealer.

1. Manufacturer

a. Hanover Architectural Products, Inc.
5000 Hanover Road
Hanover, PA 17331
Phone: (717) 637-0500
Toll Free: (800) 426-4242
Fax: (717) 637-7145
www.hanoverpavers.com

b. Sikagard Natural Look Sealer
Sika Corporation
201 Polito Ave
Lyndhurst, NJ 07071
Phone: (800) 933-7452
Toll Free: (800) 933-SIKA
Fax: (201) 933-6225
usa.sika.com

c. Approved Equal

2. Type: Intensifying Sealer or Natural Sealer

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Where pavers are to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.

B. Proof-roll prepared subgrade according to requirements in Section 312000 "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after

deficient subgrades have been corrected and are ready to receive subbase and base course for unit pavers.

3.3 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.

B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

D. Joint Pattern: See Drawings.

E. Tolerances: Do not exceed 1/32-inch unit-to-unit offset from flush (lippage) nor 1/8 inch in 10 feet from level, or indicated slope, for finished surface of paving.

3.4 MORTAR SETTING-BED APPLICATIONS

A. Saturate concrete sub-base with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

B. Apply mortar-bed bond coat over surface of concrete sub-base about 15 minutes before placing mortar bed. Limit area of bond coat to avoid its drying out before placing setting bed. Do not exceed 1/16-inch thickness for bond coat.

C. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting- bed material that has reached initial set.

D. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch- thick bond coat to mortar bed or to back of each paver with a flat trowel.

E. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.

3.5 FIELD QUALITY CONTROL

A. After removal of excess joint sand, check final elevations for conformance to the drawings

3.6 REPAIRING, POINTING, AND CLEANING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining

units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

B. Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.

C. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.

1. Remove temporary protective coating as recommended by coating manufacturer and as acceptable to paver and grout manufacturers.
2. Do not allow protective coating to enter floor drains. Trap, collect, and remove coating material.

END OF SECTION 32 14 00

SECTION 32 17 23 - PAVEMENT MARKINGS AND MISCELLANEOUS SIGNING

PART 1 GENERAL

1.1 SUMMARY

A. This work consists of furnishing and placing pavement striping and signage in accordance with the plans, specifications, and the Manual of Uniform Traffic Control Devices (MUTCD).

1. Closeout submittals.

PART 2 PRODUCTS

2.1 MATERIALS

A. Traffic Paint: Material shall be alkyd or water-borne traffic paint. Each container shall bear a label with name and address of manufacturer, trade name or trademark, type of paint, number of gallons, batch number and date of manufacture.

B. Paints shall be products listed in the LA DOTD QPL, shall show no excessive settling, caking or increase in viscosity during 6 months of storage, and shall be readily stirred to a suitable consistency for spray application.

1. Alkyd Traffic Paint: Material shall be a rapid-setting compound suitable for use with hot application equipment. The material shall meet the following requirements:

PROPERTY	TEST METHOD	REQUIRMENTS MIN. / MAX.
Weight, lb/gal	ASTM D 1475	12.0
Viscosity@ 77DF, Krebs Units	ASTM D 562	85 115
Drying Time, s	ASTM D 711	--- 180
Directional Reflectance, %	ASTM D 97	80 ---
White		50 ---
Yellow		
Bleeding	Fed. Spec. TT-P-115	Pass
Total Solids, % by weight	ASTM D 1644, Method A	70 ---
Film Shrinkage1		Pass
Hiding Power2		Pass
Pigment, %	ASTM D 2371 50	50 ---
Nonvolatiles in Vehicle, % by wt	ASTM D 215	35 ---

Flexibility		Pass
Pigment Composition3	Fed. Spec. TT-P-1952	Pass

a. Film Shrinkage: Cast a wet film 30 mils thick over a glass plate. Allow sample to cure at room condition for 4 to 5 hours. Cured film shall have a minimum thickness of 12 mils.
b. Hiding Power: Paint shall have a wet hiding power of at least 350 square feet per gallon. Compound shall have sufficient hiding power to cover any pavement when applied at wet film thickness of mils.
c. Pigment Composition: White paint shall contain at least 1.5 pounds of TiO2 pigment per gallon with at least 92% TiO2 content. The TiO2 shall conform to ASTM D 476. Yellow paint shall contain at least 1.3 pounds of
medium chrome yellow pigment per gallon (ASTM D 211, Type III).

C. Water Borne Traffic Paint: Material shall be a rapid-setting waterborne compound suitable for use with hot application equipment. Material shall meet the following requirements:

PROPERTY	TEST METHOD	REQUIRMENTS MIN. / MAX.
Weight, lb/gal	ASTM D 1475	12.0
Viscosity@ 77DF, Krebs Units	ASTM D 562	85 115
Drying Time, s	ASTM D 711	--- 180
Directional Reflectance, %	ASTM D 97	80 ---
White		50 ---
Yellow		
Bleeding	Fed. Spec. TT-P-115	Pass
Total Solids, % by weight	ASTM D 1644, Method A	70 ---
Film Shrinkage[1]		Pass
Hiding Power[2]		Pass
Pigment, %	ASTM D 2371	50 ---
Nonvolatiles in Vehicle, % by wt	ASTM D 215	35 ---
Flexibility		Pass
Pigment Composition[3]	Fed. Spec. TT-P-1952	Pass

[1] Paint applied at 15 mils wet on road surface with paint heated to 120-150DF shall not show tracking when vehicle crosses at 3 minutes.
[2] Paint shall show no excessive setting, caking or increase in viscosity during 12-month storage and shall be readily stirred to a consistency for use in striping of mils.
[3] Yellow shall match Federal Test Standard No. 595, Color 13538. White shall be a clean, bright, untinted binder.
[4] White paint shall contain at least 1.0 lb of TiO2 per gallon conforming to ASTM D 476.

2.2 GLASS BEADS FOR DROP-ON APPLICATION: GLASS BEADS SHALL BE COLORLESS, CLEAN AND TRANSPARENT, AND FREE FROM MILKINESS OR EXCESSIVE AIR BUBBLES. THE CONTRACTOR MAY FURNISH MOISTURE-PROOF BEADS.

A. Shape: At least 70% of beads on each screen shall be true spheres as determined by microscopic Examination.

B. Refractive Index: Glass beads shall have a Refractive Index of 1.5 to 1.6 when tested by liquid immersion method at 77DF. Size and quality of beads shall be such that performance requirements for retroreflective pliant polymer film will be met.

C. Gradation: Beads shall conform to the following gradation when tested by DOTO TR 634:

U.S. Sieve	% Retained
No. 20	0
No. 30	10 – 20
No. 50	30 – 75
No. 80	9 – 32 [1]

[1] No more than 15% shall pass No. 80 sieve.

D. Acid Resistance: Approximately 100 beads shall be placed on a microscope slide and immersed in a 3N-H2SO4 solution. After 10 minutes immersion, not more than 20 % of beads by count shall show a hazed surface, and there shall be no popping or bursting of beads.

E. Sodium Sulfide Resistance: Place approximately 1 gram of beads in glass container with stopper and cover with a solution of 50% Na2S, 48% distilled water, and 2% Aerosol OL or similar wetting agent. Shake container frequently and examine beads after 1 hour. Beads shall show no darkening.

2.3 HANDICAPPED PARKING

A. Screen Printed Signs

1. 18 Gage bonderized steel with blue baked enamel finish and white screen-printed copy.

B. Copy and Size

1. "Handicapped Parking Only" – 12 inches by 18 inches.

2. "Van Accessible" – 12 inches by 6 inches.

C. Post: Galvanized pipe column minimum 9 feet long.

2.4 TEMPORARY SIGNS AND BARRICADES: THE CONTRACTOR SHALL FURNISH AND INSTALL TEMPORARY CONSTRUCTION SIGNS AND BARRICADES BEFORE CONSTRUCTION BEGINS. WHEN CONSTRUCTION SIGNS ARE IN PLACE AND APPROVED, EXISTING PERMANENT SIGNS THAT ARE IN CONFLICT WITH CONSTRUCTION SIGNS SHALL BE COVERED OR REMOVED. THAT CONTRACTOR SHALL FURNISH AND INSTALL ADDITIONAL SIGNS AS NECESSARY DURING CONSTRUCTION, RELOCATE SIGNS ON THE PROJECT WHEN REQUIRED, MAINTAIN SIGNS BY CLEANING OR REPLACING AS NECESSARY, AND REMOVE CONSTRUCTION SIGNS UPON COMPLETION OF THE WORK.

2.5 PERMANENT ROADSIDE SIGNS: REMOVAL OF EXISTING SIGNS SHALL ALWAYS BE COORDINATED WITH NEW SIGN CONSTRUCTION TO PROVIDE ADEQUATE SIGNING.

A. Posts: The contractor shall determine length of post required at each sign location. Post shall be driven vertical by methods that will not damage posts. Minimum ground penetration shall be 2 feet for delineator and object marker signs, and 3 feet for other signs.

B. Sign Faces: Signs shall be mounted 7 feet above pavement edge to bottom of sign, except that a secondary sign below another sing shall be mounted 4 feet from pavement edge to bottom of sign. Signs shall have a lateral clearance of 2 feet from pavement edge (or face of curb) to edge of sign, except that delineators and object markers on open ditch sections shall have a lateral clearance of 2 feet from shoulder edge to sign.

PART 3 EXECUTION

3.1 PAINTED STRIPING:

A. Paint shall be applied at approximately 130°F to a thickness of 15 dry mils or 22 wet mils. Glass beads shall be applied immediately to wet paint at rate of 10 lb/gal of paint by compressed air.

3.2 PROTECTING OF STRIPING:

A. Traffic shall be prevented from crossing a wet stripe by use of flaggers or other methods. Stripes which have been marred or picked up by traffic shall be repaired, and pavement outside striping cleaned.

3.3 INSTALLATION:

A. Install signs plumb, level and square and in proper planes with other work, at heights as indicated. Attach as recommended by sign manufacturer.

3.4 EXTERIOR INSTALLATION – PARKING SIGNS:

A. Mount posts in 12-inch round by 2'-6" deep concrete footing.

3.5 PAYMENT:

A. Payment for pavement striping will be made as a part of the lump sum price bid for the entire project.

END OF SECTION

SECTION 32 84 00 - 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. This Section includes valves, piping, sprinklers, specialties, accessories, controls, and wiring for lawn and shrubbery irrigation systems.

1.3 DEFINITIONS

A. Pipe sizes used in this Section are nominal pipe size (NPS) in inches. Tube sizes are standard size in inches. Equivalent SI (metric) sizes are indicated in millimeters (mm) in parentheses.

B. Pressure piping: Piping downstream from point of connection to and including control valves. Piping is under irrigation system pressure. Piping in this category includes pressure regulators, water meters, and backflow preventers, when used.

C. Circuit Piping: Piping downstream from control valves to irrigation system sprinklers, emitters, devices, and drain valves. Piping is under pressure (less than pressure piping) during flow.

D. Control Valve: Manual or automatic (electrically operated) valve for control water flow to irrigation system zone.

E. Drain Piping: Downstream from circuit piping drain valves. Piping is not under pressure.

F. Drain Valve: Manual or automatic (pressure operated) drain valve for draining of irrigation system circuit piping.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Location of Sprinklers and Devices: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards.

B. Minimum Water Coverage: Contractor shall be responsible for 100% coverage for all irrigated areas.

C. Components and Installation: Capable of producing piping systems with the following minimum pressure ratings: 50 psi static, 32 psi working
   1. Pressure Piping: 50 psi (static).
   2. Circuit and Drain Piping: 32 psi (working).

1.5 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections:

B. Materials List: Include sleeving, pipe, fittings, mainline components, sprinkler components, drip irrigation components, control system components, and other components shown on drawings and installation details or described herein. Include pipe sealant, wire, wire connectors, ID tags, and other miscellaneous items. Quantities of materials need not be included.

C. Product Data: Submit manufacturer's product data including pressure rating, rated capacity, settings, and electrical data of selected models for the following if different than specified on plans:
   1. Backflow preventers, including size and test equipment

2. Pressure regulators.
3. Valves, including general-duty, underground, manual and automatic control, and quick coupler types, and valve boxes.
4. Sprinklers, including emitters, bubblers, and devices.
5. Controls, including controller wiring diagrams.
6. Wiring.
7. Any other component listed on material list.

D. Shop Drawings: Contractor shall submit shop drawings to illustrate the following:
1. Water meter size and location
2. Backflow preventor size and location
3. mainline layout
4. Sprinkler head layout
5. Controller location
6. Layout of any other major components

E. Maintenance data for inclusion in "Operating and Maintenance Manual" for:
1. Backflow preventers, including instructions for testing.
2. Pressure regulators.
3. Automatic control valves.
4. Sprinklers.
5. Controllers.

F. Warranty: Manufacturer's standard warranty.

1.6 QUALITY ASSURANCE

A. Comply with requirements of utility supplying water for prevention of backflow and back-siphonage.

B. Comply with requirements of authority with jurisdiction for irrigation systems.

C. Product Options: Irrigation system piping, specialties, and accessories are based on specific types, manufacturers, and models indicated. Components with equal performance characteristics produced by other manufacturers may be considered, provided deviations in dimensions, operations, and other characteristics do not change design concept or intended performance as judged by the Landscape Architect. The burden of proof of product equality is on the Contractor.

1.7 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Verify that irrigation system piping may be installed in compliance with original design and referenced standards.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate irrigation systems work with landscape work specified in Division 2 Section "Landscape Work."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage: Store materials in clean, dry area in accordance with manufacturer's instructions. Keep materials in manufacturer's original, unopened containers and packaging until installation.

C. Handling: Protect materials and finish during handling and installation to prevent damage.

1.10 TESTING

A. Products will be free from defects in material and/or workmanship for a period of three years from the date of invoice. Schedule testing with Owner's Representative a minimum of three days in advance of testing.

B. Mainline pipe jointed with rubber gaskets or threaded connections may be subjected to pressure test at any time after partial completion of backfill. Allow irrigation pipe jointed with solvent-welded PVC joints to cure at least 24 hours before testing.

C. Subsections of mainline pipe may be tested independently, subject to review of Irrigation Engineer.

D. Provide clean, clear water, pumps, labor, fittings, and equipment necessary to conduct tests or retests.

E. Test Documentation:
   1. Submit a written report of all tests to Owner. Each test must list name of test, date of test, name of the individual completing the test, name of the company completing the test. Submit test documentation to Owner within three (3) days of completing test.
   2. Hydraulic Pressure Test – Include starting and ending pressures. If pipe does not pass test, document reason for pressure loss.
   3. Copper Tracing Wire – Include voltage readings for length of tested wire. If wire does not pass test, document reason for voltage failure.
   4. Control System Grounding – Include identification of each grounding equipment by the remote control valve number and the ohms resistance to ground.

F. Hydrostatic Pressure Test:
   1. Subject mainline pipe to hydrostatic pressure equal to 120 PSI for two hours. Test with mainline components installed.
   2. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
   3. Purge air from mainline pipe before test. Attach pressure gauge to mainline pipe in test section.
   4. Observe pressure loss on pressure gauge. If pressure loss is greater than 5 PSI, identify reason for pressure loss. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat test until pressure loss is equal to or less than 5 PSI.
   5. Visually inspect irrigation pipe for leakage and replace defective pipe, fitting, joint, valve, or appurtenance. Repeat test until pipe passes test.
   6. Cement or caulking to seal leaks is prohibited.

G. Operational Test:
   1. Activate each remote control valve in sequence from controller. Provide either one additional personal with radio or use handheld remote to activate remote control valves from controller. Manually activating remote control valve using manual bleed mechanism at remote control valve is not an acceptable method of activation. Owner's Representative will visually observe operation, water application patterns, and leakage.
   2. Replace defective remote control valve, decoder, solenoid, two wire cable, wiring, or appurtenance to correct operational deficiencies.
   3. Replace, adjust, or move water emission devices to correct operational or coverage deficiencies.
   4. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.
   5. Repeat test(s) until each lateral passes all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to Owner.

H. Copper Tracing Wire:
   1. Pass current through wire and demonstrate that wire is capable of locating all mainline pipe.
   2. If wire will not pass current, locate break in circuit, repair or replace wire or splice, and test until tracer wire works in accordance for its intended use.

I. Control System Grounding:

1. Test for proper grounding of control system and two wire cable per manufacturer's recommendations. Test results must meet or exceed manufacturer's guidelines for acceptance.
2. Replace defective wire, grounding rods, or appurtenances. Repeat test until manufacturer's guidelines are met.

J. Testing Review:
1. Failure of initial testing review will require additional review. Payment of costs, including travel expenses and site visits by Owner's Representative, for additional reviews that may be required due to non-compliance with the Construction Documents will be Contractor's responsibility.

K. Field Mock Up:
1. Fabricate an on-site example of the following assemblies for demonstration prior to construction. The mock-ups must be presented to the Owner's Representative and meet approval prior to construction.
   a. Remote Control Valve Assembly: Mock-up is to include remote control valve, wire splices, two wire cable, and decoder.
   b. Decoder Grounding: Mock-up is to include decoder, wire splices, and grounding equipment.

1.11 CONSTRUCTION REVIEW

A. The purpose of on-site reviews by Owner's Representative is to periodically observe work in progress, Contractor's interpretation of construction documents, and to address questions with regard to installation.

B. Schedule reviews for irrigation system layout or testing with Owner's Representative as required by these specifications.

C. Impromptu reviews may occur at any time during project.

D. A review will occur at completion of irrigation system installation and Project Record Drawing submittal.

1.12 WARRANTY

A. Products will be free from defects in material and/or workmanship for a period of three years from the date of invoice.

B. The warranty does not apply to damage resulting from accident, alteration, misuse, tampering, negligence, or abuse.

C. Purchasers should be aware that normal use of these high quality products can result in superficial damage affecting the finish. Scratches, nicks, and dents are to be considered normal wear and tear, and are not the responsibility of the manufacturer.

PART 2 - PRODUCTS

2.1 QUALITY

A. Use new materials without flaws or defects.

2.2 SUBSTITUTIONS

A. Specified equipment is only used to denote the general style, type, character, and quality standard of the product desired. Bidders are not restricted to the specified brand, make, or manufacturer.

B. Use specified equipment, or pre-approved equal. Alternative equipment must be approved by Landscape Architect prior to bidding. Changes and associated design costs to accommodate alternative equipment are Contractor's responsibility.

C. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at Contractor's option.

2.3 PIPES AND TUBES

A. Mainline Pipe and Fittings:

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with integral belled end.
2. Use Schedule 40, Type 1 pipe, conforming to dimensions and tolerances established by ASTM Standard D2241.
3. Use solvent weld pipe for mainline pipe with nominal diameter less than or equal to 3-inches. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784. Use primer approved by pipe manufacturer. Use solvent cement conforming to ASTM Standard D2564.
4. Mainline pipe within sleeves: Use solvent weld pipe for mainline pipe with nominal diameter 3-inches and smaller installed within sleeves.

B. Lateral Pipe and Fittings:

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D1784, with integral belled end suitable for solvent welding.
2. Use Class 200, SDR-21, rated at 200 PSI, conforming to dimensions and tolerances established by ASTM Standard D2241SDR-26,. Use PVC pipe rated at higher pressures than Class 160 in cases where small nominal diameters are not manufactured in Class 160. Use solvent weld pipe for lateral pipe. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1784 for PVC pipe. Use primer approved by pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of type approved by pipe manufacturer.

C. Specialized Pipe and Fittings:

1. Copper pipe: Use Type "K" rigid pipe conforming to ASTM Standard B88.
2. Use wrought copper or cast bronze fittings, soldered, flared mechanical, or threaded joint per installation details or local code. Use a 95-percent tin and 5- percent antimony solder.
3. Use dielectric union wherever copper-based metal (copper, brass, bronze) is joined to iron-based metal (iron, galvanized steel, stainless steel).
4. Ductile iron pipe: Use Class 50 conforming to ANSI A21.51 (AWWA C151). Use mechanical joints conforming to ANSI A21.10 (AWWA C110) and ANSI A21.11 (AWWA C111).
5. Galvanized steel pipe: use Schedule 40 conforming to ASTM Standard A53. Use galvanized, threaded, standard weight, malleable iron fittings.
6. Use PVC Schedule 80 nipples and PVC Schedule 40 or 80 threaded fittings for threaded pipe connections.
7. Joint sealant: Use non-hardening, nontoxic pipe thread sealant formulated for use on threaded connections and approved by pipe fitting or valve manufacturer.

2.4 COPPER TRACING WIRE

A. Use American Wire Gauge (AWG) No. 12-1 solid copper, 600 volt, Type UF or PE cable, UL approved for direct underground burial.

B. Color: Tracing wire must be of color different from that of any active two wire cable, control wire, or common wire. Wire color shall be continuous over entire length.

C. Splices: Use 3M DBR/Y wire connector with waterproof sealant.

2.5 MAINLNE COMPONENTS

A. Check Valve Assembly: as presented in drawings and installation details.

B. Blow Out Assembly: as presented in drawings and installation details.

C. Isolation Gate Valve Assembly: as presented in drawings and installation details.

D. Quick Coupling Valve Assembly: as presented in drawings and installation details.

2.6 SPRINKLER IRRIGATION COMPONENTS

A. Check Remote Control Valve (RCV) Assembly for Sprinkler Laterals:
   1. Rainbird PESB
   2. Hunter ICV
   3. Approved Equal

B. Sprinkler Assembly: as presented in drawings and installation details.

2.7 JOINING MATERIALS

A. Solvent Cement: ASTM F 656 primer and ASTM D 2564 solvent cement.

2.8 BACKFLOW PREVENTERS

A. See Plumbing Drawings.

2.9 AUTOMATIC CONTROL SYSTEM

A. See Drawing for Irrigation Systems Components List.

B. Irrigation Controller Assembly:
   1. Controller
      a. Rainbird ESP-LXD 2-Wire Decoder Controller
      b. Hunter ICC2 Controller with EZDS 2-Wire Module
      c. Approved Equal
   2. Controller Assembly Enclosure: As presented in drawings and installation details.
   3. Electrical conduit: Use PVC Schedule 40 conduit conforming to dimensions and tolerances established by ASTM Standard D-1785. Use Schedule 40, Type 1, PVC solvent weld sweep fittings for PVC conduit conforming to ASTM Standards D2466 and D1784 for buried installations. Use rigid metallic conduit with sweep elbows for above grade installations.
   4. Lightning protection: As presented in drawings and installation details.
   5. Wire markers: Prenumbered or labeled with indelible nonfading ink, made of permanent, nonfading material.

C. Two Wire Cable From Controller to Decoders:
   1. Use two wire cable per controller manufacturer's guidelines.
   2. Splices
      a. 3M DBR/Y wire connector with waterproof sealant.
      b. Dryconn DBR/Y-600 wire connector with waterproof sealant.
      c. Approved Equal
   3. Electrical conduit: Use PVC Schedule 40 conduit conforming to dimensions and tolerances established by ASTM Standard D-1785. Use Schedule 40, Type 1, PVC solvent weld sweep fittings for PVC conduit conforming to ASTM Standards D2466 and D1784 for buried installations. Use rigid metallic conduit with sweep elbows for above grade installations.
   4. Warning tape: Inert plastic film highly resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. Three inches wide, colored red, and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW."

D. Low Voltage Control Wire from Solenoid Valve to Decoder:
   1. Use American Wire Gauge (AWG) No. 14-1 solid copper, 600 volt, Type UF or PE cable, UL approved for direct underground burial for individual control wires from the decoder to each remote control valve assembly.
   2. Color: Use colors same as decoder station wires. Use easily distinguished colors for other control wires. Wire color shall be continuous over entire length.
   3. Use 3M DBR/Y or Dryconn DBR/Y-600 wire connector with waterproof sealant.

E. Instrumentation:

1. As presented in the drawings and installation details.

G. Rain Sensor:

1. Sensor
   a. Rain Bird WR2-RFC-48
   b. Hunter RAIN-CLIK
   c. Approved Equal
2. Location to be verified with Landscape Architect.

H. Controller Mount: Wall mounted – see irrigation drawings for location.

I. Other Components
1. Tools and Spare Parts: Furnish operating keys, servicing tools, test equipment, spare parts and other items indicated in drawings and specifications.
2. Other Materials: Provide other materials or equipment shown on drawings or installation details that are part of irrigation system, even though items may not have been referenced in specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Investigate and determine available water supply water pressure and flow characteristics.

3.2 PREPARATION

A. Set stakes to identify proposed sprinkler locations. Obtain landscape Architect's approval before excavation.

3.3 PIPING APPLICATIONS

A. Refer to Part 2 of this Section for detailed specifications for pipe and fittings products listed below. Use pipe, tube, fittings, and joining methods according to the following applications. Piping in pits and above ground may be joined with flanges instead of joints indicated.

B. Use pipe, tube, fittings, and joining methods according to the following applications.
1. Pressure Piping Above ground: Use the following:
   a. ASTM D 1785, Schedule 40 PVC pipe, ASTM D 2466 Schedule 40 PVC fittings, solvent cemented joints.
2. Pressure Piping Underground: Use the following:
   a. Main Lines - ASTM D 2466 Schedule 40 PVC, ASTM D 2466 Schedule 40 PVC fittings, and solvent cemented joints
   b. Lateral Lines - ASTM D 1785 Class 200 PVC pipe, ASTM D 2466 Schedule 40 PVC fittings, and solvent cemented joints
   c. HDPE Pipe: Lateral piping in sleeves under building shall be 1" HDPE.
3. Circuit Piping: Use the following:
   a. ASTM D 1785 Class 200 PVC pipe, ASTM D 2466 Schedule 40 PVC fittings, and solvent cemented joints.
4. Swing Joints: Use the following:
   a. ASTM D1785 Schedule 40 PVC pipe, ASTM D 2466 Schedule 40 PVC fittings, and solvent cemented joints. (use only for 'rotor' type heads).
   b. Plastic piping made for this application "Funny Pipe" shall be used instead of pipe and fittings specified for all 'spray' type heads.
5. Sleeves: ASTM D 1785, Schedule 40, polyvinyl chloride (PVC) plastic pipe; ASTM D 2466, Schedule 40, PVC plastic, socket-type fittings and solvent- cemented joints.

3.4 JOINT CONSTRUCTION

A. Polyvinyl Chloride (PVC) Piping Solvent-Cemented Joints: Construct joints according to ASTM D 2672 and ASTM D 2855.
   1. Handling of Solvent Cements, Primers and Cleaners: Comply with procedures in ASTM F 402 for safe handling when joining plastic pipe and fittings with solvent cements.

3.5 PIPING SYSTEMS – COMMON REQUIREMENTS

A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, and in other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.

B. Install components having pressure rating equal to or greater than system operating pressure.

C. Install piping free of sags and bends.

D. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

E. Install fittings for changes in direction and branch connections.

3.6 PIPING INSTALLATION

A. Install underground piping according to ASTM D 2774.

B. Lay piping on solid sub-base, uniformly sloped without humps or depressions.
   1. Slope exhaust header in drip system down toward drain valve minimum of ½ inch in 10 feet (1:240).
   2. Install polyvinyl chloride (PVC) plastic pipe in dry weather when temperature is above 40 deg F (4 deg C). Allow joints to cure at least 24 hours at temperature above 40 deg F (4 deg C) before testing, unless otherwise recommended by manufacturer.

C. Drain Pockets for Drip System: Excavate to a minimum of 12” x 12”.
   1. Backfill with cleaned gravel or crushed stone, graded from 3 inches (75mm) to ¾ inch (19mm) minimum.

D. Minimum Cover: Provide following minimum cover over top of buried piping:
   1. Pressure Piping: Greater depth of minimum of 24 inches (915 mm) below finished grade, or not less than 18 inches (460 mm) below average local frost depth.
   2. Circuit Piping: 12 inches (300 mm).
   3. Drain Piping: 12 inches (300 mm).
   4. Sleeves: 24 inches (600 mm).
   5. Drip tube: 2”

E. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed, by tunneling, boring, or jacking.

F. Install piping under sidewalks and paving in sleeves provided.

3.7 VALVE INSTALLATION

A. Valves: Install underground valves in valve boxes.

B. Control Valves: Install in valve control valve boxes, arranged for easy adjustment and removal. Install union on downstream side.

3.8 WATER METER INSTALLATION

A. Install one appropriately-sized water meter that will be dedicated to irrigation system. Coordinate meter size with the local municipality or regulatory agency. Locate meter per layout on Drawings.

3.9 BACKFLOW PREVENTER INSTALLATION

A. Contractor shall install the backflow prevention device at the location as shown on the Drawings.

3.10 SPRINKLER INSTALLATION

A. Sprinklers: Flush circuit piping with full head of water and install sprinklers after hydrostatic test is completed.
   1. Install sprinklers at manufacturer's recommended heights.
   2. Locate sprinklers to maintain a minimum distance of 4 inches (100 mm) from walls and other structures, unless otherwise indicated.

3.11 AUTOMATIC CONTROL SYSTEM INSTALLATION

A. Install control wiring in same trench with piping.

3.12 CONNECTIONS

A. Connect piping to sprinklers, devices, valves, control valves, specialties, and accessories.

B. Connect water supplies to irrigation systems. Include backflow preventers on potable water supplies.

C. Electrical Connections: Connect to power source, controllers, and automatic control valves.

D. Ground system

3.13 FIELD QUALITY CONTROL

A. Testing: Perform hydrostatic test of piping and valves before back-filling trenches. Piping may be tested in sections to expedite work.
   1. Cap and subject the piping system to a static water pressure of 50 psi above the operating pressure without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
   2. Repair leaks and defects with new materials and retest system of portion thereof until satisfactory results are obtained

3.14 CLEANING AND ADJUSTING

A. Flush dirt and debris from piping before installing sprinklers and other devices.

B. Adjust automatic control valves to provide flow rate of rated operating pressure required for each sprinkler circuit.

C. Adjust settings of controllers and automatic control valves.

3.15 COMMISSIONING

A. Starting Procedures: Follow manufacturer's written procedures. If no procedures are prescribed by manufacturers, proceed as follows:
   1. Verify that specialty valves and their accessories have been installed correctly and operate correctly.
   2. Verify that specified tests of piping are complete.
   3. Check that sprinklers and devices are correct type.
   4. Check that damaged sprinklers and devices have been replaced with new materials.
   5. Check that potable water supplies have correct type backflow preventers.
   6. Energize circuits to electrical equipment and devices.
   7. Adjust operating controls.

B. Operational Testing: Perform operational testing after hydrostatic testing Is completed, backfill is in place, and sprinklers are adjusted to final position.

3.16 DEMONSTRATION

A. Demonstrate to Landscape Architect that system meets coverage requirements and that automatic controls function properly.

B. Demonstrate to Owner's maintenance personnel operation of equipment, sprinklers, specialties, and accessories. Review operating and maintenance information.

C. Provide 7 days' written notice in advance of demonstration.

3.17 WARRANTY

A. Contractor shall warranty entire system to be complete and operational for a period of one year from the date of final project acceptance.

END OF SECTION 32 84 00

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. Fine grading and preparing lawn areas.
2. Furnishing and applying new topsoil.
3. Furnishing and applying soil amendments.
4. Furnishing and applying fertilizers.
5. Sodding new lawns.
6. Hydroseeding / hydromulching new lawns areas
7. Replanting unsatisfactory or damaged lawns.

B. Related Sections:
1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
2. Section 312001 "Earth Moving" for excavation, filling and backfilling, and rough grading.
3. Section 328400 "Planting Irrigation " for turf irrigation.
4. Section 329300 "Plants" for border edgings

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

C. 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.

D. 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.

E. 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.

F. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

G. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

H. 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.

1.4 ACTION 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.
   2. Product data for Soil Amendments and Fertilizer

1.5 INFORMATIONAL SUBMITTALS

A. Certification of Sod: From sod vendor indicating the botanical and common name of the grass sod to be provided.

B. Certification of Grass Seed: From seed vendor for each grass or meadow 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.

C. Qualification Data: For qualified landscape Installer.

D. Product Certificates: For soil amendments and fertilizers, from manufacturer.

E. Material Test Reports: For standardized ASTM D 5268 topsoil and imported or manufactured 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.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.
   1. Experience: Five years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
   2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
   3. 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.

1.7 DELIVERY, STORAGE, AND HANDLING

A. 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.

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.

1.8 PROJECT CONDITIONS

A. 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.

B. Planting Season: Hydroseed and install sod during normal planting seasons for the type of lawn work required. Correlate planting with specified maintenance periods to provide required maintenance from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Initial Turf and Meadow Maintenance Service: Maintain as required in Part 3. Provide full maintenance by skilled employees of landscape Installer. Begin maintenance as required in Part 3 immediately after each area is planted and continue until Satisfactory Turf is established and accepted. The maintenance period shall not be less than the following periods:

1. Sodded Turf: 30 days from date of Substantial Completion.
2. Hydro-seeded Lawns: 90 days from date of Substantial Completion.
3. Hydro-seeded Meadows/Native Grasses: 12 months from Substantial Completion

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

A. Turfgrass Sod: Certified Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod at a thickness of approximately 2” and of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.

1. Strongly rooted ‘Palmetto’ St. Augustine sod (or approved, similar variety), not less than 3 years old, from off site source; free of weed, undesirable plants, large stone and other materials detrimental to development and maintenance of the lawn. Sod shall consist of ninety-five (95%) of the specified grass (St. Augustine). Sod that fails to meet requirements shall be rejected.

2.2 GRASS SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with the Association of Official Seed Analysts' "Rules for Testing Seeds" for purity and germination tolerances.

1. Seed Type: Provide seed of grass species and varieties as indicated at end of Section (3.5).

2.3 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. Provide lime in form of ground dolomitic limestone.

B. Aluminum Sulfate: Commercial grade, unadulterated.

2.4 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 1/2-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. 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.

2.5 FERTILIZERS

A. Granular Fertilizer:

1. Complete Fertilizer of 1-2-2 ratio.
2. Gypsum or dolomite calcium fertilizer.
3. Urea or IBDU fertilizer.
4. Rates to be determined based on soil fertility analysis and environmental conditions.

B. Liquid Biological and Biostimulant – Post sod and meadow installation
1. Verma Plex® Concentrate
   a. Apply 15 ounces per 1000 SF active ingredient with 3 gallons total spray volume per 1000 SF
2. 6-20-6
   a. Apply with VermaPlex at 15 ounces per 1000 SF active ingredient and a total spray volume of 3 gallons per 1000 SF.
3. Do not mix with pesticides.
4. Supplier:
   a. Southern Organics & Supply
      4813 East Fork Lane
      Monroe, NC 28110
      Phone: 866-240-8501
      Web: www.southernorganicsandsupply.com

2.6 PLANTING SOILS

A. Planting Soil: ASTM D 5268 topsoil, with pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones 1 inch or larger in any dimension and other extraneous materials harmful to plant growth. Mix ASTM D 5268 topsoil with soil amendments and fertilizer at rates recommended

B. 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.

C. 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.

2.7 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

C. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.8 SOIL STABILIZATION MATTING

A. Rolls & Blankets: Net-Free, 100% biodegradable wood excelsior, natural straw, or coconut-fiber mats provided in rolls. Include manufacturer's recommended steel wire staples or biodegradable staples at 48" O.C. max.

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 TURF AREA SOIL PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
   1. 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.

C. Standard Turf Preparation: For new construction projects, projects with significant site renovations, areas of grade changes, areas of unacceptable topsoil, and all other areas with compacted soil conditions at the proposed lawn areas, especially in and around buildings, parking lots, or other hardscape areas, the following steps shall be taken:
   1. Limit preparation to areas that will be planted in the immediate future.
   2. Excavate and remove compacted or unacceptable soil to a depth of 4" below the final grade elevation in the turf areas.
   3. After excavation, loosen subgrade to a maximum depth of one inch (1"). Remove stones larger than 1-1/2 inches in any dimension and all sticks, roots, rubbish, and all extraneous matter. Agricultural lime, if required, shall be spread prior to scarifying the areas.
   4. Install 2" min. of clean topsoil on top of loosened subgrade.
   5. Apply soil amendments and fertilizers with topsoil at rates recommended. Delay mixing fertilizer if planting does not follow placing of planting soil within a few days. Either mix soil before spreading or apply soil amendments on surface of spread topsoil and mix thoroughly into topsoil before planting.

D. Preparation of Unchanged Grades: Where lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, or where existing topsoil is sufficient to support plant growth, prepare soil as follows:
   1. No sod cutting, application of herbicides, or soil placement shall be permitted beneath the canopies of existing trees that are scheduled to remain, except at the direction of the Landscape Architect.
   2. Apply approved grass and weed herbicide on area to be sodded at manufacturer's recommended rate and under weather condition to be effective. Avoid overspray onto adjacent areas and other plant materials.
   3. Areas to receive slab sod shall be pulverized to a depth of at least 3", graded and cleared of weeds, roots, grass, stones and other debris. Excessive roots, which may be present in some areas where trees have been removed, shall be removed by hand or mechanical method. Remove waste material, including grass, vegetation, and turf, and legally dispose of it off the Owner's property. Agricultural lime, if required, shall be spread prior to scarifying the areas.
   4. Apply required soil amendments and initial fertilizers and mix thoroughly into scarified soil to meet proposed grade.

E. Grade lawns and grass areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to are-as that can be planted in the immediate future. Remove trash, debris, stones larger than 1-1/2 inches in any dimension, and other objects that may interfere with planting or maintenance operations.

F. Moisten prepared lawn areas before planting when soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

G. Restore prepared areas if eroded or otherwise disturbed after fine grading and before planting.

H. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.3 SODDING NEW LAWNS

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Sod shall be placed in areas designated on the drawings. Sod to be installed prior to October 15th.
   1. Sod shall be harvested in 42-inch and 21-inch widths. Depth of soil harvested for sod shall be 0.25 to 0.5 inches measured from below the thatch layer.
   2. When placing sod, the Contractor shall use great care so as not to disturb the finished grades of the rootzone mix. Contractor will make provisions to avoid rutting of the

Rootzone Mix. Equipment used to lay sod shall have large floatation tires. Equipment is not allowed to drive over laid sod.

3. The first row of sod should, if possible, be laid in a straight line with subsequent rows placed parallel and tightly against one another. Lateral joints shall be staggered 36 inches minimum to promote more uniform growth and strength. Do not stretch or overlap sod pieces. All joints are butted tight in order to prevent voids. Lap ends of sod rolls 6" and cut new tight joint.
4. Lay sod across angle of slopes exceeding 1:3.
5. 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.

3.4 HYDROSEEDING / HYDROMULCHING NEW LAWNS

A. Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application. Apply slurry uniformly to all areas to be seeded with tackifier at the rate required to obtain desired seed sowing rate. Increase the amount of tackifier in mixture or apply hydroseeding with thicker application of tackifier in steeply sloped areas of project.

B. Seed Rates:

1. Seeding operations done September 1st through January 31st – Apply Annual Rye Grass seed at a rate of 2lbs. per 1000sf at time of project completion. The Landscape Contractor will be required to perform a second seeding operation at the beginning of the next growing season by over-seeding with a mixture of un-hulled Common Bermuda applied at a rate of 1 ½ lbs. per 1000sf and Centipede applied at a rate of 5 ½ lbs. per 1000sf.
2. Seeding operations done February 1st through August 31st – Apply a mixture of hulled Common Bermuda applied at a rate of 1 ½ lbs. per 1000sf and Centipede applied at a rate of 5 ½ lbs. per 1000sf

3.5 POST INSTALLATION TURF MAINTENANCE

A. The Contractor shall be responsible for the maintenance, fertilization, watering, performance, and operation of the turf area for the specified maintenance period. Maintenance shall consist of watering, replanting, maintaining existing grades, and repair of erosion damage as specified and any other work incidental to proper maintenance.

1. When the surface to be grassed becomes gullied or otherwise damaged or repair work is required due to faulty operations or negligence on the part of the contractor, repair work shall be performed at no additional cost to the owner.

B. Mowing: One mowing shall be performed at the time that the grass obtains a height of two inches (2”). At that time, it shall be mowed to a height of one and a half inches (1-1/2”). Repeat mowing as required to maintain specified height without cutting more that 40 percent of the grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings, to maintain grass height of 1½” - 2”.

C. Weed and Pest Control: The Contractor is to maintain the turf free from disease and infestation. Required treatments will be made according to the needs of the turf as determined by the Owner’s Representative. Comply with applicable requirements of Federal, State, and Local laws, regulations and codes having jurisdiction over chemical treatments.

D. Maintenance Log: The Contractor shall maintain a log of all maintenance activities on the construction site at all times. Make a daily record of all work performed until final acceptance of the work, including:

1. Daily soil and ambient temperature measurements at a minimum of 2 times per day at peak temperature periods of the day.
2. Chemical application logs – All labels, application rates, equipment used to apply chemicals shall be kept in the maintenance log. Chemicals shall include all fertilizers, bio-stimulants, growth regulators, and pesticides.
3. Irrigation applications – Any use of the irrigation system should be documented as to zones used, duration of application, and any problems with coverage or system components.
4. System repair logs for each system must be maintained. Record replaced or repaired items such as irrigation heads and valves, or any drainage components in the appropriate system repair log.

E. Watering: Install and maintain permanent or temporary piping, hoses, and turf-watering equipment (if necessary) to convey water from sources and to keep turf uniformly moist to a depth of 2 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 is adequate.

F. Turf post fertilization: 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.

G. Inspection and Acceptance: Acceptance of Satisfactory Turf as outlined herein will be determined by visual inspection after the completion of the initial maintenance period.

3.6 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Landscape Architect
1. Turf has rooted into the Rootzone mix to a depth of 3 inches.
2. The turfgrass surface has a smooth appearance and no erosion or washout problems are visible
3. Turf is free of dead or bare spots in excess of 3 square inches in 5,000 SF.

B. Replant or repair lawns that are unsatisfactory.
1. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.7 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.

3.8 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 32 93 00 - 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. Excavation as required for all planting and backfilling tree pits.
2. Minor filling and leveling as necessary to insure survival of plants in all areas.
3. Furnishing, transporting, preparing and placing of prepared topsoil for plant beds.
4. Bed preparation.
5. Steel Landscape Edging
6. Furnishing and planting of tree, shrubs, and ground covers as indicated on Drawings.
7. Staking trees.
8. Samples and analyses for approval.
9. Maintenance during Period of Establishment (365 days), and one-year plant material guarantee.
10. Landscape gravel
11. Replacement of unsatisfactory plant material.

B. Related Sections:
1. Section 022310 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
2. Section 311000 "Site Clearing" for protection of existing trees and plantings, topsoil stripping and stockpiling, and site clearing.
3. Section 312001 "Earth Moving" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
4. Section 329200 "Turf and Grasses" for turf (lawn)

1.3 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. 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.

D. Finish Grade: Elevation of finished surface of planting soil.

E. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

F. 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.

G. 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.

H. Planting Area: Areas to be planted.

I. 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.

J. 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.

K. 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.

L. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

M. 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.

N. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

O. 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.

P. Contractor: The term "Contractor" as referred to in this section only means the Landscape Contractor. The Landscape Contractor shall be currently licensed by the Louisiana Horticulture Commission to do landscape contracting work in the State of Louisiana.

1.4 ACTION 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.
   4. Steel Landscape Edging

B. Samples for Verification: For each of the following:
   1. 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.
   2. Steel Landscape Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.
   3. Tree Staking System: Submit 1 full staking system for review
   4. Rock and Gravel Types: 1-quart volume of rock or gravel type required; in sealed plastic bags labeled by type. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, and texture.

1.5 INFORMATIONAL SUBMITTALS

A. 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.

B. 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.

C. Material Test Reports: For standardized ASTM D 5268 topsoil existing native surface topsoil existing in-place surface soil and imported or manufactured topsoil.

D. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

E. Warranty: Sample of special warranty.

1.6 APPLICABLE STANDARDS

A. Work shall be in strict accordance with sound nursery practice. The following documents, used as standards, are to be considered part of these Specifications.
1. American Standard for Nursery Stock, Latest edition, as published by the American Association of Nurserymen, Inc.
2. Standardized Plant Names, latest edition, as adopted by the American-Joint Committee on Horticultural Nomenclature.
3. Grades and Standards for Landscape Materials, latest edition, as prepared by the Louisiana Association of Nurserymen, Inc.

1.7 SPECIAL LANDSCAPE PROVISIONS

A. Contractor: The term "Contractor" as referred to in this section only means the Landscape Contractor. The Landscape Contractor shall be currently licensed by the Louisiana Horticulture Commission to do landscape contracting work in the State of Louisiana.

B. Water: All proposed landscaping is to be irrigated under an automatic irrigation system. It is the Contractor's responsibility to insure proper scheduling and quantity of watering of all plant material.

C. Finished Grading: It shall be the Contractor's responsibility to do whatever additional fine grading as may be required to bring areas to be planted back up to the existing finished grades or to grades specified on the Drawings or these Specifications. This shall also apply to existing slopes, berms, or lawn areas damaged during the Work herein, and the Contractor shall replace or repair and such existing area to return it to its original grade or condition.

D. Disposal of Waste Materials: Reusable items are to be removed and stored in such a manner that they may be used again. The Owner shall have priority for the selection of salvaged equipment and materials. Any excess soil and/or other materials determined to remain as the property of the Owner shall be removed and delivered to a location as designated by the Owner. Materials not retained by the Owner shall become the property of the Contractor and shall be removed from the site by the Contractor.

E. Period of Establishment and Replacement
1. Upon the completion of planting, and providing plants are in place, living and conform to these Specifications, this portion of the Contract will be given provisional acceptance.
2. The Contractor shall be responsible for replacing dead, damaged, or unhealthy plant materials and in general insuring proper plant growth by watering as needed for a Period of Establishment, which shall be 365 calendar days after the provisional acceptance is made. Plant materials shall be guaranteed for a period of one year after provisional acceptance.
3. Plant materials, which have partially died so that the shape, size, or symmetry has been damaged, shall be considered subject to replacement. In such case, the opinion of the owner shall be final.
4. Plants used for replacement shall be of the same quantity, size, kind and quality as those originally planted, and they shall be planted as originally specified. This extra work, including materials, labor, and equipment used in replacements, shall be at no cost to the Owner. Replaced plants shall carry the same establishment period as the original. Damage, including ruts in lawn or bed areas, existing utilities, paving, and other improvements, incurred in making replacements shall be immediately repaired to the satisfaction of the Owner.
5. At the direction of the Owner, plants may be replaced at the start of the next year's planting or digging season, but in such cases, dead plants shall be removed from the premises immediately.

6. The Contractor agrees that for the Period of Establishment, he will water the plants during dry periods.
7. This replacement guarantee does not apply where plants die after final acceptance because of injury by storm, hail, non-treatable insects and diseases, or vandalism.
8. Final acceptance will be made only if all plants are in place, living, and are in conformance with the Drawings and these special provisions.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.
   1. Experience; Five years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
   2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
   3. 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.

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. Pre-installation Conference: Conduct conference at Project site.

1.9 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. 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.

D. Handle planting stock by root ball.

E. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.

F. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six 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.
   1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
   2. Do not remove container-grown stock from containers before time of planting.
   3. 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.

1.10 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 and Owner no fewer than three 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 or Owner's written permission.

C. Planting Restrictions: Plant during normal planting seasons. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

D. 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.

E. 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.

1.11 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 metal edgings.
   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: Three months.
3. Include the following remedial actions as a minimum:
   a. Immediately remove dead plants and replace 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.

1.12 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: Twelve (12) months from date of Substantial Completion.

B. Initial Maintenance Service for Ground Cover and Other Plants: 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: Twelve (12) months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish No. 1 grade or better 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. Quality and Size
   1. Specific requirements concerning the various species, sizes, and manner in which they are to be furnished are shown on the Plans and Plant List.
   2. 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.

3. Plants and trees shall equal or exceed the measurements specified in the Plant List, which are minimum acceptable sizes. They shall be measured before pruning, with branches in normal position. Dimensions for height and spread as contained herein refer to the main body of the plant and not from branch tip to branch tip. No pruning of branches to obtain the required height shall be done before the plants are delivered to the site unless so approved by the Owner.
4. Stock furnished in a size range specified shall be interpreted to mean that not less than fifty percent (50%) shall be of the maximum size specified.
5. The determining measurements for the trees shall be the caliper and/or height as described in the Plant List. Caliper shall be taken three (3) feet above the top of the root ball.
6. Plants larger in size than specified in the Plant List may be used if approved by the Owner, but the use of larger plants shall not increase the contract price. If the use of larger plants is approved, the ball of earth shall be increased in proportion to the size of the plant.
7. Plants shall have a habit growth, which is normal for the species and shall be sound, healthy, vigorous, and free from insect pests, plant diseases, injuries, and aftereffects thereof.
8. Nursery grown plants shall mean plants, which are healthy, vigorous, plants, lined out in rows in a nursery and which are cultivated, sprayed, pruned, and fertilized in accordance with good horticulture practice.
9. No trees, which have had their leaders cut, or have been damaged so that cutting is necessary, will be accepted.
10. Plants lacking compactness or proper proportions and plants injured by being planted too close in nursery rows will not be accepted.
11. Plants shall be freshly dug or containerized; neither heeled-in plants nor plants from cold storage will be accepted. Nursery grown plants shall have been transplanted or root pruned at least once in the past three years.
12. Plants designated "B&B" in the Plant List shall be balled and burlapped. Requirements for the measurement, branching, grading, quality, balling and burlapping of the plants generally follow the code of standards in the "American Standard of Nursery Stock". They shall be dug with firm, natural balls of earth sufficient diameter and depth to encompass the plant. Balls shall be firmly wrapped with burlap or similar material and bound with twine or cord. Plants with a rootball greater than or equal to 20 inches in diameter shall be placed in a properly sized wire basket for transport and handling. After planting, the wire basket is to be cut away and removed. Any plant with a loose soil ball or broken ball at the time of planting will be rejected.
13. The balls of "B&B" plants, which cannot be planted immediately on delivery, shall be covered with moist soil or mulch, or other protection from drying winds and sun. Bare rooted plants will not be allowed. Plants shall be watered as necessary by the Contractor until planting.
14. Plants grown in containers shall be fully rooted throughout the earth ball within the container, but not root bound. Container plants must be acclimated to area conditions.

C. Shape and Form:
1. Plant material shall be symmetrical, typical for the variety and species, and shall conform to the measurements specified in the Plant List. Plants used where symmetry is required shall be matched as nearly as possible.
2. Plants meeting the requirements specified in the Plant List, but not possessing a normal balance between height and spread will be rejected.
3. No plant shall be bound with wire or rope at any time so as to damage the bark or break the branches. After planting, wires and ropes will be removed.

D. Inspection / Rejection: The Owner may inspect plants at place of growth, but such inspection does not preclude the right of rejection on site. Any materials may be rejected if, in the opinion of the Owner, such does not meet the requirements of the Plant List, Drawings, or Specifications. Rejected materials shall be removed from the site by the Contractor at no cost to the Owner.

E. Plant Material Selection: Contractor shall make provision for Owner approval of all plant material to be used prior to installation (except those plant materials pre-selected by Owner). Approval of plant material may require a site visit to nursery of field where material is grown. Expense of any site visit for plant material approval/selection will be the responsibility of the contractor.

F. Substitutions: Will not be permitted without approval of Landscape Architect. If proof is submitted that any plant specified is not reasonably obtainable, a proposal will be considered for the use of

the nearest equivalent size or variety with an equitable adjustment of Contract price. Notification of possible substitutions prior to award of Contract will be made at least 7 DAYS prior to bid opening.

G. Quantities: Quantities necessary to complete the planting as shown and located on the Drawings shall be furnished. Dimension for ground cover beds have, in all instances, been established from scaled drawings. It is the Contractor's responsibility to check these dimensions on the site and allow for correct quantity of plants accordingly.

H. 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.

I. 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.

J. 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.

K. 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 SOIL PREPARATION MATERIAL

A. Topsoil: Topsoil shall be fertile, friable soil obtained from well drained arable land. It shall be free draining, non-toxic and capable of sustaining healthy plant growth. Topsoil shall be reasonably free of calcium carbonate, subsoil, refuse, roots, and other deleterious substances. The contractor shall furnish a written soil analysis prepared by an accredited soil analyst. The analysis shall indicate pH, total soluble salts, and plasticity index and particle size gradation.

B. Sand: Sand shall be loose, granular soil containing particles smaller than gravel but coarser than silt. Sandy soil shall obtain a minimum of 90% sand and no greater than 5% clay.

C. Peat Moss: Peat moss shall be imported Canadian sphagnum peat moss, brown, low in content of woody material and free of any mineral matter harmful to plant life. Peat moss shall have an acid rating of approximately 4.5 pH and have a water absorbing capacity of 1100 to 1200 % by weight. Peat moss shall be thoroughly pulverized before use except when used as a top-dressing. No native or sedge peats shall be approved.

D. Organic Soil Conditioner: Organic soil conditioner shall be partially decomposed ground pine bark. Sawdust will not be accepted. Particle size and surface area shall be such as to resist displacement by wind or by surface storm water or irrigation runoff for two growing seasons.

E. Commercial Fertilizer: Fertilizer shall be a complete, slow release, 12-6-6 fertilizer or approved alternate delivered in original unopened containers bearing the manufacturer’s guaranteed analysis. To be applied at manufacturer’s recommended rate.

F. Herbicide: Snapshot brand pre-emergent herbicide manufactured by Dow Agra or approved equal, applied at manufacturer’s recommendations.

G. Composted Cow Manure: Composted cow manure shall be a minimum of 50% cow manure by weight. Contractor to provide sample and analysis for approval by Landscape Architect.

H. Standard Planting Bed Mix: This mix shall be used for all planting bed areas and pits unless otherwise noted and shall consist of:
   1. 1 CY Organic Soil Conditioner per 50SF of bed area
   2. 1 CY Composted Cow Manure per 150SF of bed area
   3. 1 3.8 CF Bale of Peat Moss or coffee chaff per 50SF of bed area
   4. Sandy Topsoil may be added to be planting mix if the existing soil is of poor quality. The Landscape Architect will make this determination prior to beginning of work.
   5. Commercial Fertilizer and Pre-emergent Herbicide per manufacturer’s recommendations.
   6. Topdressing shall be Standard Bed Mulch as listed below.
   7. Substitutions may be made on the advice of the Landscape Architect.

I. Modified Planting Bed Mix: This mix shall be used for all planting bed areas located within the drip lines of existing live oak trees:
   1. Begin by clearing underbrush and any debris. Any existing mulch shall be raked back and stockpiled for reuse

2. Apply Herbicide approved by the institution's landscape or facility services for use under live oaks to eliminate existing grass and weeds. Allow two weeks for complete kill.
3. Install soil mix consisting of the following to a maximum depth of 2"
   a. 1 CY Organic Soil Conditioner per 100 0SF of bed area
   b. 1 3.8 CF Bale of Peat Moss or coffee chaff per 50SF of bed area
4. Tilling shall be prohibited within the tree dripline
5. Plant material shall be pit planted in these areas.
6. Topdressing shall be Modified Bed Mulch
7. Herbicide and fertilizer as listed in the Standard Planting Bed Mix

J. Rain Garden Bed Prep: This mix shall only be used for the areas designated as rain gardens on the drawings, and shall consist of:
1. 35% Topsoil
   40% Sand
   5% Coffee Chaff or Peat Moss
   5% Cow Manure
   15% Soil Conditiner
   Commercial Fertilizer and Pre-Emergent Herbicide per manufacturer's recommendations
2. Premium Bioswale Mix by Wood Materials (504-738-6079) may also be used.
3. Commercial Fertilizer and Pre-emergent Herbicide per manufacturer's recommendations.
4. Jute matting as listed below shall be installed before the topdressing in all areas that exceed a 15% surface slope (1 : 6.66)
5. Topdressing shall be Standard Bed Mulch as listed below.

2.3 FERTILIZERS

A. 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: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus.

2.4 STEEL LANDSCAPE EDGING

A. Manufacturers:
1. Colmet
2. JD Russel
3. Steel flat bar stock
4. Approved equals

B. Steel Landscape Edging. Comply with ASTM A 569, hot-rolled, standard flexible carbon steel landscape edging, fabricated in sections with stake pockets stamped or pre-punched into face of sections at 30" o.c. Steel landscape edging (header) shall be double staked at overlap joints, and designed to receive tapered steel stakes. Standard steel flat bar stock may also be utilized.

C. Sizes:
1. For Lawn at planting bed: ¼" Thick x 4" Wide
2. For Maintenance trough at planting bed: 1/8" Thick x 4" Wide

D. Finish: Raw Steel. Provide sample to Landscape Architect for approval.

E. Anchors:
1. For pre-punched landscape edging: Anchor stakes shall be 1/4" thick x 1" wide (tapered) x 18" long prefabricated stakes provided by the landscape edging manufacturer for use in the stamped pockets
2. For flat bar stock: Cut #3 rebar into 18" long sections and weld to the planting bed side of the landscape edging @ 30" O.C. max. Top of rebar shall be 1" min. below top of edging
3. J-Hook style anchors or similar anchors that overlap the top of the edging shall not be accepted.

2.5 LANDSCAPE GRAVEL

A. Smooth Brown Gravel
   1. 1" – 2" Diameter smooth brown rock, washed. Sides shall be mostly rounded and smooth with varying sizes and shapes. Depth of gravel as noted on the Drawings. Submit Sample for L.A. Approval.
   2. Used around base of building in the maintenance trough and as noted on the Drawings.

B. Rain Garden Gravel
   1. 3"-4" Diam Diameter smooth brown rock, washed. Sides shall be mostly rounded and smooth with varying sizes and shapes. Depth of gravel as noted on the Drawings. Submit Sample for L.A. Approval.
   2. Use as the top gravel layer along the rain garden flow lines as indicated on Drawings.

2.6 SOIL STABILIZATION MATTING

A. For Rain Garden areas:
   1. Natural fiber jute netting designed for soil stabilization and erosion control. Netting shall be made from 100% biodegradable fibers.
   2. Secure with 6" long metal landscape or sod staples at 48" O.C. Max.

2.7 MULCHES

A. Standard Bed Mulch: Pine Straw. Shall be un-dyed pine straw of sufficient character to resist displacement by wind or storm water or by irrigation runoff. Pine straw to be freshly harvested, uniform in color, and free of deleterious materials. Contractor is required to submit a sample to Landscape Architect for approval prior to placing. Pine Straw Mulch shall be used as top dressing for all bed, and tree areas. Retain appropriate materials in first subparagraph below.

B. Modified Bed Mulch: Composted Shredded Hardwood. Mulch shall be un-dyed premium grade decomposed shredded hardwood of sufficient character to resist displacement by wind or storm water or by irrigation runoff. Composted shredded hardwood to be uniform in color and free of deleterious materials. Contractor is required to submit a sample to Landscape Architect for approval prior to placing. Composted Shredded Hardwood Mulch shall be used beneath existing live oak trees in a two-inch layer as indicated on plan. See plan and details for locations and specified depth.

2.8 PESTICIDES & HERBICIDES

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.

2.9 TREE STABILIZATION MATERIALS

A. Root-Ball Stabilization Materials:
   1. Root-Ball Stabilization Devices: 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 the following or approved equal:
         1) Foresight Products, LLC; Duckbill Rootball Fixing System
            6430 East 49th Drive
            Commerce City, CO 80022
            USA Contact: Matthew Esquibel

Phone: 800-325-5360 / 303 286-8955
E-mail: mesquibel@earthanchor.com

2) Tree Frog Environmental Products; Tree Frog RBK System
411 N. Donnelly St
Mount Dora, FL 32757
Phone: 1-352-735-7411
Fax: 1-352-735-7412
E-mail: info.treefrogep@gmail.com

3) Approved Equals.

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 GENERAL 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. 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.

E. 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 TREE AND PLANTING BED PREPARATION

A. General:
   1. Time and Planting: Planting operations shall be conducted under favorable weather conditions during the seasons, which are normal for such work as determined by accepted practice in the locality.
   2. Preparation for Planting Operations: Before planting operations are begun, existing turf areas which are to be trucked over or upon which soil is to be temporarily stacked pending

its reuse or removal, or turf areas which may be subject to abuse of any other kind, shall be covered in a manner which will satisfactorily protect such areas from damage.

3. Plant Material Locations: As shown on the drawings are diagrammatic, and the exact locations shall be approved by the Owner. Shade and ornamental trees shall be located with stakes according to the plan. Shrubs, vines, and ground cover shall be positioned on prepared bed areas as shown on the Drawings in their original containers. After quantity, staking, and spacing has been adjusted, if necessary, and approved by the Owner, plant where located.
4. Obstructions or Unsuitable Conditions Below Grade: Any rock over 3/4" diameter, concrete, or other underground obstruction or unsuitable planting soil shall be removed to the depth necessary to permit proper planting according to Plans and Specifications. If underground construction, utilities, unusually large rock, other serious obstructions or unsuitable soil conditions are encountered in planting areas, other locations for the planting may be selected by the Owner.

B. Excavation for Planting:
1. For new construction projects or for projects with significant site renovations that result in compacted soil conditions at the planting areas, especially in and around buildings, parking lots, or other hardscape areas, the following steps shall be taken:
   a. Reference Section 32 92 00 for excavation at sod and meadow areas.
   b. For all areas to receive shrub and groundcover planting, excavate and remove compacted soil to a minimum depth of 12” below the anticipated finished grade of the landscape bed, accounting for the bed height above the adjacent hardscape and lawn areas as specified herein.
   c. For tree pits:
      1) Compacted soil shall be excavated to the size and depth as listed herein. After excavation, a percolation test shall be performed at each tree pit to verify adequate drainage.
      2) Perform percolation test by digging a 12” diameter x 12” deep hole at the bottom of the tree pit. Fill the hole with water and allow the water to drain completely. Refill the hole completely with water, and document how long it takes for the water to drain completely.
      3) If it takes longer than 6 hours to fully drain, or it does not fully drain, the contractor shall install three (3) sump holes equally spaced around the bottom of the tree pit. Each sump hole shall be 6” diameter x 24” deep as measured from the bottom of the tree pit and filled with drainage gravel. The top of each sump hole shall be covered with a sheet of non-woven geotextile fabric to prevent soil migration.
2. Tree and large shrub pits: Shall be circular in outline with vertical, scarified sides and conical bottoms. Mechanical digging of pits may be approved by the Landscape Architect. Tree pit diameter shall be at least three times the size of the root ball diameter. Pits for trees shall be of sufficient depth to allow a six-(6) inch layer of planting soil spread around the ball while resting on scarified subgrade pedestal when they are set to grade. Pits for shrubs and other plants shall be of sufficient depth to allow a six-(6) inch layer of planting soil under the ball when they are set to grade.
3. Planting Beds: All planting bed areas shall be stripped of any grass, weeds and debris prior to excavation. Excavate to a minimum depth of 3” if compacted or poor soils are not present.
4. Special Conditions: Beneath Existing Tree Canopies: Soil preparation depths for bed and lawn areas shall be modified to accommodate tree roots. Coordinate work with Landscape Architect.

C. Soil Preparation:
1. Shrub and groundcover beds:
   a. After stripping grass or removing the compacted soil from the proposed bed area, the area shall be thoroughly roto-tilled to a depth of six (6) inches. Place the specified Planting Bed Mix into the area to a depth of six (6) inches and the bed area shall then be roto-tilled again.
   b. Repeat this process in 6” lifts until the top of the landscape bed is approximately 9” above the adjacent lawn or paved area. Incorporate fertilizer as specified herein.

c. The total bed depth, excluding the initial roto-tilled depth, shall be a minimum of twelve (12) inches.
d. Treat bed areas with specified pre-emergent herbicide at the manufacturer's recommended rate.

2. Tree and large shrub plantings:
a. After planting pit excavation, install the root-ball anchors as specified herein prior to setting the tree in the pit. Verify the anchors are securely installed into undisturbed soil.
b. Planting Bed Mix shall be installed after setting the plants as listed below.

D. Setting Plants:
1. General: Plants, excepting ground cover plants, shall be set approximately 1-1/2 to 2 inches above existing grade so that after settlement they will bear the same relationship to the finished grade of the surrounding soil that they bore to the grade of the soil from which they were dug.
2. Lay out plants at locations as indicated on plans or as directed by Landscape Architect. Stake locations of individual trees and shrubs for approval by Landscape Architect prior to planting.
3. Trees and large shrubs: After pits have been dug as specified previously, set plants straight and plumb in pits and remove burlap from sides and tops of balls, but no burlap shall be pulled from underneath. Place specified Planting Bed Mix around the ball to two-thirds (2/3) the depth of the pit. Firmly hand tamp and compact carefully to avoid injury to roots and to fill voids. Add water and allow it to drain away, and fill the pit to finished grade with soil. After the ground settles, additional soil shall be filled in to the level of the finished grade.
4. Plants in Beds: Carefully insert plants into prepared topsoil at slightly above finished grade. When plants are in place, rake the entire bed area smooth, water, and allow to drain away. After settlement, add soil as necessary to finished grade and water again.
5. Forming Saucers: After planting has been completed, form a "saucer" or "bowl" of soil around each plant. Bowl shall extend to the limits of the plant pit for trees and shrubs. No bowls are required in areas of bed preparation, and shrubs in lines may share a common bowl around their perimeter.

E. Fertilizing of Planting:
1. Rates: Use a complete fertilizer with contents as specified herein and apply at the manufacturer's recommended rates.
2. Placement for trees: Place slow-release fertilizer uniformly around and within the diameter of the plant saucer and incorporate into the top 6" layer of planting soil.
3. Placement for shrubs and groundcovers: Place fertilizer evenly throughout the bed area and incorporate into the top 6" layer of planting soil.

F. Topdressing / Mulching: Upon completion of the planting of all areas, install the specified topdressing or mulch evenly, entirely covering the area around each plant to the specified depth. In case of bed areas, the area between the plants is to be so treated, regardless of plant spacing, and trees shall be mulched entirely covering the tree pit area within the saucer.

3.4 TREE STABILIZATION

A. Install below-grade stabilization system to secure each new planting by the root ball unless otherwise indicated.

B. Root-Ball Stabilization
1. Install root-ball stabilization system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.
2. Verify the root-ball anchors are installed prior to backfilling the tree pit.
3. Wrap the anchoring straps around the top of the root-ball and tighten to secure.

C. If the root-ball anchoring system is determined to be insufficient for the site conditions, including unstable soils, an alternative tree stabilization system shall be submitted to the Landscape Architect for approval.

3.5 TREE, SHRUB, AND VINE PRUNING

A. Each tree shall be assessed for pruning by an experienced plantsman to preserve the natural shape and character of the tree upon acceptance by the Landscape Architect. Method of pruning shall follow the International Society of Arboriculture guidelines for “Pruning Young Trees”. 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.

B. 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.

C. Pruning cuts shall be sharp and clean. Pruning cuts over 3/4" in diameter may be painted with an approved tree surgery paint or sealer, applied only for cosmetic reasons, at the direction of the Landscape Architect.

3.6 LANDSCAPE EDGING INSTALLATION

A. General: Install landscape edging after major construction activities are complete to avoid damage.

B. Steel Edging: Install steel edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced at 30 inches apart, driven below top elevation of edging, or at every stake pocket location in landscape edging (header) sections designed and manufactured to receive stakes. Stakes shall be located in solid undisturbed soil, or in soil set at 85% relative compaction. A minimum of at least two stakes shall be used to ancho any partial section of edging.

C. Horizontal Alignment. Install straight sections true to the alignments as indicated, free of waves or bends, using strings as guides. Install curved sections true to the alignments as indicated, free of waves or bends, following marked alignments approved in the field by the Landscape Architect. The Landscape Architect shall be given the opportunity to review the layouts.

D. Vertical Alignment. Top of edging shall follow the finished grade elevations as indicated on the Drawings. Face of edging shall be plumb.

E. Corners: All corners shall be bent to achieve straight 90-degree angles. No radius corners shall be accepted. The inside face of the edging may be scored to assist with bending the edging. No corner splices shall be accepted unless they are fully welded and ground smooth after splicing. Pre-fabricated corner splice stakes shall not be accepted.

F. Splices: If using pre-punched edging, splices shall be double staked at overlap joints and adjacent pieces shall be flush with one another. If flat bar stock is being used, butt joints shall be fully welded, ground smooth, and anchored.

G. Edging damaged or bent during installation or subsequent construction activities shall be replaced at not cost to the Owner.

3.7 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.

3.8 PESTICIDE & HERBICIDE 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.

3.9 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.

3.10 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 32 93 00

SECTION 33 14 00 - WATER PIPING MATERIALS AND STRUCTURES

PART 1 GENERAL

1.1 SUMMARY

A. The work covered by this section consists of ail labor, materials, equipment, and incidentals necessary to completely furnish, install, test, and clean all water piping, valves, fittings, hydrants, services and accessories indicated on the drawings and/or specified herein including all appurtenances necessary to make the water system complete and fully operational.

1.2 REFERENCED STANDARDS

1. American Petroleum Institute (API), 5L Specification for Line Pipe.
2. American Railroad Engineering Association Manual for Railroad Engineering.
3. American Standards Association
4. ASA 816.1, American National Standard for Cast Iron Flanged Fittings and Flanges.
5. American Society of Testing Materials
6. ASTM A 120, Standard Specification for Black and Hot Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses.
7. ASTM A338, Standard Specification for Malleable Iron Flanges, Pipe Fittings and Valve Parts for Railroad, Marine, and other Heavy Duty Service at Temperatures up to 650 Degrees F.
8. ASTM B88, Standard Specification for Seamless Copper Water Tube.
9. ASTM C127, Standard Test for Thermal Conductivity of materials by Means of the Guarded Hot Plate.
10. ASTM D256, Standard Test for Impact Resistance of Plastics and Electrical Insulating Materials.
11. ASTM D635, Standard Test for Flammability of Self-Supporting Plastics.
12. ASTM D638, Standard Test for Tensile Properties of Plastic.
13. ASTM D648, Standard Test Deflection Temperature of Plastics under Flexural Load.

14. ASTM D696, Standard Test for Coefficient of Linear Thermal Expansion of Plastics.

15. ASTM D746, Standard Test of Brittleness Temperature of Plastics by Means of a Cantilever Beam.

16. ASTM D792, Standard Test for Specific Gravity and Density of Plastics by Displacement.

17. ASTM D1238, Measuring Flow Rates of Thermoplastics by Extrusion Platometer.

18. ASTM D1248, Standard Specification for Polyethylene Plastic Molding and Extrusion Materials.

19. ASTM D1525, Standard Test for Vicat Softening Point of Plastics.

20. ASTM D1693, Standard Test for Environmental Stress Cracking of Ethylene Plastic.

21. ASTM 01784, Standard Specification for Rigid Poly (Vinyl Chloride) Compounds and Chlorinated Poly (Vinyl Chloride) Compounds.

22. ASTM D2240, Standard Test for Indentation Hardness of Rubber and Plastics by Means of a Durometer.

23. ASTM D2241, Standard Specification for Poly (Vinyl Chloride)(CPVC) Plastic Pipe (SDR-PR).

24. ASTM D2837, Obtaining Hydrostatic Design Basis for ThermoPlastic Pipe Materials.

25. American Water Works Association

26. AWWA C101, American National Standard for Thickness Design of Cast Iron Pipe (ASA 21.1).

27. AWWA C104, American National Standard for Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water (ASA 21.4).

28. AWWA C106, American National Standard for Gray-Iron Pipe Centrifugally Cast in Metal Molds, for Water and Other Liquids (ASA 21.6).

29. AWWA C108, American National Standard for Cast Iron Pipe Centrifugally Cast in Sand-lined Molds, for Water or Other Liquids (ASA 21.8).

30. AWWA C110, American National Standard for Gray-Iron and Ductile Iron Fittings 3" through 48", for Water and Other Liquids (ASA A21 .10)

31. AWWA C111, American National Standard for Rubber Gasket Joints for Ductile Iron and Gray-Iron Pressure Pipe and Fittings (ASA A21.11).

32. AWWA C150, American National Standard for the Thickness Design of Ductile Iron Pipe (ASA A21.50)

33. AWWA C151, American National Standard for Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-lined Molds, for Water or Other Liquids (ASA A21.51)

34. AWWA C153 Short Body Full Flow Ductile Iron Fittings 3" through 24" for Water and Other Liquids (AAS A21.10).

35. AWWA C500, Standard for Gate Valves, 3" through 48" NPS, for Water and Sewage Systems.

36. AWWA C502, Standard for Dry-Barrel Fire Hydrants.

37. AWWA C504, Standard for Rubber-seated Butterfly Valves.

38. AWWA C600, American National Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances.

39. AWWA C601, Standard for Disinfecting Water Mains.

40. AWWA C700, Standard for Cold-water Meters - Displacement Type.

41. AWWA C800, Standard for Threads for Underground Service Line Fittings with Appendix on Collected Standards for Service Line Material.

42. AWWA C900, Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4" through 12", for Water.

43. AWWA C901, Standard for Polyethylene (PE) Pressure Pipe, Tubing, and Fittings, 2" through 3", for Water.

44. AWWA C905, Standard for Polyvinyl Chloride (PVC) Pressure Pipe 14" through 36".

45. National Fire Protection Association

46. NFPA No. 194, Standard for Screw Threads and Gaskets for Fire Hose Couplings.

47. Louisiana Standard Specification for Roads and Bridge

48. American National Standards/National Sanitation Foundation Standard for Drinking Water System Components (ANSI/NSF 61)

1.3 GENERAL

A. Contract Drawings: The contract drawings indicate the general design, arrangement, and extent of the piping system. It is desired that the indicated positions be followed as closely as possible. Do not scale drawings for roughing in measurements nor use as shop drawings. Prepare shop drawings per Paragraph 1.04, Submittals, herein. The exact location of the various items is subject to construction, and the actual materials and equipment furnished by the Contractor. The Contractor shall verify the location of all items furnished, installed, or connected to by him. Coordinate work with other specification divisions.

1. Piping systems shall be located from dimensions given on drawings or all implied locations shall be determined after field measurements have been taken.

2. Should interferences or discrepancies prevent the installation of any part of the work, the Engineer shall be notified, and he will determine the steps necessary to complete the true development of the intent of the drawings and specifications.

B. Materials

1. Unless otherwise specified or shown, pipe, fittings, and general-purpose valves for each piping system shall be as shown in the drawings.

2. If there are any conflicts in the specifications, use the stronger pipe class. Contractor shall submit calculations with shop drawings where specified.

3. All piping shall have a minimum cover of 30 inches unless otherwise shown on the drawings.

1.4 SUBMITTALS

A. General: Shop drawings and product data shall be submitted in accordance with the General Requirements.

B. Product data shall include all manufacturer's literature, catalog cuts and other descriptive literature to fully substantiate the conformance with specifications of materials and equipment submitted. Mark product-data to indicate exactly those items that are to be provided and cross out unrelated or nonapplicable items.

C. Shop drawings shall include Contractor prepared plans, sections and details fully dimensioned showing all piping systems and appurtenances to be installed and with system designations as indicated herein.

1.5 JOB CONDITIONS

Schedule of Work: Arrange work to comply with schedule of construction. In scheduling, anticipate means of installing equipment through available openings in structure.

A. Coordination Of Work: The Contractor shall coordinate all trades whose work is adjacent, in order to avoid field interference and delay in execution of the work of all trades. Furnish detailed advance information regarding all requirements related to work by others. Furnish sizes and accurate data and location of any and all foundations, pits, chases, holes through beams, floors, walls, ceilings and roof, and other special openings required for this contract work.

B. Inserts: Prior to the execution of each step in the general construction work, determine that all chases and holes required for the specified work are properly located and sized and supervise the setting of all sleeves, inserts and other required build-in items. If this preliminary work is not properly performed and should cutting be required to install the specified work, the Contractor shall bear all expense of cutting and restoring the construction to its original condition.

C. Cutting: The work shall be carefully laid out in advance and any cutting of construction shall be done only with the written permission of the Engineer. Cutting shall be carefully done, and any damage to the building, piping, wiring and equipment as a result of the cutting shall be repaired by persons skilled in the particular trade.

1.6 MANUFACTURER

A. Pipe and fittings shall be manufactured by a firm regularly engaged in the successful manufacture of the type of pipe furnished AU water piping specified

shall be NSF approved and all piping shall bear the NSF stamp of approval. (ANSI/NSF 61)

1.7 HANDLING OF PIPE

A. The pipe shall not be dropped or subjected to any unnecessary jar, impact or other treatment that might damage the pipe. Any unit of pipe that in the opinion of the Engineer is damaged beyond repair by the Contractor shall be replaced by another unit. Any pipe that is damaged and repairable shall be repaired in the field, or at the direction of the Engineer shall be returned to the manufacturing plant for repair.

PART 2 PRODUCTS

2.01 DUCTILE IRON PIPE AND FITTINGS

A. Manufacture. Ductile Iron pipe shall be manufactured in the U.S.A. in accordance with the latest revision of ANSI/AWWA C151/A21.51. All ductile iron pipe shall be hydrostatic pressure tested at the plant of the manufacturer to 500 psi.

B. Design. Ductile iron Pipe shall be designed in accordance with the latest revision of ANSI/AWWA C150/A21.50. The design shall include a minimum working pressure of 150 psi plus a 150 psi surge allowance. A two to one safety factor shall be applied to the sum of the working pressure plus the surge allowance. A two to one safety factor shall also be applied to the bending stress and deflection design for a Type 3 to Type 5 laying condition with the depth of cover as required per the plans.

C. Unless noted otherwise on the plans, the minimum pressure classes for ductile iron pipe shall be as follows: PC 350 for 8" 12" pipe, PC 250 for 14" - 20" pipe, PC 200 for 24" pipe and PC 150 for 30" and larger pipe.

D. Coating and Lining. Pipe shall have a standard asphaltic coating on the exterior. Pipe shall have a cement mortar lining on the interior in accordance with the latest revision of ANSI/AWWA C104/A21.4.

E. Joints. All in plant ductile iron piping shall be restrained joint. "Fast-Grip", "Flex-Grip", "Field Flex-Ring", "Lok-Ring" or approved equal shall be used.

F. Flanged Pipe. All above ground or exposed pipe shall be ductile iron and shall comply with ANSI/AWWA C115/A21.15. The pipe barrel shall be made in accordance with ANSI/AWWA C151/A21.51, and shall have a thickness of no less than special thickness Class 53. All flanges

shall be ductile iron and rated for a working pressure of 250 psi. Flange pipe and fittings shall be cement lined as specified above and shall be shop primed on the outside diameter with either TNEMEC 37H77 Chem Primer for an alkyd-phenolic primer or TNEMEC 140-1211 Pota-1211 Pota-Pox Plus for high solids epoxy primer.

G. Outlets. Welded on outlets may be provided in lieu of trees and crosses. Outlets shall be fabricated from centrifugally cast ductile iron pipe, manufactured and tested in accordance with the latest revision of ANSI/AWWA C151/A21.51, using a high nickel content weld such as t\Ji-Rod #55. Welding shall be performed in the pipe manufacturer's shop only. Outlets shall not be more than 70% of the size of the parent pipe. Minimum walls for the parent and outlet pipes shall be as published by American Ductile Iron Pipe or other approved manufacturer.

2.02 POLYVINYL CHLORIDE (PVC) PIPING:

All PVC piping shall meet the requirements of ASTM D2241 and conform to one of the paragraphs as designated on the Drawings.

A. AWWA C900, Plastic pipe designated as C900 shall be made of rigid polyvinyl chloride (PVC) compounds conforming to ASTM D1784 for Type 1, Grade 1 (PVC 1120). The pipe shall be standard sizes 1" through 12" in pressure class 100, 150 and 200 conforming with the outside diameter (OD) of cast-iron (CI) and with the wall thickness of dimension ratio DR series 25, 18 and 14 as indicated on the Drawings. Standard laying

B. SDR 21 and 26. Plastic pipe designated as SDR 21 or 26 shall be made of rigid polyvinyl chloride (PVC) compounds conforming to ASTM D1784 for Type 1, Grade 1 (PVC 1120). The pipe shall be standard sizes 4n through 12" in pressure classes 160 (SDR-26) and 200 (SDR-21). The standard length shall be twenty feet (2ff) or forty feet (40').

C. Polyvinylchloride (PVC) material for pipe, fittings, and couplings shall conform to ASTM D1784, Type 1, Grade 1, with 2,000 psi design stress. Pipe shall be Schedule 40 or 80 and shall be in accordance with ASTM D1785. Thickness schedule shall be as specified on pipe specifications sheets. PVC fittings shall be socket type conforming to ASTM D2466/2467. Solvent cement shall comply with ASTM D2564.

D. Joints:

Joints shall be rubber ring and made to manufacturer's specifications. Rubber rings shall be securely locked into the bell.

E. Fittings:

Fittings shall be the same type and grade, pressure rating and manufacturer of the pipe, and conform to the pipe specifications AWWA 900 or AWWA 905; or shall be ductile iron as specified herein under ductile iron pipe, except that fittings shall have all connections of standard AWWA dimensions or dimensions as required or with adapters of the proper class for the size of plastic pipe laid. Fittings 3" and smaller shall be PVC equal. Fittings 4" through 36" shall be ductile iron meeting C-153 specifications of

AVVVVA. Where new water main is being cut into existing water main, only ductile iron fittings, all sizes, will be accepted.

F. Manufacturer's Representative:

The pipe manufacturer must furnish a trained representative for not less than one (1) eight (8) hour day on the job site to instruct and supervise the contractor in the proper method for installation of pipe and pipe fittings.

2.03 HIGH DENSITY POLYETHYLENE PRESSURE PIPE

A. High density polyethylene pipe shall be made from polyethylene resin compound that meet the for Type lll, Category 5, Class C, Grade P34 as defined in ASTM D1248.

B. The pipe produced from this resin shall have a classification of 345434C in accordance with ASTM D 3350 and shall have a Plastic Pipe Institute (PPI) rating of PE 3408.

C. The material shall be of virgin quality and contain a minimum of 2% well dispersed carbon black. The workmanship shall be of the highest level compatible with current commercial practice. The pipe shall contain no recycled compound except that generated in the manufacturer's own plant from resin of the same specification and from the same raw material supplier. The polyethylene pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other injurious defects. It shall be uniform in color, opacity, density and other physical properties.

D. The pipe shall have a manufacturer's recommended hydrostatic design stress rating of 800 psi based on a material with a 1,600-psi design basis determined in accordance with ASTM 02837. The pipe shall conform to the dimensions, wall thickness, testing, marking and all other provisions of ASTM F 714 for the dimension ratios as shown on the drawings or on the bid form

E. Pipe shall be marked at 5-foot intervals with a coded number which identifies the manufacturer, SOR; size, PPI rating, manufacturing standard reference and production code form which date and place of manufacture can be determined.

F. Flange adaptors shall be manufactured by the same manufacturer as the pipe using the same resin as the pipe. Each flange adaptor shall be furnished with a ductile iron convoluted backup ring drilled to match a standard ANSI bolt pattern for welded steel pipe.

G. The pipe shall be homogeneous throughout and free of visible cracks, holes, foreign inclusions or other injurious defects. It shall be uniform in color, opacity, density and other physical properties.

H. Butt fusion of the pipe and fittings shall be performed by the thermal butt fusion system. Polyethylene pipe lengths, fittings and flange adaptor connections to be fused shall be of the same type, grade and class of polyethylene compound and supplied by the same raw material supplier.

2.04 STEEL PIPE AND FITTINGS

A. Steel pipe shall meet the requirements of ASTM A 53 Grade B and shall be standard weight. Steel pipe specified to meet the requirements of A'NVVA C200 shall be designed to the maximum internal pressure given in the specifications.

B. The minimum wall thickness for steel pipe 4 inches and up to and including 36 inches shall be 1/4 inch.

C. Exposed pipe shall have grooved or shoulder type joints complying with AWWA C606 unless flanged ends or plain ends for flexible couplings are shown on the drawings are required. Flanged ends shall conform to AWWA C207 Class B with rubber gaskets.

   Pipe used with groove and couplings shall be not less than standard weight and at least as thick as the minimum recommended by the coupling manufacturer or shall be provided with double fillet or butt welded collared ends to meet requirements. Laying length shall be as specified by the Contractor. Bends, fittings, and special fittings for pipe 14 inches and larger shall meet the requirements of AWWA C 208 and the same stress and load conditions required for pipe meeting the requirements of AVVVVA C 200 specified above. The Contractor shall determine and provide reinforcements or additional shell thickness as required to keep the combined stresses within the specified maximum.

D. Coatings for steel pipe and fittings shall be hot applied coal tar enamel with Kraft paper wrap in accordance with AWWA C203, or coal tar epoxy per AWWA C210 or fusion epoxy coating per AWWA C213. Other steel pipe and fittings shall be factory cleaned and primed and field painted.
   1. Lining for steel pipe and fittings shall be cement mortar lining per AWWA C205.
   2. All field repair work shall conform to one of the following as applicable. Welding per AWWA C206, cement mortar lining per A\/VVVA C602, and cold applied coal tar coating per AVVVVA C209.

E. The manufacturer shall provide an affidavit of compliance as described in AWWA C200. tests of steel pipe and fittings, as specified in AWWA C200, are required.

2.05 CASING PIPE

A. Pipe:

1. Casing pipe shall be steel having a minimum yield strength of 35,000 psi, conforming to A.P.I. Specification 5L. Casing shall have the following minimum wall thicknesses:

Size (Non. Diam., In.)	Thickness (Inches)
Under 12" I.D.	0.250
14 and 16 O.D.	0.281
18 O.D.	0.313
20 O.D.	0.344
24 O.D.	0.375
26 O.D.	0.438
28 and 30 O.D.	0.469
32 O.D.	0.500
34 and 36 O.D.	0.532
38, 40 and 42 O.D.	0.563

2. Both the interior and exterior of the pipe shall have a bituminous coating.

B. Joints: Joints shall be butt welded. Coatings shall be continuous at the joints.

C. Carrier Runners:

3. The carrier pipe shall be supported by utilizing three way to concentric casing cradle as manufactured by T. D. Williamson, Inc., Pipeline Seal and Insulator Company, APS Casing Spacers or equal.

D. Casing Seal:

1. Casing seals, which seals the annulus between the casing and carrier pipe, shall be made of cement grout or bituminous material.

2.06 PLASTIC SERVICE PIPE

A. Polyethylene Pipe:

1. Polyethylene service pipe shall conform to AWWA Standard C901 and be approved by the National Sanitation Foundation. The pipe shall have a standard dimension ration (SOR) of9, and pipe shall conform to PE 3306, Type III, Grade 3, Class C.

B. Service Pipe Connections:

1. Only compression type couplings with inserts or flared couplings will be acceptable. Hot flared or hose connections are not permitted. The pipe must be continuous from water main to meter.

2.07 MECHANICAL COUPLINGS

A. Flexible Couplings: Flexible (sleeve) couplings shall be of the full sleeve type, split sleeve type, or flanged adaptor type, as shown on the Drawings, specified herein, or as otherwise permitted by the Engineer. The coupling shall provide the requisite pipe flexibility without jeopardizing pipe integrity due to hydraulic thrust and shall have the

same pressure-rating as the pipe. Couplings shall have all metal bearing surfaces and shall be provided with galvanized steel bolds and nuts. Flexible couplings shall be restrained unless the Engineer has given his approval to omit this feature for specific cases.

1. Full Sleeve Type Couplings shall be properly gasketed and shall be of a diameter to fit the Each coupling shall consist of a steel middle ring, 2 steel followers, 2 gaskets and the necessary steel bolts and nuts to compress the gaskets. The couplings shall be Dresser Style 38, Smith-Blair Type 411, or equal. Couplings to be installed underground shall have a hot-dipped galvanized sleeve with corrosion resistant bolts conforming to AVV\NA C-111 (type 316 stainless steel).
2. Split Sleeve Type Couplings shall consist of one gasket, 2 housing clamps, and 2 bolts and nuts to obtain the flexibility for connecting the piping. Steel shoulders shall be provided and welded to the pipe ends to accommodate the couplings. The couplings shall be Kuhns, Ductile Iron Pipe Lock Coupling;
3. M.B. Skinner Seal; or equal.
4. Flexible Flanged Coupling Adaptors shall be of the sleeve type, consisting of steel middle ring, steel followers, gaskets, and steel! bolts and nuts to compress the gaskets. The couplings shall contain anchor studs of strength adequate to hold the pipe together under a pull equal to the longitudinal strength of the pipe at a tensile stress of 20,000 psi, and shall be Smith-Blair No. 913, Dresser Style 128, or equal. Couplings to be installed underground shall have a hot-dipped galvanized steel with corrosion resistant bolts conforming to AWWA C-111 (type 316 stainless steel). All gauges shall employ valves or gauge cocks to facilitate cleaning and changing.

2.08 NEW SERVICE ASSEMBLY WITH METER SETTING

A. New water service assemblies with meter setting where called for on the Plans or in the Proposal, shall each include a plastic meter box with cast iron reading lid, service tap clamps or fittings, curb stop, corporation stop, and the required connectors and service pipe. All equipment shall be bronze. Water meters shall be furnished by the Contractor, except in the case where it is designated on the Plans or in the Special Conditions that meters will be purchased by the Owner, and furnished to the Contractor, in which case the Contractor will set the meters. These items, in place and accepted, shall together form a pay item for service assemblies of the various sizes. All connectors shall comply with A.\/V.VV.A. Standard C800..33Service Assembly and Corresponding Service Pipe Size:

SERVICE ASSEMBLY	SERVICE PIPE SIZE
5/8" x 3/4" small res. & comm. (up to 2 baths)	3/4"
5/8" x 3/4" large res. & comm. (more than 2 baths)	1"
3/4" or 2-5/8" x 3/4"	1 1/2"
1" or 2-3/4"	1 1/2"
1 1/4" or 2-3/4"	2"
1 1/2" or 2-1"	2 1/2"
2"	3"
3"	4"

B. Water Meters

Water meters shall be cold water rotating disc type with hermetically sealed and magnetically driven registers as manufactured by AMCO Water Metering Systems, Inc., Ocala, Florida or an approved equal. Meters shall be first line quality of the manufacturer. The latest specifications of the A.W.W.A. Standard C700 shall be complied with, except in cases of conflict with these Specifications.

1. Cases: The main case shall be high grade waterworks bronze with hinged single lid cover and raised characters cast on them to indicate the direction of number stamped on Main the lid. The working pressure shall be 150 psi. Standard, Southern or non-frost proof bottoms shall be furnished unless noted otherwise on the Plans or in the Special Conditions. Non-ferrous strainers shall be provided which fit tightly against the main case. Meters 1 1/2" and larger shall be flanged.
2. Measuring Chamber:
   The measuring chamber shall be of 85-5-5-5 bronze a!!oy composition and stainless steel! or monel trimmed. The moving unit shall be hard rubber rotating disc type. The disc shall be preferably the three-piece and the chamber shall be the two-piece type employing a thrust roller and insert.
3. Register: The register shall be straight reading in gallons. The unit shall be completely encased, hermetically sealed, and driven by permanent magnets. There shall be a test index circle which shall be divided into one hundred (100) equal parts and red test hand.

C. Corporation stops shall be of bronze or brass and shall be designed and manufactured in accordance with AWWA C800, except as modified herein.

D. Corporation stops shall have Mueller inlet threads except that corporation stops for use with service clamps shall have IPS threads. Where corporation stops are used with plastic pipe, a brass companion flange shall be provided on the outlet of each corporation stop.

E. Curb stops shall be similar to corporation stops as manufactured by Crane; Ford; McDonald or equal.

F. All service taps shall be threaded couplings or strap clamps for A.VV.W.A threads. Thread couplings for galvanized pipe shall not be permitted.

Maximum Size Threaded Coupling
Permitted in Ductile Iron Pipe

Pipe Size	Tap Size	Pipe Size	Tap Size
2"	1/2"	8"	1 1/4"
3"	1/2"	10"	1 1/2"
4"	3/4"	12"	2"
6"	1"		

Where it is necessary to provide a service larger than the allowable ductile tap size, multiple taps shall be employed by staggering the taps around the pipe and

spacing the taps at least twelve (12) inches apart and twelve (12) inches from the end of the pipe length, or service clamps shall be used.

Service strap clamps shall be galvanized malleable or ductile iron or bronze with rubber gasket. Clamps shall be Smith-Blair, Mueller, Dresser, Nappco or approved equal.

Maximum Size Service Clamp Permitted

Pipe Size (Inches)	Size	Ductile Iron	Size	Plastic and Galvanized
2		1"		3/4"
2 1/2		1 1/4"		1"
3		1 1/2"		1 1/2"
4		2"		1 1/2"
6		2"		1 1/2"
8		3"		1 1/2"
10		3"		1 1/2"
12		4"		1 1/2"

PART 3 EXECUTION

3.1 LAYING WATER PIPE

A. General:

GRADING, EXCAVATION, AND EARTHWORK REQUIRED IN LAYING WATER PIPE SHALL CONFORM TO SECTION 02315 OF THESE SPECIFICATIONS. INSTALLATION OF WATER PIPE SHALL BE IN CONFORMANCE WITH PROVISIONS OF A.W.\AJ.A. STANDARD C605, INSTALLATION OF PVC PRESSURE PIPE FOR WATER MAINS, EXCEPT IN CASES OF CONFLICT WITH THESE SPECIFICATIONS, IN WHICH CASE THESE SPECIFICATIONS WILL GOVERN.

WHEN WORK IS SUSPENDED EITHER FOR THE NIGHT OR FOR ANY OTHER REASON, OPEN ENDS OF THE PIPE SHALL BE SECURELY CAPPED OR PLUGGED TO PREVENT THE ENTRANCE OF MUD, WATER, ANIMALS, OR ANY OBSTRUCTION.

DEAD ENDS OF PIPE AND UNUSED BRANCHES OF CROSSES, TEES, VALVES, ETC., SHALL BE CLOSED WITH A PLUG SUITABLE TO THE TYPE OF PIPE USED.

PROPER AND SUITABLE TOOLS AND APPLIANCES FOR THE SAFE AND CONVENIENT HANDLING AND LAYING OF PIPE SHALL BE USED, AND CARE SHALL BE TAKEN TO PREVENT DAMAGE TO PIPE COATING. IF REQUIRED BY THE SIZE PIPE BEING USED, MECHANICAL

PULLERS (OR SPREADERS) SHALL BE USED IN CONFORMANCE WITH THE PIPE MANUFACTURER' INSTRUCTIONS.

WHILE PIPE LAYING IS IN PROGRESS, THE TRENCH SHALL BE KEPT FREE OF WATER.

WHILE SUSPENDED IN THE SLING AND BEFORE LOWERING IN THE TRENCH, THE PIPE SHALL BE SWABBED DEAN AND INSPECTED FOR DEFECTS AND TAPPED, WITH A LIGHT HAMMER TO DETECT CRACKS. DEFECTIVE, DAMAGED, OR UNSOUND PIPE SHALL NOT BE USED.

B. Excavation and Bedding:

THE WIDTH OF THE TRENCH AT THE TOP OF THE PIPE FOR WATER PIPE INSTALLATION SHALL NOT EXCEED THE EXTERNAL DIAMETER OF THE BARREL OF THE PIPE PLUS NINE INCHES (9") ON EACH SIDE.

TRENCHES FOR WATER LINES SHALL BE OF A DEPTH TO PROVIDE A THIRTY INCH (30") MINIMUM COVER OVER THE TOP OF THE PIPE.

WHERE SANITARY SEWER, STORM SEWER, OR OTHER SUBSURFACE UTILITIES ARE ENCOUNTERED IN TRENCHING FOR WATER LINE, IT WILL BE PERMITTED TO LAY PIPE ABOVE THE OBSTRUCTION IF A MINIMUM COVER OF TWENTY-FOUR INCHES (24") CAN BE OBTAINED WHILE PROVIDING A CUSHION BETWEEN THE BOTTOM OF THE PIPE AND THE TOP OF THE OBSTRUCTION OF AT LEAST SIX INCHES (18") IN THICKNESS. OTHERWISE, THE OBSTRUCTION WILL HAVE TO BE BY-PASSED OR TUNNELED UNDER. APPROVAL MUST BE SOUGHT BY THE DEPARTMENT OF HEALTH IN THESE SITUATIONS.

MECHANICAL EXCAVATION SHALL BE STOPPED SO THAT THE PIPE MAY BE LAID ON A FIRM, UNDISTURBED, CONTINUOUS NATIVE EARTH BED. PRIOR TO LAYING THE PIPE, THE TRENCH SHALL BE MANUALLY EXCAVATED SO THAT IT IS FLAT, TRUE TO GRADE, AND PROVIDES CONTINUOUS CONTACT WITH THE PIPE BARREL. BELL HOLES SHALL BE SPACED AS REQUIRED PROVIDING TWO INCHES (2") MINIMUM BETWEEN EARTH AND THE PIPE COUPLING.

IF OVER DIGGING OCCURS, THE TRENCH BOTTOM MUST BE BROUGHT BACK TO GRADE WITH COMPACTED SELECT MATERIAL, AND THE COST BORNE BY THE CONTRACTOR.

WHERE THE BOTTOM OF THE TRENCH IS ROCK, WATER BEARING SOIL, OR UNSTABLE MATERIAL, THE RESIDENT PROJECT REPRESENTATIVE MAY DIRECT THAT THE PIPE BE BEDDED IN GRANULAR MATERIAL, A CONCRETE CRADLE, OR GRANULAR MATERIAL ON TIMBER RUNNERS, AND PAID FOR AS SEPARATE ITEMS. THE PIPE SHALL BE BEDDED AS PROVIDED ABOVE, BUT IN NO CASE SHALL THE BEDDING PROVIDE LESS THAN EIGHTEEN-INCH (18") CUSHION BELOW AND AT THE SIDES OF ANY PART OF THE PIPE.

GRANULAR MATERIAL, WHERE REQUIRED, SHALL BE SAND, CRUSHED STONE, OR GRAVEL, AND SHALL NOT EXCEED 3/4 INCH MAXIMUM SIZE.

CONCRETE FOR PIPE FOUNDATIONS, WHERE REQUIRED, SHALL BE PROPORTIONED A REQUIRED HEREINBEFORE FOR THRUST BLOCKING CONCRETE. OTHER EXCAVATION AND TRENCHING REQUIREMENTS AS SPECIFIED HEREINBEFORE (SECTION 2) SHALL BE COMPLIED WITH.

C. Backfilling:

THE INITIAL BACKFILL UNDER THE PIPE HAUNCHES, AROUND THE PIPE, AND OVER THE TOP OF THE PIPE SHALL BE MANUALLY PLACED IN LAYERS, EACH LAYER BEING THOROUGHLY HAND TAMPED. THE THICKNESS OF EACH LAYER, PRIOR TO COMPACTION, SHALL BE SIX INCHES (6"). SPECIAL LAYING INSTRUCTIONS OF ANY PIPE MANUFACTURER SHALL BE RIGIDLY FOLLOWED.

WHERE A CONTRACTOR USES A TRENCHING MACHINE FOR THE EXCAVATION, THE INITIAL BACKFILL SHALL BE BOUGHT TO NOT LESS THAN ONE FOOT (1') ABOVE THE TOP OF THE PIPE, AS HEREINAFTER SPECIFIED. SHOULD THE CONTRACTOR ELECT TO USE A BACKHOE, DRAGLINE CLAM SHELL BUCKET OR EQUIPMENT OTHER THAN A TRENCHING MACHINE, THEN THE INITIAL BACKFILL SHALL BE BROUGHT TO NOT LESS THAN TWO FEET (2') ABOVE THE TOP OF THE

OTHER BACKFILL REQUIREMENTS AS SPECIFIED HEREINBEFORE IN SECTION 2 OF THE SPECIFICATIONS SHAII BE COMPLIED WITH.

3.2 PLACING VALVES AND FITTINGS

A. Valves and fittings shall be placed in the location indicated on the Plans and as directed by the ENGINEER.

ALL UNDERGROUND VALVES SHALL BE SET VERTICALLY. BOXES SHALL BE SET WITH COVERS FLUSH WITH THE SURFACE.

B. Before being placed in the trenches, a!! valves, meters, fittings, etc., shall be carefully examined to see that they are in good working order and are clean.

3.3 JACKING AND BORING PIPE

A. General:

Where pipe is to be laid beneath railroads, Federal Highways, State Highways, and concrete pavement, jacking and boring is required. The Contractor will not be permitted to open cut.

1. The requirements of the approving agency; such as railroad or State Highway Department, shall govern over these Specifications and Plans.

2. Sub-surface operations resulting in damage to the tracks or pavement, shall be the responsibility of the Contractor and shall be repaired at no cost to the OWNER.

B. Jacking and Boring Casting Pipe:

1. Installing of steel casing pipe shall conform to the A.R.E.A. Manual for Railway Engineering and Louisiana Standard Specifications for Roads and Bridges, Sections 7 and 8, latest edition.

Where the ends of pipe used as casing for other pipe are below ground, the ends shall be sealed.

The barrel of the carrier pipe shall be supported within the casing. Supports or carrier runners shall be spaced as recommended by the manufacturer, or as directed by the ENGINEER.

3/4" diameter service lines not permitted to be jack and bored. Contractor must use 1" minimum service line.

3.4 CONNECTING EXISTING PIPE LINES TO NEW WATER MAINS

A. On 3" and smaller water mains these connections shall be made each with the required number and size of corporation cocks, goosenecks, and branch connection. Valves and cast-iron fittings and pipe shall be paid for separately and in addition to this item. On 4" and larger water mains, tapping valves and tees will be required. These shall be a separate pay item.

3.5 TESTING WATER PIPING

A. No pressure tests shall be made until all concrete thrust blocks are at least forty-eight (48) hours old.

B. Before any water lines will be accepted by the Engineer, all lines shall be subjected to a hydrostatic pressure of 1.5 times the working pressure and shall not exceed the pressure rating of the pipe for a period not less than two (2) hours and any defective work revealed by the test shall be repaired or replaced by the Contractor and the system re-tested.

C. the pressure test, a separate 24-hour leakage test shall be conducted. Leakage shall not exceed = 133,200

L= allowance in gallons per hour S = length of pipe tested in feet

D = nominal diameter of the pipe in inches

P = average test pressure during the hydrostatic test in lbsiin2 (gauge).

All visible leaks shall be stopped, defects connected, and pipe shall be re-tested. The Contractor shall submit to the Engineer test results in a neat, tabular form.

The Contractor shall furnish all taps, pumps, piping, gauges, and measuring devices for performing all pressure and leakage tests. Where cement lined ductile iron pipe is used, the pipe shall be filled twenty-four (24) hours in advance of the pressure test.

3.6 STERILIZATION

A. Following the pressure and leakage tests, all lines shall be flushed at a velocity of not less than 2.5 FPS and sterilized in accordance with A.W.W.A. Standard C601.

B. All new potable water lines, including pipe, valves, etc. shall be sterilized prior to being placed in use with a solution of HTH Liquid Chlorine, or other approved disinfectant containing no less than fifty (50) parts per million of available chlorine.

C. For this work, the Contractor shall furnish suitable plugs or caps for the pipe, injection pumps, pipe connections, and other equipment together with all labor required.

D. While the disinfectant is being applied to any section of the system, the water shall be allowed to escape at all extremities of this section until an orthotolidin test shows a deep orange color. The disinfectant shall be allowed to remain in the pipe for twenty-four (24) hours, after which the lines shall be thoroughly flushed. Each section of the system shall be sterilized and re-sterilized until bacteriological approval has been obtained from the appropriate health agency.

3.7 CLEAN UP AND REPAIR

A. General: The Contractor shall maintain his operations in a neat and orderly manner causing as little inconvenience as possible. Within 10 working days from the time a trench is opened aii roadside ditches, culverts, etc, shall be repaired and surfaces thoroughly cleaned. All excess excavation shall be removed from the trench side and disposed of at the Contractor expense. The work area shall be then thoroughly cleaned.

B. Clean-up and repair shall conform to the applicable requirements of Section 02315, Excavation, Backfilling and Compacting.

3.8 ACCEPTANCE

A. Final acceptance of the project will not be made until the CONTRACTOR has completed the total project and all tests, restoration, and clean-up have been performed to the satisfaction of the ENGINEER.

3.9 END OF SECTION 33 1000

3.10

SECTION 33 31 13

SANITARY SEWER GRAVITY PIPING

PART 1 GENERAL

1.1 GENERAL

A. SCOPE

B. THE CONTRACTOR SHALL FURNISH ALL LABOR, EQUIPMENT, MATERIALS, AND INCIDENTALS, AND SHALL CONSTRUCT GRAVITY SEWERS, COMPLETE, AS SHOWN ON THE DRAWINGS AND AS HEREIN SPECIFIED.

C. THE WORK SHALL INCLUDE FURNISHING, LAYING, AND TESTING GRAVITY SEWER PIPE.

1.2 SUBMITTALS DURING CONSTRUCTION

A. SUBMITTALS DURING CONSTRUCTION SHALL BE MADE IN COMPLIANCE WITH SECTION 01340, SHOP DRAWINGS, PROJECT DATA, AND SAMPLES.

B. THE CONTRACTOR SHALL SUBMIT WITHIN THIRTY (30) DAYS AFTER THE DATE OF THE NOTICE TO PROCEED, A LIST OF MATERIALS TO BE FURNISHED, THE NAMES OF SUPPLIERS AND AN EXPECTED SCHEDULE OF DELIVERY OF MATERIALS TO THE SITE.

C. FURNISH IN DUPLICATE TO THE ENGINEER SWORN CERTIFICATES THAT ALL TESTS AND INSPECTIONS REQUIRED BY THE SPECIFICATIONS UNDER WHICH THE PIPE IS MANUFACTURED HAVE BEEN SATISFIED.

D. THE PIPE MANUFACTURER SHALL INSPECT ALL PIPE JOINTS FOR OUT-OF-ROUNDNESS AND PIPE ENDS FOR SQUARENESS. THE MANUFACTURER SHALL FURNISH TO THE ENGINEER A NOTARIZED AFFIDAVIT STATING ALL PIPE MEETS THE REQUIREMENTS OF ASTM ASCE, ANSI, ETC., THESE SPECIFICATIONS, AND THE JOINT DESIGN WITH RESPECT TO SQUARE ENDS AND OUT-OF-ROUND JOINT SURFACES.

1.3 INSPECTION AND TESTS

A. ALL PIPE AND ACCESSORIES TO BE INSTALLED UNDER THIS CONTRACT SHALL BE INSPECTED AND TESTED AT THE PLACE OF MANUFACTURE BY THE MANUFACTURER AS REQUIRED BY THE STANDARD SPECIFICATIONS TO WHICH THE MATERIAL IS MANUFACTURED.

B. EACH LENGTH OF PIPE SHALL BE SUBJECT TO INSPECTION AND APPROVAL AT THE FACTORY, POINT OF DELIVERY, AND SITE OF WORK. SAMPLE OF PIPE TO BE TESTED SHALL BE SELECTED AT RANDOM BY THE ENGINEER OR THE TESTING

LABORATORY AND SHALL BE DELIVERED BY THE CONTRACTOR TO THE TESTING LABORATORY APPROVED BY THE ENGINEER.

C. WHEN THE SPECIMENS TESTED CONFORM TO APPLICABLE STANDARDS, ALL PIPE REPRESENTED BY SUCH SPECIMENS SHALL BE CONSIDERED ACCEPTABLE BASED ON THE TEST PARAMETERS MEASURED. COPIES OF TEST REPORTS SHALL BE SUBMITTED TO THE ENGINEER BEFORE THE PIPE IS INSTALLED IN THE PROJECT. ACCEPTABLE PIPE WILL BE STAMPED WITH AN APPROPRIATE MONOGRAM UNDER THE SUPERVISION OF THE TESTING LABORATORY.

D. IN THE EVENT THAT ANY OF THE TEST SPECIMENS FAIL TO MEET THE APPLICABLE STANDARDS, ALL PIPE REPRESENTED BY SUCH TESTS SHALL BE SUBJECT TO REJECTION. THE CONTRACTOR MAY FURNISH TWO ADDITIONAL TEST SPECIMENS FROM THE SAME SHIPMENT OR DELIVERY FOR EACH SPECIMEN THAT FAILED AND THE PIPE WILL BE CONSIDERED ACCEPTABLE IF ALL OF THESE ADDITIONAL SPECIMENS MEET THE REQUIREMENTS OF THE APPLICABLE STANDARDS.

E. PIPE WHICH HAS BEEN REJECTED BY THE ENGINEER SHALL BE REMOVED FROM THE SITE OF THE WORK BY THE CONTRACTOR AND REPLACED WITH PIPE WHICH MEETS THESE SPECIFICATIONS.

F. OTHER TESTING REQUIREMENTS SPECIFIC TO THE TYPE OF PIPE ARE INCLUDED UNDER THE APPROPRIATE PARAGRAPH IN PART 2, BELOW.

PART 2 PRODUCTS –

1.4 GENERAL

A. Sizes and strength classification of gravity sewer pipe to be used in all locations are indicated on the Drawings.

B. Each length of pipe shall bear the name or trademark of the manufacturer, the location of the manufacturing plant, and the class or strength classification of the pipe. The markings shall be plainly visible on the pipe barrel.

1.5 POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE

A. Smooth wall pipe and fittings in sizes 4" through 15" shall be manufactured in accordance with the requirements of ASTM 03034 SOR 35 and 18" and larger shall be manufactured in accordance with ASTM F679, T-I wall Type 1, SOR 35. P.V.C. pipe shall be manufactured from PVC compound having a minimum cell classification of 12454C as described in ASTM D1784. The pipe shall be joined with an integral bell; bell and spigot; type rubber gasket _joint. Each integral bell joint shall be of the push-on type meeting the requirements of ASTM D3212 and shall consist of a formed bell complete with a single rubber gasket. The rubber gasket shall conform to the requirements of ASTM F477 and shall be held in place in the bell by mechanical means.

B. If pipe type is not indicated on the drawings, profile wall PVC pipe shall only be used with special permission from the Engineer. Profile wall PVC pipe in sizes 4" through 18" shall be manufactured in accordance with ASTM F794 and shall have a minimum pipe stiffness of 60 lbs./in./in. at five percent deflection when tested in accordance with ASTM D2412. Fittings for profile wall P.V.C. pipe shall be as those specified for smooth wall PVC pipe with use of appropriate adapters to make the connections. Profile wall PVC pipe and adapters shall be manufactured from PVC compound meeting a minimum cell classification of 12454C as described in ASTM D1784. The pipe shall be joined by either integral bell or coupling rubber gasket joints. The joint shall be of the push-on type meeting the requirements of ASTM 03212. The rubber gasket shall conform to the requirements of ASTM F477 and shall be held in place, either in the integral bell or coupling or on the pipe spigot, by mechanical means.

C. If pipe type is not indicated on the drawings, profile wall PVC pipe shall only be used with special permission from the Engineer. This specification includes materials, test methods and installation requirements for 4 to 36-inch dimeter polyvinyl chloride (PVC) corrugated pipe with a smooth interior. The requirements of this specification are intended to provide pipe and fittings suitable for underground use in non-pressure applications for sanitary sewers.

D. PVC corrugated pipe with a smooth interior shall conform to the requirements of ASTM Designation F949-99 (or latest revision). Pipe and fittings shall be homogenous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The pipe shall be made of PVC compound having a minimum cell classification of 124548 as defined in ASTM Specification 01784.

E. All fittings for PVC corrugated sewer pipe with a smooth interior shall conform to ASTM F9494-99 Section 5.23.3. To ensure compatibility, the pipe manufacturer shall provide all fittings.

F. All joints shall be made with integrality-formed bell and spigot gasketed connections. The manufacturer shall provide documentation showing no leakage when gasketed pipe joints are tested in accordance with ASTM Test Method 03212. Elastomeric seals (gaskets) shall meet the requirements of ASTM Designation F477.

1.6 PVC PIPE JOINTS

A. The P.V.C. joints shall be of the push-on type so that the pipe and fittings may be connected on the job without the use of solvent cement or any special equipment. The joint seal shall be affected by a single rubber joint gasket designed to be assembled by the positioning of the continuous, molded rubber ring gasket in an annular recess and the forcing of the spigot end of the joining pipe into the socket, shall compress the gasket radially. the gasket and annular recess shall be designed and shaped so that the gasket is locked in place against displacement by mechanical means. Systems in which the gasket is held in place only by means of an adhesive agent shall not be

B. considered equal to the mechanical anchorage and shall not be allowed. The rubber ring joint shall be designed for thermal expansion or contraction with a total temperature change of at least 75° F and shall meet the requirements of ASTM 03212.

Lubricant furnished for lubricating joints shall be nontoxic, shall not support the growth of bacteria, shall have no deteriorating effects on the gasket or pipe material.

1.7 JOINTS FOR DISSIMILAR PIPE

A. Joints between pipes of different materials shall be made with a flexible mechanical compression coupling with No. 305 stainless steel bands as manufactured by Joints, Inc. of Gardena, California; Fernco Sealer Co., Ferndale, Michigan, or equal, or a concrete closure collar as directed by the Engineer.

1.8 PIPE BEDDING AND PIPE COVER MATERIALS

A. Pipe bedding material and trench backfill material shall be as specified in Section 02200.

1.9 STEEL PIPE AND FITTINGS

A. Steel pipe shall meet the requirements of ASTM A 53 Grade Band shall be standard weight. Steel pipe specified to meet the requirements of AWWA C200 shall be designed to the maximum internal pressure given in the specifications.

B. 8. The minimum wall thickness for steel pipe 4 inches and up to and including 36 inches shall be 1/4 inch.

C. Exposed pipe shall have grooved or shoulder type joints complying with AWWA C606 unless flanged ends or plain ends for flexible couplings are shown on the drawings are required. Flanged ends shall conform to AWWA C207 Class B with rubber gaskets.

D. Pipe used with groove and couplings shall be not less than standard weight and at !east as thick as the minimum recommended by the coupling manufacturer or shall be provided with double fillet or butt welded collared ends to meet requirements. Laying length shall be as specified by the Contractor. Bends, fittings, and special fittings for pipe 14 inches and larger shall meet the requirements of AWWA C 208 and the same stress and load conditions required for pipe meeting the requirements of AWWA C 200 specified above. The Contractor shall determine and provide reinforcements or additional shell thickness as required to keep the combined stresses within the specified maximum.

E. Coatings for steel pipe and fittings shall be hot applied coal tar enamel with Kraft paper wrap in accordance with AWWA C203, or coal tar epoxy per AWWA C210 or fusion epoxy coating per AWWA C213. Other steel pipe and fittings shall be factory cleaned and primed and field painted.

F. Lining for steel pipe and fittings shall be cement mortar lining per AWWA C205.

G. All field repair work shall conform to one of the following as applicable. Welding per AWWA C206, cement mortar lining per AWWA C602, and cold applied coal tar coating per AWWA C209.

H. The manufacturer shall provide an affidavit of compliance as described in AWWA C200. Shop hydrostatic tests of steel pipe and fittings, as specified in AWWA C200, are required.

1.10 CASING PIPE

A. Pipe:

1. Casing pipe shall be steel having a minimum yield strength of 35,000 psi, conforming to AP.I. Specification 5L. Casings shall have the following minimum wail thicknesses:

Size (Non. Diam.• in.)	Thickness (Inches)
Under 12" I.D.	0.250
14 and 16 O.D.	0.281
18 O.D.	0.313
20 O.D.	0.344
24O.D.	0.375
26 O.D.	0.438
28 and 30 O.D.	0.469
32 O.D.	0.500
34 and 36 O.D.	0.532
38, 40 and 42 O.D.	0.563

Both the interior and exterior of the pipe shall have a bituminous coating.

B. Joints:

1. Joints shall be butt welded. Coatings shall be continuous at the joints.

C. Carrier Runners

1. The carrier pipe shall be supported by utilizing three way to concentric casing cradle as manufactured by T. D. Williamson, Inc., Pipeline Seal and Insulator Company, APS Casing Spacers or equal.

D. Casing Seal:

1. Casing seals, which seals the annulus between the casing and carrier pipe, shall be made of cement grout or bituminous material.

PART 3 EXECUTION

1.11 PIPE DISTRIBUTION

A. Distribute material on the job no faster than it can be used to good advantage. Unload pipe which cannot be physically lifted by workers from the trucks, by a forklift, or other approved means. Do not drop pipe of any size from the bed of the truck to the ground. Do not distribute more than one week's supply of material in advance of laying, unless otherwise approved by the Engineer.

1.12 PIPE PREPARATION AND HANDLING

A. Inspect all pipe and fittings prior to lowering into trench to insure no cracked, broken, or otherwise defective materials are being used. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

B. Use proper implements, tools, and facilities for the safe and proper protection of the work. Lower pipe into the trench in such a manner as to avoid any physical damage to the pipe. Remove all damaged pipe from the jobsite. Do not drop or dump pipe into trenches under any circumstances.

1.13 LINE AND GRADE

A. Do not deviate from line and grade, as established by the Engineer, more than 1/2-inch for line and 1/4-inch for grade, provided that such variation does not result in a level or reverse sloping invert. To account for permissible variation in the pipe wall thickness, the measurement for grade shall be at the pipe invert, not at the top of the pipe. The Contractor shall furnish and st the line and grade boards at maximum intervals of 25 feet. if grade boards prove impractical because of trench or other conditions, other methods of controlling line and grade (including laser beam) may be submitted to the Engineer for approval.

B. A substantial stake shall be driven on each side of the trench on a line at right angles to each stake of the primary line. A straight and even-edged 2-inch by 6-inch board shall be nailed or clamped to the stakes in a level position and at some even foot height above the grade line of the proposed sewer. The centerline of the proposed sewer shall be located by measurement from the primary line stake and marked upon the board. Not less than three such line and grade boards shall be set and immediately checked visually for errors in line and grade. As each additional board is placed, it shall be checked visually for error in line and grade. At least three boards shall be maintained at all times. During the laying of the pipe, a stout twill line shall be fastened to the boards at the center of alignment marks and pulled sufficiently tight to remove any noticeable or measurable sag. The line and grade of each pipe shall be obtained by measuring down from the string line by means of a plumbed grade pole.

C. The Contractor may use the laser beam method of maintaining line and grade upon approval of the Engineer. Prior to approval, the Contractor shall submit evidence to the Engineer that a qualified operator will handle the equipment during construction. A "Caution-Laser Light" placard shall be mounted in a conspicuous place. When "in the pipe" method is used, grade boards will be required to install the first 50 feet of pipe, and the Contractor shall check the line and grade at any additional points at which offset stakes have been placed wherever so requested by the Engineer. If bending of the beam due to air temperature variations becomes apparent with "in the pipe" units, a fan shall be provided to circulate the air. However, air velocity shall not be so excessive as to cause pulsating or vibrating of the beam. if, in the opinion of the Engineer, the beam cannot be accurately controlled, this method of setting line and grade shall be discontinued. When the above ground method is used, the set-up shall be checked with three grade boards including one set at the upstream manhole. If the laser has a gradient indicator, two boards may be used to check the set-up. The grade board at the upstream manhole shall be retained to be used as a check as pipe laying progresses.

1.14 PREPARATION OF TRENCH

A. Provide pipe bedding material under all pipe for the full width of the trench. Minimum depth of bedding material below the pipe barrel shall be as follows

Pipe Size	Minimum Depth of Bedding Under Pipe Barrel
Up to 24 inches	6inches
Over 24 inches	9 inches

B. Hand-grade bedding to proper grade ahead of pipe laying operation to provide continuous and unyielding support along the entire pipe length.

C. If the trench has been excavated below the required depth for pipe bedding material placement, fill the excess depth with pipe bedding material as specified in these specifications to the proper subgrade. Compensation for excess or extra depth excavation and refill with bedding material ordered by the Engineer shall be as provided in the bid documents and Section 02316.

D. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint.

1.15 DEWATERING

A. Prevent water from entering the trench during excavation and pipe laying operations to the extent required to properly grade the bottom of the trench and allow for proper compaction of the backfill. Pipe shall be laid in the dry.

1.16 LAYING AND JOINTING CONCRETE PIPE AND FITTINGS

A. Pipe laying shall proceed upgrade with spigot ends pointing in direction of flow. After a section of pipe has been lowered into the prepared trench, clean the end of the pipe to be joined, the inside of the joint, and, if applicable, the rubber ring immediately before joining the pipe. Make assembly of the joint in accordance with the recommendations of the manufacturer of the type of joint used. Provide all special tools and appliances required for the joint assembly.

B. All pipe shall be laid uniformly to line and grade so that the finished sewer will present a uniform bore. Variations from line and grade in excess of the tolerances specified under LINE AND GRADE will be considered sufficient cause for rejection of the work.

C. Check pipe for alignment and grade after the joint has been made. The pipe bedding shall form a continuous and uniform bearing and support for the pipe barrel between joints. Apply sufficient pressure in making the joint to assure that the joint is "home" as defined in the standard installation instructions provided by the pipe manufacturer. Place sufficient pipe cover material to secure the pipe from movement before the next joint is installed to assure proper pipe alignment and joint makeup.

D. Pipe 21-inches and smaller intended to be in straight alignment shall be laid so the inside joint space does not exceed 3/8 inch in width. If interior joints on 24 inch and larger pipe laid either in straight alignment or on a curve are greater than 3/8 inch, thoroughly clean the joint surfaces, and fill and seal the entire joint with premixed mortar conforming to ASTM C-387 only after the trench has been backfilled, unless otherwise approved by the Engineer. Trowel smooth on the inside surface. Water shall not be allowed to rise in or around or pass over any joint before it has substantially set.

E. When pipe is laid within a movable trench box, take all necessary precautions to prevent pipe joints from pulling apart when moving the box ahead.

F. Prevent excavated or other foreign material from getting into the pipe during the laying operation. Close and block the open end of the last laid section of pipe to prevent entry of foreign material or creep of the gasketed joints when laying operations are not in progress, at the close of the day's work, or whenever the workers are absent from the job.

G. Plug or close off pipes which are stubbed off for manhole construction or for connection by others with temporary plugs as specified in Section 01040 - Project Coordination.

H. Take all necessary precautions to prevent the "uplift" or floating of the line prior to the completion of the backfilling operation.

I. Make connections of non-reinforced pipe to manholes or concrete structures, so that a standard pipe joint is located not more than two feet from the outside edge of the structure.

J. When field cutting and/or machining the pipe is necessary, use only tools and methods recommended by the pipe manufacturer and approved by the Engineer.

K. After the pipe has been laid and sufficient backfill placed to prevent movement of the pipe, welding of the PVC liner at the joints of the concrete pipe may begin. All PVC liner shall be welded and tested in accord with the requirements stated herein prior to performing any leakage testing.

1.17 LAYING PLASTIC PIPE

A. Plastic (PVC) piping shall be installed in accordance with the details shown on the Drawings and applicable requirements of ASTM D-2321, "Standard Practice for Underground Installation of Flexible Thermoplastic Pipe" and the manufacturer's recommendations. Pipe Bedding as specified in Section 02200 will be used for PVC pipe unless directed otherwise by the Engineer. The pipe shall be backfilled with granular material and thoroughly compacted to 12-inches above the top of the pipe and thereafter backfilled as specified in Section 02200.

B. The Contractor shall use care in handling, storage, and installation of pipe. Storage of pipe on the job site shall be done in accordance with the pipe manufacturer's recommendation. Under no circumstances shall pipe be dropped into the trench.

1.18 BACKFILL IN THE PIPE ZONE

A. The pipe zone shall be considered to include the full width of the excavated trench from the bottom of the trench to a point above the top outside surface of the barrel of the pipe.

B. Particular attention must be given to the area of the pipe zone from the flow line to the spring line of the pipe to ensure that firm support is obtained to prevent any lateral movement of the pipe during the final backfilling of the pipe zone.

C. Care shall be taken to ensure that the pipe does not rest directly on the bell or pipe joint but is uniformly supported on the barrel throughout its entire length.

D. After the pipe is laid to line and grade, place and carefully compact pipe bedding material for the full width of the trench as required by the pipe bedding details. Place the material around the pipe in 6-inch layers and thoroughly hand tamp with approved tamping sticks supplemented by "walking in" and slicing with a shovel to assure that a!! voids are filled.

E. Backfill and carefully compact the area above the bedding material with pipe cover material to a point 12-inches above the top outside surface of the pipe barrel. Pipe bedding material may, at the Contractor's option, be substituted for pipe cover material.

1.19 EXCESS TRENCH WIDTH

A. Normal trench width shall be as defined on the Drawings. Where the normal trench width below the top of the pipe is exceeded for any reason, the Contractor shall, unless the Engineer determines that the pipe being used is strong enough for the actual trench width, furnish an adequate support for the pipe. This may be accomplished by furnishing a stronger pipe or a concrete cradle only when approved in writing by the Engineer and as described below.

B. The thickness of concrete under the pipe shall be one-third of the nominal diameter of the pipe, but not less than four inches. Concrete block or brick may be used for adjusting and maintaining proper grade and elevation of pipe. After the pipe is laid to line and grade, place 3,000 psi concrete under the pipe and for the full width of the trench to form a cradle of the required length and thickness with the concrete brought up to a level equal to 1/4 of the inside pipe diameter below the spring line of the pipe. Start and terminate the concrete cradle at the face of a pipe bell or collar. Do not encase pipe joints at the ends of the concrete cradle.

C. After the concrete has taken initial set, cover material shall be placed and compacted over the concrete cradle and up to a level 12 inches above the pipe barrel and for the full width of the trench. Cover material shall be placed by hand or by equally careful means.

1.20 CONNECTING DISSIMILAR PIPE MATERIALS

A. Connect dissimilar pipe materials by means of a flexible coupling or a concrete closure collar as directed by the Engineer. Install couplings in strict accordance with the manufacturer's recommendations.

B. Use concrete closure collars only when approved by the Engineer, and then only to make connections between dissimilar pipe when standard rubber gasketed joints or flexible couplings are impractical. Before the closure collars are poured, wash the pipe to remove all loose material and soil from the surface on which the concrete will be placed. Prepare PVC pipe by painting a minimum four-inch-wide band that will be in contact with the concrete with a thin coat of solvent cement and embed a layer of concrete or masonry sand in the cement before it sets to create a bonding surface. Wet nonmetallic, except PVC, pipe thoroughly prior to pouring the collars. Wrap and securely fasten a light gauge of sheet metal or building-felt around the pipe to insure that no concrete shall enter the line. Place reinforcement as shown on the Plans. Make entire collar in one pour using 3,000 psi concrete and extend a minimum of 12 inches on each side of the joint. The minimum thickness around the outside diameter of the pipe shall be six inches. No collar shall be poured in water. After the collars are poured and have taken their initial set, cure by covering with well-moistened earth.

1.21 PIPE BULKHEADS

A. All tees, wyes, sockets, and bell-and-spigot pipe sewers 18 inches in diameter or smaller shall be bulk headed with caps or disc stoppers with factory-fabricated resilient joints.

The disk or cap shall be banded or otherwise secured to withstand all test pressures without leakage.

B. Connections 21 inches and 24 inches in diameter shall be bulk headed with a four-inch brick wall, using clay brick or concrete brick. The wall shall be capable of withstanding all test pressures without leakage.

1.22 JACKING AND BORING PIPE

A. General:

1. Where pipe is to be laid beneath railroads, Federal Highways, State Highways, and concrete pavement, jacking and boring is required. The Contractor will not be permitted to open cut.

2. The requirements of the approving agency, such as railroad or State Highway Department, shall govern over these Specifications and Plans

3. Sub-surface operations resulting in damage to the tracks or pavement, shall be the responsibility of the Contractor and shall be repaired at no cost to the OWNER.

B. Jacking and Boring Casing Pipe:

Installing of steel casing pipe shall conform to the A.R.E.A. Manual for Railway Engineering and Louisiana Standard Specifications for Roads and Bridges, Sections 7 and 8, latest edition.

Where the ends of pipe used as casing for other pipe are below ground, the ends shall be sealed.

The barrel of the carrier pipe shall be supported within the casing. Supports or carrier runners shall be spaced as recommended by the manufacturer, or as directed by the ENGINEER

3/4" diameter service lines not permitted to be jack and bored. Contractor must use 1" minimum service line.

1.23 LEAKAGE TESTS FOR GRAVITY SEWERS – GENERAL

A. Gravity sewers shall be required to pass a leakage test before acceptance. Leakage tests may be by the infiltration test or exfiltration test, depending on the level of the groundwater table or by the low-pressure air test all as described below. All testing shall be conducted in the presence of the Engineer or his designated representative.

B. Water infiltration or exfiltration or air loss rates will be measured with equipment supplied by the Contractor and shall be observed by the Engineer. The tests shall be performed by the Contractor under the observation of the Engineer.

C. The groundwater height for all test methods above the installed pipe shall be determined by attaching a transparent plastic tube to a pipe nipple in the manhole and using the plastic tube as a manometer.

D. The ends of branches, laterals, tees, wyes, and stubs to be included in a test section shall be plugged to prevent water or air leakage. All plugs shall be secured to prevent blowout due to internal pressure. A test section is defined as the length of sewer between manholes.

E. The Contractor shall repair all visible leaks in manholes and pipe, even though the leakage test requirements are met.

1.24 LEAKAGE TEST- INFILTRATION METHOD

A. The water infiltration test shall not be considered a valid leakage test unless the top surface of the groundwater level is at least seven feet (7') above the pipe crown during the test measurement. The rate of infiltration of water into the sewers, including manholes and appurtenances, shall not exceed 125 gallons per day per inch diameter per mile of sewer. In the event groundwater does not submerge the pipe as specified, the Contractor shall conduct an exfiltration test described hereinafter.

B. A visual inspection and an infiltration test will be conducted on all completed sewers 30 inches in diameter or larger when they are submerged by groundwater as specified above. The Contractor shall provide facilities to stop inflow from adjacent sections of sewer and to provide pondage to permit measurement of infiltration. Visible leaks, defective joints, and defective pipe shall be satisfactorily repaired or replaced.

1.25 LEAKAGE TEST- EXFILTRATION METHOD

A. Sewers not submerged by groundwater shall be tested for exfiltration or, if approved, by low-pressure air method. The Engineer reserves the right to waive the exfiltration test on any section of sewer based on his evaluation of the results of previous tests.

B. The hydrostatic head for test purposes shall be seven feet (7') above the sewer crown at the upstream end. The water level in the sewer shall be adjusted so that the hydrostatic head is seven feet minimum above the ground water level when the ground water level is higher than the pipe crown. Any arrangement of testing equipment which will provide obser,1able and accurate measurement of water leakage under the specified conditions will be permitted. The rate of exfiltration of water out of the sewers, including manholes and appurtenances, shall not exceed 125 gallons per day per inch diameter per mile of sewer. Visible leaks, defective joints, and defective pipe shall be satisfactorily repaired or replaced.

C. The sewer test section may be filled 24 hours prior to time of exfiltration testing, if desired, to permit normal absorption into the sewer pipe '1valls to take place.

1.26 LEAKAGE TEST - LOW-PRESSURE AIR METHOD

A. Test Procedure. The following test procedures shall be used in making each test:

1. The section of sewer line to be tested shall be flushed and cleaned prior to conducting the low-pressure air test to clean out any debris, wet the pipe, and produce more consistent results.

2. Isolate the section of sewer line to be tested by means of inflatable stoppers or other suitable test plugs. Each plug shall have an inlet/outlet tap, or other provision for connecting a hose to a portable air source · at one plug and bleeding the air pressure off at the other plug.

3. If the test section is below the groundwater level, determine the height of the groundwater above the spring line of the pipe at each end of the test section and compute the average. For every foot of groundwater above the pipe spring line, increase the gauge test pressure by 0.43 pounds per square inch.

4. Connect the air hose to the inlet tap and a portable air source. The air equipment shall consist of necessary valves and pressure gauges to control the rate at which air flows into the test section and to enable monitoring of the air pressure within the test section. The testing apparatus shall be equipped with a pressure relief device to prevent the possibility of loading the test section with the full capacity of the compressor.

5. Add air slowly to the test section until the pressure inside the pipe is raised to 4.0 psig greater than the average back pressure of any groundwater that may be over the pipe.

6. After a pressure of 4.0 psig above the groundwater back-pressure is obtained, regulate the air supply so that the pressure is maintained between 3.5 and 4.0 psig (above the average groundwater Sack pressure) for a period of two minutes to allow the air temperature to stabilize in equilibrium with the temperature of the pipe walls.

7. Determine the rate of air loss by the time pressure-drop method. After the two-minute air stabilization period, disconnect the air supply and adjust the pressure to 3.5 psig above the average groundwater back pressure. The time required for the test pressure to drop from 3.5 psig to 2.5 psig shall be determined by means of a stopwatch and this time interval will be compared to the required time in the tables to determine if the rate of air loss is within the allowable time limit. If the time is equal to or greater than the times indicated in the tables, the pipeline shall be deemed acceptable.

8. The pressure shall be monitored by a recording type pressure gauge and a copy of the strip chart shall be given to the Engineer upon completion of the test. The chart shall show the initial pressurization of the sewer, the

two minute stabilization time, the test period, and the bleed-off of the pressure at the completion of the test.

9. Upon completion of the test, the air pressure in the sewer shall be bled off slowly and from the end of the test section opposite to the location of the test pressure gauge. The reduction in air pressure shall be shown on the recording of the pressure test as described above.

B. For sewer diameter between 6 inches and 24 inches inclusive, the Pipe shall be tested between adjacent manholes.

1.27 LAMP TESTING

A. Prior to final acceptance all sewers laid on a straight alignment shall be lamp tested. The test shall be performed by placing a bright source of light at one end of a manhole run and observing the light at the other end. The image of light projected through the sewer shall be a full or nearly full circular section. Pipe segments not passing this test shall be relayed to the correct alignment.

1.28 MANDREL TEST

A. At the option of the Engineer, the Contractor shall run a "Go-No-Go" rigid mandrel deflection test on PVC sewer mains. The Contractor shall furnish an approved mandrel suitable for accurately measure the maximum deflection of the main. The deflection shall be five (5) percent maximum at job acceptance. Any main which has deflection in excess of maximum shall be rejected and removed and replaced by the Contractor with sufficient bedding to meet the deflection requirements at no cost to the Owner.

1.29 MANHOLE AIR VACUUM TEST

A. All manholes installed in gravity flow sanitary sewerage systems shall be tested using an inflatable compression band, vacuum pump and appurtenances specifically designed for vacuum testing manholes. Test procedures shall be in accordance with the test equipment manufacturer's recommendations. Test equipment to be manufactured by peter A. Glazier & Associates, worchester, MA, or approved equal.

B. Manholes may be tested by vacuum test immediately after assembly of the manhole and connecting pipes and before any backfill is placed around the manholes. However, the final test and acceptance shall be based only upon a test after the manhole is backfilled and the cover frame castings are grouted in place.

C. A!l pipes entering the manhole shall be plugged, taking care to securely brace the piugs and pipe.

D. After the testing equipment is in place, a vacuum of ten inches (1O") of Hg shall be drawn on the manhole. The manhole will be considered to have passed the test if the vacuum does not drop more than one inch (1") of Hg in one minute.

E. If the manhole fails the initial test, the Contractor shall locate the point(s) of leakage and make proper repairs, and retest until a satisfactory test result is obtained.

F. After the manholes have been backfilled, the cover frame casting sealed in place, vacuum tested, and prior to final acceptance of the project, any signs of leaks or weeping visible from the inside of the manhole shall be repaired and the manhole made watertight and retested in accordance with this specification.

G. The vacuum test shall be monitored by a recording type pressure/vacuum gauge and a copy of the strip chart shall be given to the Engineer upon completion of the test. The chart shall show the initial vacuum draw down, the test period, and a slow, controlled release of the vacuum.

1.30 FINAL ACCEPTANCE

A. Prior to final acceptance and final manhole-to-manhole inspection of the sewer system by the Engineer, flush and clean all parts of the system. Remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the sewer system at or near the closest downstream manhole. if necessary, use mechanical rodding or bucketing equipment.

B. Upon the Engineer's final manhole-to-manhole inspection of the sewer system, if any foreign matter is still present in the system, reflush and clean the section and portions of the lines as required.

END OF SECTION 33 3100

SECTION 33 41 00 – CATCH BASINS AND DRAINAGE PIPE

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. The requirements for drainage conduits and catch basins (also referred to as yard drains on Drawings) including all related appurtenances in conformance with the lines and grades as shown on the Drawings, as outlined within this Specification, and to the satisfaction of the OWNER.

B. Related Sections:
   1. Section 311000 "Site Clearing" for protection of existing trees and plantings, topsoil stripping and stockpiling, and site clearing.
   2. Section 312001 "Earth Moving" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
   3. Section 329200 "Turf and Grasses" for turf (lawn)

1.3 QUALITY ASSURANCE

A. To ensure unity of responsibility, all drainage conduit, pipe fittings, connectors, catch basins risers, joints, etc. shall be the standard product of a single manufacturer having a minimum of five (5) years experience in the manufacturing of plastic drainage systems conforming to this Specification.

1.4 ACTION SUBMITTALS

A. Shop Drawings
   1. Manholes: Include plans, elevations, sections, details, frames, and covers.
   2. Catch basins. Include plans, elevations, sections, details, frames, covers, and grates.
   3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design-mix reports.

1.5 INFORMATIONAL SUBMITTALS

A. 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.

B. 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.

C. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.

D. Warranty: Sample of special warranty.

1.6 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.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

B. Notify Landscape Architect and Owner no fewer than two days in advance of proposed interruption of service.

C. Do not proceed with interruption of service without Owner's written permission.

PART 2 - PRODUCTS

2.1 CATCH BASINS & GRATES

A. Catch Basins: shall be factory fabricated AASHTO H-20 heavy duty one piece units of the size and geometrics as shown on the Drawings. The catch basins shall be custom fitted for this project. Catch basins shall be constructed to specifically adapt to frame and grate sizes shown on the Drawings. Catch basins that require separate transitions to fit the frame and grate will not be acceptable.

B. Catch Basin Grates: Grates shall be a one (1) piece unit factory fabricated and provided by and specifically designed to instantly install on the exposed end of the vertical pipe catch basin. All grates shall be square, round, or atrium-style as indicated on the Drawings and shall be cast iron meeting AASHTO H-20 rating.

C. Manufacturers:
1. ADS
2. Oldcastle
3. Dura Trench
4. Approved equal
5. Cast in place catch basins also acceptable

2.2 HDPE DRAIN PIPE AND FITTINGS

A. Corrugated HDPE Drainage Pipe (solid and perforated)
1. All HDPE Drain pipe shown on the drawings shall have smooth interior ("Smooth Lined") and annular exterior corrugations conforming to AASHTO M252 or M294.
2. Material must be high density polyethylene meeting ASTM D 3350 minimum call classification 335420 C Piping in paragraph below is available in NPS 12 to NPS 60 (DN 300 to DN 1500).
3. HDPE drain pipe shall be N–12 (dual wall)

B. Corrugated HDPE Drainage Pipe Fittings
1. Drain pipe fittings shall meet the requirements of paragraph 2.1 and conform to AASHTO M252 or M294.
2. Fabricated fittings shall be factory welded at all accessible interior and exterior junctions.
3. Drain pipe fittings shall be by the same manufacturer as specified herein for drain pipe.

C. Corrugated HDPE Pipe Joints
1. Pipe shall be joined with integral bell and spigot joints meeting AASHTO M252, M294 or MP7-97.
2. All joints shall be silt tight and non-rated watertight
3. Gaskets shall be made of polyiosprene meeting the requirements of ASTM 477 with the addition that gaskets shall not have any visible cracking when tested according to ASTM D1149 after 72 hours exposure in 50 PPHM ozone at 104° Fahrenheit.
4. Gaskets shall be installed by the pipe manufacturer and covered with a removable wrap to insure the gasket is free from debris.
5. A joint lubricant shall be supplied by the pipe manufacturer to be used on the gaskets at the time of installation.
6. Drain pipe joints shall be by the same manufacturer as specified herein for drain pipe.

2.3 SDR 35 DRAIN PIPE AND FITTINGS

A. SDR 35 Drainage Pipe and Fittings
1. Drain pipe and fittings shall be by the same manufacturer as specified herein for drain pipe.
2. Fabricated fittings shall be factory welded at all accessible interior and exterior junctions.

2.4 PEA GRAVEL

A. Pea gravel for perforated HDPE Pipe

U.S. Sieve	Percent Passing
1½"	95-100
No. 4	0-15
No. 200	0-2

2.5 GEOTEXTILE FABRIC

A. Geotextile fabric for HDPE pipe joints and PVC catch basins shall be in conformance with Section 312001 – Earth Moving.

2.6 DRAINAGE COURSE BACKFILL

A. Backfill material required for the drainage system shall be in conformance with Section 312022 – Earth Moving.

PART 3 - EXECUTION

3.1 GENERAL

A. Install drainage facilities as recommended by the manufacturer and in conformance with the grades designated on the Drawings.

B. Deflections; The maximum deflection of any drain pipe either solid or perforated shall be one and one half (1 ½°) degrees at each joint. The maximum radius of the deflections combined is seven hundred sixty five (765') feet. Any turns, bends, angles, etc., in the drainage system that exceed this criteria shall be constructed using fittings. The plastic drainage system (HDPE pipe and PVC catch basins) shall be installed in conformance with the manufacturers recommendations.

END OF SECTION 33 41 00

SECTION 33 43 00 - STORMWATER CONVEYANCE

PART 1 GENERAL

1.1 SUMMARY

A. Furnish all labor, materials, equipment and incidentals required to install drainage pipe and drainage structures as shown on the Drawings and specified herein.

B. Tie- in proposed site drainage pipe to existing drainage structures.

PART 2 PRODUCTS

2.1 MATERIALS SHALL CONFORM TO THE FOLLOWING SECTIONS AND SUBSECTIONS:

2.2 BEDDING MATERIAL: BEDDING MATERIALS SHALL BE A SAND-AGGREGATE MIXTURE. AGGREGATE IN THE MIXTURE SHALL BE GRAVEL, STONE OR CRUSHED CONCRETE. THE MIXTURE SHALL BE FREE OF FOREIGN MATTER AND SHALL BE GRADED AS FOLLOWS

U.S. Sieve	% Passing
1 ½"	95-100
No. 4	30-50
No. 10	20-45
No. 200	0-10

2.3 BACKFILL SAND: SAND FOR BACKFILLING TRENCHES AND STRUCTURES SHALL BE NONPLASTIC SILICEOUS MATERIAL, GRADED AS FOLLOWS:

U.S. Sieve	% Passing
½"	100
No. 10	75-100
No. 200	0-10

2.4 PIPE:

A. Reinforced Concrete Pipe. Pipe shall conform to ASTM C 76, Class III. Gasket material shall be rubber gasket conforming to AASHTO M 315, LA DOTD QPL-4

B. Plastic Pipe: Pipe may be of any of the following types and shall be products listed in the QPL. Joints shall be bell and spigot type with rubber gaskets conforming to AASHTO M 252

1. POLYVINYL CHLORIDE (PVC) PIPE: Pipe shall conform to ASTM F 794 or ASTM F 949, Series 46 with UV inhibitors or AASHTO M 304 minimum pipe stiffness 46. The resin shall have a minimum cell classification of 12454-C in accordance with ASTM D 1784.

C. Portland Cement Concrete: Reference Section 32 1000

D. Geotextile Fabric

E. Geotextile fabric shall be a product listed in the QPL 61 and shall be composed of at least 85% by weight of polyolefins, polyesters or polyamides. Fabric shall be resistant to chemical attack, rot and mildew and shall have no tears or defects which adversely alter its physical properties. When required, fabric shall contain stabilizers or inhibitors to make filaments resistant to deterioration due to ultraviolet and heat exposure. Edges of fabric shall be finished to prevent outer yarn from pulling away from fabric. Fibers of other composition may be woven into fabric for reinforcing. Durability of these fibers shall be equivalent to that of the geotextile fabric.

Geotextile fabric rolls shall have an opaque, waterproof wrapping. Each roll shall be labeled with manufacturer's name, date of manufacture, batch number and name of product.

Geotextile fabric shall be utilized as follows:

<u>Drainage:</u>	
Underdrains	A, B, C or D
Pipe and Precast Box Culvert Joints	A, B, C or D
Weep Holes	A, B, C or D
Bedding Fabric	B, C or D
Approach Slabs	D
<u>Stabilization:</u>	
Bulkheads	C or D

Flexible Revetments	C or D
Rip Rap	D
Railroad Crossings	D
Soil Stabilization	C, D or S
Silt Fencing:	
Wire Supported	F
Self-Supported	G

PART 3 EXECUTION

3.1 PIPE:

A. Trenching and Bedding: Trenches shall be excavated to specified width; if not specified, trenches shall be excavated to a width of at least 18" on each side of conduit. Trenches shall be excavated to the depth required accommodate placement of bedding material. Bedding material shall be placed and mechanically compacted in lifts not more than 6" thick (compacted) to at least 95% of maximum density determined by AASHTO T 99. If foundation is stable, bedding material shall be placed as follows:

1. Concrete Pipe or Box Culvert: Bedding material shall be placed in trench bottom.

2. Plastic Pipe or Steel Pipe:

   a. Pipe Under or Within 5 Feet of Pavement: Bedding material shall be placed up to 12" above pipe.

   b. Pipe More Than 5 Feet From Pavement: Bedding material shall be placed up to the top of the pipe.

   c. If unstable material is encountered at the trench bottom, unstable material shall be excavated as directed and replaced with bedding material at no additional cost to the owner.

3. Laying Conduit: Laying shall begin at downstream end of line. Conduit shall be in contact with foundation throughout its length. Bell or groove ends of conduit and outside circumferential laps of corrugated steel pipe shall be placed facing upstream. When existing pipe is to be re-laid, pipe shall be removed by methods that will not damage pipe and re-laid as specified for new pipe.

4. Jointing Conduit:

a. General: Joints shall be capable of withstanding at least 10 psi hydrostatic pressure without leakage.

Joints without coupling bands shall be wrapped with geotextile fabric for at least 12" on each side of joints for conduits up to and including 36", and at least 18" on each side of joints for larger conduits.

Joints with coupling bands shall be wrapped with geotextile fabric for at least 12" on each side of joints for conduits up to and including 36", and at least 18" on each side of joints for larger conduits.

Ends of fabric shall be lapped at least 10" and ends and edges secured.

b. Concrete Pipe: For conduits less than 48", sections shall be joined by methods which fully seat joints without damaging conduit. For larger conduits, sections shall be joined with a mechanical puller.

1) Round Pipe: Gaskets shall be rubber O-rings. Just prior to jointing, O-rings and gasket seat shall be cleaned of dirt and other foreign matter and coated with a flax soap lubricant. Pipe section shall then be joined tightly to previously laid pipe.

2) Pipe Arch: Conduit ends shall be cleaned of dirt and other foreign matter and shall be dry. A uniform and adequate thickness of plastic gasket material shall be placed on the entire circumference of gasket seat. In temperatures below 60ºF, gasket material shall be heated prior to placement. Conduit section shall then be joined tightly to previously laid conduit.

c. Plastic Pipe:

1) Bell and Spigot Joints: Gaskets shall be rubber O-rings. Just before jointing, O-ring and gasket seat shall be cleaned of dirt and other foreign material and coated with a flax soap lubricant. Pipe sizes less than 48" may be joined by any method which fully seats joints without damaging pipe; larger pipe sizes shall be joined with a mechanical puller

2) Backfill: Backfill shall be placed and mechanically compacted in lifts not more than 12" thick (loose). Cast-in-

place box culverts shall not be backfilled until concrete has attained at least 2500 psi compressive strength.

3) Conduits Under or Within 5 Feet of Pavement: Backfill shall be sand or sand-gravel compacted to at least 95% of maximum density determined by AASHTO T 99; however, the top 12" of backfill for conduits not under pavement shall be select excavated material or borrow material.

4) Conduits More Than 5 Feet From Pavement: Backfill may be sand, sand-gravel, select excavated material or borrow material; however, the top 12" shall be select excavated material or borrow material. Backfill shall be compacted to at least the density of undisturbed surrounding ground.

5) Detection Tape: For plastic pipe, a metallic detection tape shall be installed just above pipeline.

d. Drainage Structures:

1) General: This work consists of constructing and adjusting storm drain manholes, inlets and junction boxes.

3.2 EXECUTION

A. General: Excavation shall extend 18" from outside of structure on all sides. Structures shall be set on a 6" compacted thickness of bedding material if foundation soil is stable; if foundation soil is unstable, unstable soil shall be removed as directed and replaced with bedding material. Bedding material shall be placed in lifts and compacted in lifts not exceeding 6" thick to at least 95% of maximum density determined by AASHTO T99. At time structure is placed, excavation shall be dry.

PIPES SHALL BE FLUSH WITH INSIDE WALLS OF STRUCTURE. COMPLETED NEW OR ADJUSTED STRUCTURES SHALL BE CLEANED OF DIRT AND DEBRIS.

B. Cast-in-Place Concrete Structures:

1. Earth on which concrete is placed shall be firm and free from water. Ground water shall be kept below foundation grade until concrete has set. When foundation is in dry earth, it shall be moistened with water from a spray nozzle immediately before concrete is placed.

2. Forms shall be of type, size, shape, quality and strength to enable construction as designed. Forms shall be true to line and grade, mortar tight and sufficiently rigid to resist distortion. Responsibility for their adequacy shall rest with the contractor.

3. Dirt, chips, sawdust, nails and other foreign matter shall be removed from forms before concrete is placed. Surfaces of forms shall be smooth and free from irregularities, dents, sags and holes. Forms previously used shall be cleaned of dirt, mortar and foreign matter before being re-used. Before concrete is placed, inside surfaces of forms shall be treated with a release agent that will not discolor concrete.

4. Forms for exposed surfaces shall be made of surfaced lumber or material which will provide a surface equally satisfactory. Wood forms for copings and curbs shall have a thickness not less than 1-5/8" and a width not less than depth of coping or curb. Forms shall be so constructed that portions where finishing is required may be removed without disturbing portions of forms to remain. Forms shall be so constructed that form marks will conform to general lines of structure.

5. Approved form clamps or bolts shall be used to fasten forms. Use of twisted wire loop ties or wood spreaders to hold forms in position will not be permitted. Clamps or bolts

6. shall be of sufficient strength and number to prevent spreading of forms. They shall be of such type that they can be entirely removed or cut back 1/2" below finished surface of concrete. Forms for outside surfaces shall be constructed with stiff wales at right angles to studs and form clamps shall extend through and fasten such wales.

7. Forms for surfaces requiring a Class 2 finish shall be removed not less than 1 nor more than 2 days after concrete placement. Other non-supporting forms may be removed after concrete has been in place for at least 1 day.

8. Supporting forms and falsework may be removed as soon as concrete has attained at least 75% of required 28-day compressive strength.

C. Reinforcement

1. Placing Reinforcement: Reinforcing bars shall be securely held in position by wiring at intersections and elsewhere as necessary to prevent shifting of bars, with wire not smaller than No. 16, and by using concrete or metal chairs, spacers, metal hangers or other approved devices. Metal chairs in contact with exterior surfaces shall be plastic-coated or stainless steel. Layers of bars shall be separated by approved devices. Use of pebbles, broken stone or brick, metal pipe and wood blocks will not be permitted,

2. Before placing steel in forms, steel shall be thoroughly cleaned of mortar, oil, dirt, loose mill scale, loose or thick rust and coatings that would reduce the bond. No concrete shall be deposited until placing of reinforcing steel has been inspected and approved.

3. Reinforcement shall be Grade 60 furnished in full lengths indicated on the plans. Splicing of bars, except where shown on the plans, will not be permitted without approval. Splices shall be staggered as far as possible. Minimum length of splice lap shall be as follows:

Lap Splice Lengths (inches)

Bar Size	Grade 60 Steel
3	18
4	24
5	30
6	39
7	53
8	59
9	88
10	111
11	137

D. Welding of reinforcement steel will not be permitted

Bends and hooks in bars shall be made as prescribed in the Concrete Reinforcing Steel institute's "Manual of Standard Practice." Bars shall not be bent nor straightened in a manner that will damage the material. Bars with kinks or unspecified bends shall not be used. (n Welded Wire Fabric: Fabric shall be held firmly in place. Fabric shall be spliced not less than 2 meshes.

Joints between precast concrete units shall be sealed with flexible plastic gasket material. Prior to installing gasket materials, the gasket seat shall be cleaned of

dirt and other foreign matter and shall be dry. At temperatures below 60DF, gasket material shall be heated before installation.

E. Pipe Connections: At pipe connections with structure, a 1/2" diameter bead of hydrophilic elastic sealant shall be placed around pipe at center of structure wall and also along center of wall opening. Space between pipe and wall shall then be grouted up from both sides of wall.

F. Adjusting Structures: If grade adjustment of existing structures is required, frames, covers and gratings shall be removed and structure walls reconstructed as specified for new work. Frames, covers and grates shall be cleaned and placed in good repair (or replaced, if specified).

G. Structures may also be adjusted with metal adjusting rings connected to existing ring by either welding at least 30% of circumference or by using an epoxy system designed for metal-to-metal adhesion.

H. Placing Concrete: Horizontal sections shall not be placed until concrete in supporting vertical sections has been consolidated.

I. The work shall be so prosecuted that construction joints occur at specified locations. The contractor shall complete, by continuous depositing of concrete, sections of the work between such joints. Joints shall be kept moist until adjacent concrete is placed.

Construction joints at bottom of walls or arches, at top of walls, and longitudinal construction joints having a keyed, stepped or roughened surface shall be cleaned by sandblasting or other approved methods prior to pouring adjacent concrete.

Cleaning operations shall be continued until unsatisfactory concrete, laitance, coating, stains, debris and other foreign materials are removed. Concrete surface shall be washed thoroughly to remove loose material. Method of disposing of wash water shall be such that waste water will not discolor exposed surfaces of structures.

Horizontal construction joints and those on slight slopes shall be covered with mortar.

J. Expansion joints shall be formed where shown on the plans or as directed. Such joints shall have smooth abutting surfaces. No reinforcement shall be extended through joints, except where shown on the plans.

K. Hardened concrete surfaces of vertical construction joints shall be blast cleaned and coated with a Type II, Grade C epoxy resin listed in the QPL 32 in accordance with the manufacturer's instructions immediately prior to placing adjacent concrete.

L. Weather Limitations: Concrete shall not be placed on frozen ground nor while air temperature is below 40 ° F and falling nor resumed until temperature is above 35 ° F and rising. Concrete shall be protected from freezing for at least 5 days after placing.

M. Placing concrete shall be stopped when rainfall is sufficient to cause a flow or wash the surface.

N. Concrete which has become damaged shall be replaced by and at the expense of the contractor.

O. Pumping: Pumping equipment shall be so arranged that no vibrations result which might damage freshly placed concrete. Pipes carrying concrete to placing area shall be laid out with a minimum of bends and no unauthorized change in size. A grout mortar, or concrete with coarse aggregate omitted, shall be pumped through equipment ahead of regular concrete to provide lubrication to start pumping operations. This material shall not be used in placement.

P. Operation of pump shall be such as to provide a continuous stream of concrete without air pockets. When pumping is completed, concrete remaining in pipes, if used, shall be ejected in such manner that there will be no contamination or segregation of concrete.

Q. Curing: Immediately after finishing, exposed concrete surfaces shall be covered with curing materials.

R. Surfaces requiring a Class 2A finish shall be cured with wet burlap. Bridge decks shall be cured with a Type 2 curing compound. All other surfaces shall be cured with either wet burlap or a Type 1-D curing compound. When burlap is used, surface shall be covered with 2 layers of burlap kept wet and in contact with concrete for at least 5 days.

S. When curing compound is used, it shall be applied in accordance with Subsection 502-9. Reinforcing steel and joints shall be covered or shielded to prevent contact with curing compound.

T. Surface Finishes: Surface finishes shall be as follows:

Class 1	Ordinary Surface Finish
Class 2A	Special Surface Finish
Class 4	Sandblast Finish
Class 6	Bridge Deck Finish
Class 7	Sidewalk Finish
Class 8	Precast – Prestressed Concrete Finish

1. All exposed concrete shall be given Class 1, Ordinary Surface Finish, in addition to other type of finish specified.

2. The following surfaces shall be given a Class 2A finish: exposed faces of wing walls, retaining walls, railings and parapets; outside faces of caps and columns. Wing walls shall be finished from top to 1 foot below finish slope lines on exposed face and from top for a depth of 1 foot below top on backfill sides.

3. When a Rubbed Finish is specified, a Class 2 finish shall be used.

4. Class 1 Ordinary Surface Finish: Immediately after removal of forms, fins and irregular projections shall be removed from all surfaces except those which will not be exposed to view. Cavities produced by form ties and other holes, honey-combed spots, broken corners or edges and other defects shall be cleaned and, after having been kept saturated with water, shall be pointed and trued with a mortar of cement and fine aggregate.

5. Mortar used in pointing shall be not more than 1 hour old. Joints shall be free of mortar and concrete. Joint filler shall be left exposed for its full length with clean and true edges.

6. Surfaces shall be true and uniform. Surfaces which cannot be satisfactorily repaired shall be coated as specified for Class 2 finish. Exposed surfaces not protected by forms shall be struck off with a straightedge and finished with a wood float to a true, even surface. Use of additional mortar to provide a grout finish will not be permitted.

7. Class 2A, Special Surface Finish: Coating shall be applied in accordance with the manufacturer's recommendations after all work which might mar surface is complete and finish application can be done in a continuous operation for the structure.

8. Class 4, Sandblast Finish: After 28 days, concrete surface shall be sandblasted to produce a surface in which mortar has been cut away, leaving aggregate exposed.

9. Frames, Covers and Grates: Frames shall be set in a full mortar bed. Nongalvanized parts shall be coated with metalwork paint.

10. Backfill: Backfill shall be select excavated material or borrow material; sand will not be permitted. Backfill shall be placed in lifts not more than 12" thick (loose).

11. Paved Areas: Backfill shall be compacted to at least 95% of maximum density determined by AASHTO T 99.

12. Nonpaved Areas: Backfill shall be compacted to at least the density of undisturbed surrounding ground.

13. Payment: Payment shall be made as part of the lump sum price bid for the entire project.

END OF SECTION

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